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# Greenhouse Gas Analysis

## Contact


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## Purpose/Background

The goal for reducing greenhouse gas (GHG) emissions from the transportation sector is consistent with direction from Governor Walz.

*"Climate change is an existential threat. We must take immediate action. If Washington is not going to lead, Minnesota will lead."* - Minnesota Governor Tim Walz[1]

Minnesota's position near the center of North America subjects us to an exceptional variety of extreme weather. During the course of a single year, most Minnesotans will experience both blizzards and heatwaves, windstorms, strong thunderstorms, and heavy rains.

The conditions, however, have changed rapidly, and an overwhelming base of scientific evidence projects that Minnesota's climate will see additional significant changes through the end of the 21st century[2]. Over the last several decades, the state has experienced substantial warming during winter and at night, with increased precipitation throughout the year, often from larger and more frequent heavy rainfall events. These changes alone have damaged buildings and infrastructure, limited some recreational opportunities, altered our growing seasons, impacted natural resources, and affected the conditions of lakes, rivers, wetlands, and our groundwater aquifers that provide water for drinking and irrigation. The years and decades ahead in Minnesota will bring even warmer winters and nights, and even larger rainfalls, in addition to other climatic changes not yet experienced in the state.

[1] https://www.mprnews.org/story/2019/03/04/walz-carbon-free-electricity-2050
[2] https://www.pca.state.mn.us/sites/default/files/p-gen4-07c.pdf

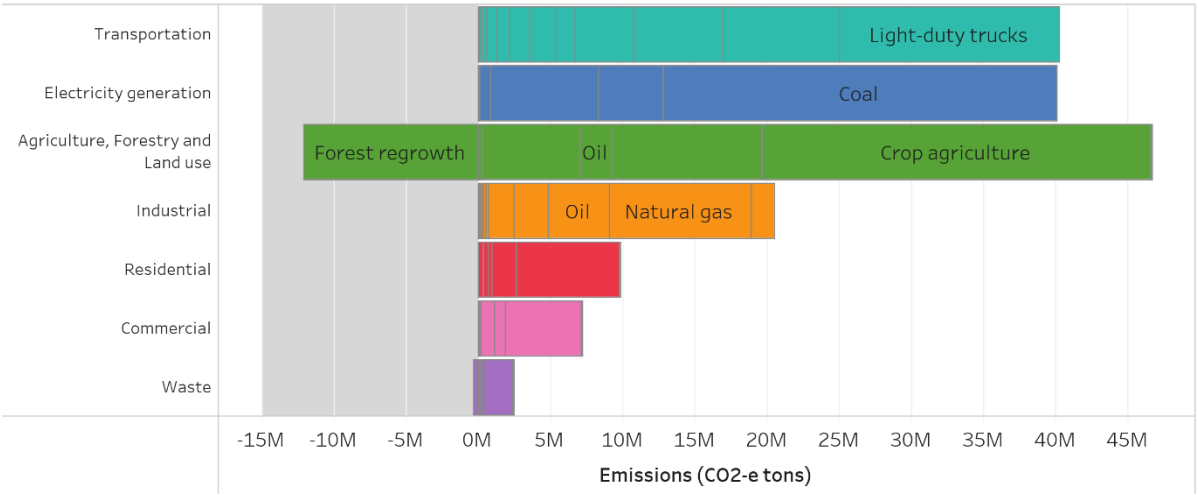
In the years and decades ahead, winter warming and increased extreme rainfall will continue to be Minnesota's two leading symptoms of climate change. Climate models used in the 2017 National Climate Assessment also project that Minnesota will have a greater tendency toward extreme heat, especially by the middle of the 21st century[3]. The future drought situation in Minnesota is less clear and may depend on how much greenhouse gas emissions increase by mid-century.

The most recent greenhouse gas (GHG) emissions inventory from the Minnesota Pollution Control Agency (MPCA) showed that transportation overtook the electricity generation sector to become the number one source of GHG emissions in Minnesota starting in 2016 (Figure 1)[4]. This is consistent with trends in other states, and changes in both sectors and trends (electricity decreasing, transportation increasing) are expected to continue in the future.

- Emissions from electricity generation have decreased almost 30% between 2005 and 2016, largely due to reduced use of coal and increased use of renewable energy and natural gas, which are more cost effective and have lower carbon emissions.
- Transportation emissions decreased 8% from 2005 to 2016, with reductions credited to federal fuel efficiency standards. However, the market trends towards purchasing larger trucks and SUVs and more miles traveled have prevented reductions that are more significant.

[3] https://nca2018.globalchange.gov/downloads/NCA4_Ch21_Midwest_Full.pdf
[4] http://www.dot.state.mn.us/sustainability/docs/2018-sustainability-report.pdf

**Figure 1. 2016 sources of GHG emissions and storage, Minnesota (MPCA)**




In 2019, MnDOT worked with other state agencies to explore ways to reduce GHG emissions from the transportation sector. This process resulted in the *Pathways* report[5], which contains a number of recommendations for strategies, including intermodal transportation, electric vehicle incentives and infrastructure, clean vehicle standards, and alternative fuels. The final recommendation of this report was for MnDOT to begin GHG emissions analysis of transportation projects.

This guidance is an outline for the requirements for GHG emissions analysis for transportation projects. However, it does not create a subsequent requirement to evaluate the potential climate *effects* of those emissions. Instead, for NEPA and MEPA purposes, the change in emissions will be used as an *indicator* of the resulting effect on climate. This is similar to MnDOT's (and FHWA's) approach to mobile source air toxics (MSATs) in NEPA[6], where guidance requires the evaluation of MSAT emissions for project alternatives, and those emissions estimates are then treated as an indicator of likely changes in health effects (e.g., a reduction in emissions is likely "better" for health than an increase in emissions). In the case of GHGs and climate change, climate is driven by *global* changes of GHG concentrations in the atmosphere; the changes in emissions from one individual project are simply too small to justify calculation of resulting changes in temperature, sea level, precipitation, and other climate effects. However, estimation of emissions is still useful to the public and decisionmakers so that they can understand whether projects are contributing to progress in mitigating climate change.

There are currently no FHWA requirements for GHG or climate impacts analysis for highway projects; this guidance describes a MnDOT requirement. However, it applies regardless of whether a project is state- or federally funded. It is intended for

[5] "Pathways to Decarbonizing Transportation in Minnesota," August 2019. http://www.dot.state.mn.us/sustainability/pathways.html

[6] https://www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/msat/

disclosure purposes only; it is not a pass/fail criterion (like transportation conformity for air quality) or a selection criterion for choosing a preferred alternative.

## Threshold Criteria

This guidance applies a tiered approach that focuses on evaluation of projects with the greatest potential GHG emissions, based on the following principles:

- Base the level and type of analysis (qualitative/quantitative) on the data available, as determined by the level of environmental documentation (e.g., more data available for projects with a required quantitative MSAT analysis).
- Apply more effort on projects with a greater potential for substantial GHG emissions.

The guidance applies to all state or federally funded projects on MnDOT facilities with a categorical exclusion (CE), environmental assessment (EA), environmental assessment worksheets (EAW), and environmental impact statement (EIS), with the following exceptions:

- Projects where an Early Notification Summary Memo is the required environmental document.
- Projects with a total construction cost of less than $1,000,000 (see current MnDOT State Transportation Improvement Program (STIP) or use current project estimate).
- Project types not covered by the Minnesota Infrastructure Carbon Estimator (MICE) tool. Examples of project types covered and not covered in MICE are listed below:

| ***Included in MICE*** | ***Not Included in MICE*** |
|---|---|
| Bridges and overpasses | Custom Pavements |
| Bus Rapid Transit | Fencing |
| Culverts | Guardrails and Cable Barriers |
| Light and Heavy Rail | Landscaping |
| Lighting | Noise Walls |
| Parking | Pavement Overlay projects (e.g., chip seal) |
| Pathways (trails & sidewalks) | Projects under negotiated maintenance contracts |
| Roadways | Ramp Metering |
| Roadway Resurfacing and Reconstruction | Traffic Signals/Replacements |
| Signage | Variable Message Signs |
| | WIM and other truck monitoring infrastructure |

# Detailed Requirements

### What types of GHG emissions are analyzed?

MnDOT evaluates the following types of GHG emissions: operational and construction.

- *Construction and maintenance emissions* - GHG emissions from production and transportation of materials used in construction, fuel burned in the equipment used to build and maintain a project, and emissions from increased traffic congestion and detours during construction.

- *Operational emissions* – If the project affects traffic volumes and/or speeds, these effects on the emissions of vehicles using the facility are included. Operational emissions are not analyzed where projects do not affect volumes or speeds.

### Construction emissions

MnDOT requires each project to estimate the specific construction and maintenance GHG emissions using the Minnesota Infrastructure Carbon Estimator (MICE) for the preferred project alternative. MICE is a spreadsheet tool that estimates the lifecycle energy and greenhouse gas emissions from the construction, operations and maintenance of transportation facilities[7]. It is a Minnesota-specific version of FHWA's Infrastructure Carbon Estimator (ICE), incorporating Minnesota-specific vehicle emissions rates, capability for build/no-build analysis, and other enhancements.

The MICE User Guide[6] contains detailed instructions for using the tool.

### Operational emissions

For projects that affect traffic volumes and/or speeds, MnDOT requires the project to estimate the operational GHG emissions using MICE for the preferred project and no-build alternative. The MICE tool uses simple inputs of daily VMT (and daily average speed, if available).

However, if the project also requires a quantitative Mobile Source Air Toxics (MSAT) Analysis, per FHWA guidance, MnDOT requires analysis of operational GHG emissions using the most current version of the EPA Motor Vehicle Emission Simulator (MOVES)[8] model for each project alternative. The MOVES model GHG analysis as part of the MSAT analysis and utilization of the MICE tool would only be required for construction emissions.

[6] http://www.dot.state.mn.us/environment/airquality/index.html
[8] http://www.epa.gov/otaq/models/moves/index.htm

GHGs for both construction and maintenance are expressed in terms of carbon-dioxide equivalent ($CO2_e$). This metric combines the climate effects of various GHGs as if they were all CO2. MOVES and MICE both report emissions in units of $CO2_e$.

### Documentation of the Analysis

If an EA, EAW, or EIS are prepared for the project, documentation of the GHG analysis is included in the text of that document. For CEs, documentation of the GHG analysis is included in the CE documentation package submitted to MnDOT and FHWA. The format for this documentation is provided in the *Prepared Statements* section below.

For efficiency, similar types of small projects can be grouped together and analyzed as a group. E.g., if a District plans to resurface 60 total lane miles of roadway at five different locations, this group of projects can be analyzed as a single project. The environmental document for each individual project would then cite this grouped analysis.

### Addressing Cumulative Effects for Project Alternatives (EIS projects)

For the cumulative effects discussion in an EIS, there is no need to conduct a project-specific cumulative GHG emissions analysis, because other sources of information on emissions from the transportation network are readily available. The Minnesota Pollution Control Agency (MPCA) prepares a GHG emissions inventory for the entire transportation sector in Minnesota, including on-road vehicles, each odd-numbered year[9]. The most recent on-road vehicle portion of the inventory can be referenced for comparison to operational GHG emissions from the single project. Depending on where the project is located, the Metropolitan Planning Organization may have prepared a more refined local inventory, with future emissions projections, that includes the emissions from the proposed project along with all other planned projects in the area. Finally, MnDOT's annual Sustainability Reports include information on MnDOT's progress in meeting its GHG emissions targets. All of this information can be used to inform a cumulative effects GHG discussion, without conducting project-specific analysis.

## Prepared Statements

### *Climate Change and Greenhouse Gas Emission Impact Statements*

*Project sponsors use these statements for categorical exclusion (CE), environmental assessment (EA), environmental assessment worksheets (EAW), and environmental impact statements (EIS). The use of these statements in environmental review documents and project files is a requirement by MnDOT's Office of Environmental*

[9] https://www.pca.state.mn.us/sites/default/files/lraq-2sy15.pdf

*Stewardship.*

If the statement appropriate for the project includes prompts marked with gray highlighting and set off by carats, <such as this>, customize the statement by inserting project specific data as indicated. Once customized, ensure all such prompts are completely deleted.

## Categorical Exclusions

Select the appropriate statement below:

### *No Changes in Traffic flow*

Use this statement for categorical exclusion projects that do not result in changes in traffic volumes or speeds.

> *MnDOT evaluates greenhouse gas (GHG) emissions from projects due to concerns about current and future impacts of climate change in Minnesota. GHGs from transportation (carbon dioxide, methane and nitrous oxide) contribute to warming of the atmosphere, which leads to effects in Minnesota that include increases in heavy precipitation, increased flooding, and more episodes of extreme heat.*
>
> *Because the project will not change traffic, operational greenhouse gas emissions are not expected to change. Construction greenhouse gas emissions will result from production and transportation of construction materials, and from fuel used in construction equipment.*
>
> **<Table X.X> Analysis Result**

| ***Construction $CO2_e$ Emissions (Total over Construction Period)*** | ***$CO2_e$, Metric Tons (total)*** |
|---|---|
| Build Alternative | |
| No Build (maintenance of existing system) | |

<If the project was analyzed as a group of similar projects, state this and clarify that the results in the table are for the entire group.>

### *Changes in Traffic flow*

Use this statement for categorical exclusion projects that *do* result in changes in traffic volumes or speeds. As needed, contact the Environmental Stewardship's Modeling and Testing Unit for assistance to determine which statement to use.

> *MnDOT evaluates greenhouse gas (GHG) emissions from projects*

*due to concerns about current and future impacts of climate change in Minnesota. GHGs from transportation (carbon dioxide, methane and nitrous oxide) contribute to warming of the atmosphere, which leads to effects in Minnesota that include increases in heavy precipitation, increased flooding, and more episodes of extreme heat.*

*The project is expected to improve/degrade traffic flow, which should reduce/increase operational greenhouse gas emissions. (<Provide a very short explanation of how the project causes this effect on traffic flow, e.g., project reduces congestion, or project increases traffic volumes without a corresponding improvement in speeds, or project reduces design speed in order to improve safety, etc.>) Construction greenhouse gas emissions will result from production and transportation of construction materials, and from fuel used in construction equipment.*

***<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) |
| | |

| ***Construction $CO2_e$ Emissions (Total over Construction Period)*** | ***$CO2_e$, Metric Tons (total)*** |
|---|---|
| Build Alternative | |
| No Build (maintenance of existing system) | |

<If the project was analyzed as a group of similar projects, state this and clarify that the results in the table are for the entire group.>

## EA, EAW and EIS Projects

*Use, customize, and include the information below in the Air Quality Section of an environmental review document, which includes most EA's, EAW's, and EIS's.*

### *Greenhouse Gases (GHGs)*

*Minnesota's position near the center of North America subjects us to an exceptional variety of extreme weather. During the course of a single year, most Minnesotans will experience both blizzards and heatwaves, windstorms, strong thunderstorms, and heavy rains.*

*The conditions, however, have changed rapidly, and an overwhelming base of scientific evidence projects that Minnesota's climate will see additional significant changes through the end of the 21st century[10]. Over the last several decades, the state has experienced substantial warming during winter and at night, with increased precipitation throughout the year, often from larger and more frequent heavy rainfall events. These changes alone have damaged buildings and infrastructure, limited recreational opportunities, altered our growing seasons, impacted natural resources, and affected the conditions of lakes, rivers, wetlands, and our groundwater aquifers that provide water for drinking and irrigation. The years and decades ahead in Minnesota will bring even warmer winters and nights, and even larger rainfalls, in addition to other climatic changes not yet experienced in the state.*

*In the years and decades ahead, winter warming and increased extreme rainfall will continue to be Minnesota's two leading symptoms of climate change. Climate models used in the 2017 National Climate Assessment also project that Minnesota will have a greater tendency toward extreme heat, especially by the middle of the 21st century[11]. The future drought situation in Minnesota is less clear and appears to depend on how much greenhouse gas emissions increase by mid-century.*

*GHG's are gases that warm the atmosphere and surface of the planet. Human activity has been increasing the amount of GHG's in the atmosphere, leading to changes in the earth's climate. The primary GHG's are carbon dioxide ($CO_2$), nitrous oxide ($N_2O$), methane ($CH_4$), sulfur hexafluoride ($SF_6$), and two classes of compounds called hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).*

*The most recent greenhouse gas (GHG) emissions inventory from the Minnesota Pollution Control Agency (MPCA) showed that transportation overtook the electricity generation sector to become the number one source of GHG emissions in Minnesota starting in 2016[12]. This is consistent with trends*

[10] https://www.pca.state.mn.us/sites/default/files/p-gen4-07c.pdf
[11] https://nca2018.globalchange.gov/downloads/NCA4_Ch21_Midwest_Full.pdf
[12] http://www.dot.state.mn.us/sustainability/docs/2018-sustainability-report.pdf

*in other states, and changes in both sectors and trends (electricity decreasing, transportation increasing) are expected to continue in the future.*

**<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) |
| | |

| ***Construction $CO2_e$ Emissions (Total over Construction Period)*** | ***$CO2_e$, Metric Tons (total)*** |
|---|---|
| Build Alternative | |
| No Build (maintenance of existing system) | |

<If the project was analyzed as a group of similar projects, state this and clarify that the results in the table are for the entire group.>

*The GHG analysis above illustrates that the project will result in a decrease in GHG emissions compared to the Base Year. The analysis also shows that the project will <increase/decrease/have no affect on> GHG emissions compared to the No Action Alternative.*

**Summary of Greenhouse Gas Discussion for EA's, EAW's, and EIS's**

This document summarizes the GHG emissions associated with construction of the proposed project, <and vehicle traffic associated with the project, if analyzed>. It does not include an assessment of the potential climate *effects* of those emissions. In the case of GHGs and climate change, climate is driven by *global* cumulative changes of GHG concentrations in the atmosphere; the changes in emissions from one individual project are simply too small to justify calculation of resulting changes in temperature, sea level, precipitation, and other significant cumulative climate effects. However, estimation of emissions is still useful to the public and decisionmakers so that they can understand whether projects are contributing to progress in mitigating climate change.

Assessing GHG emissions from transportation projects is one of several strategies that MnDOT is pursuing to address the issue of climate change. Other strategies that MnDOT is pursuing include intermodal transportation, electric vehicle incentives and infrastructure, clean vehicle standards, and alternative fuels. The agency is also developing a process for evaluating flood risk to MnDOT bridges, large culverts, and pipes. Studying the performance of infrastructure under predicted extreme events will help MnDOT gain knowledge and better assess the impacts of climate changes to plan, design, build, and maintain assets for resilience. More information regarding MnDOT's efforts to address climate change can be found at http://www.dot.state.mn.us/sustainability/.

## Relationship to HPDP

### Class I Actions (Environmental Impact Statements)

*Scoping Documents* - Conduct early assessment of magnitude and significance of potential GHG emissions impacts.

*Draft Environmental Impact Statement (DEIS)* - the draft EIS should include a background discussion of climate change and GHG emissions (above), along with results from MICE (and the MOVES model, if MOVES is also used for MSAT analysis—see Detailed Requirements, above).

*Final Environmental Impact Statement* (FEIS) – the final EIS should include a background discussion of climate change and GHG emissions (above), along with results from MICE (and the MOVES model, if MOVES is also used for MSAT analysis).

*Record of Decision (ROD)* - The draft ROD is prepared through a consultation process between FHWA, OES, and the District. Include a summary statement on GHG emissions and climate change.

### Class II Actions (Categorical Exclusions)

*Categorical Exclusion (CATEX)* - the project report should include a brief discussion of whether traffic changes as a result of the project (above), along with results from MICE.

### Class III Actions (Environmental Assessments)

*Environmental Assessment (EA)* - Follow guidance for Scoping, DEIS and FEIS above.

*Finding of No Significant Impact (FONSI)* - Include summary statement on GHG emissions and climate change.

## Agencies Involved

| ***Agency(s)*** | ***When they are involved and why*** |
|---|---|
| MPCA | Develops Minnesota GHG emissions inventories and can provide inputs for MOVES modeling. |
| FHWA | Approves federally funded highway projects. |
| MPO | Conducts regional emissions modeling and can provide inputs for MOVES modeling. |
| FTA | Approves federally funded transit projects. |

## Permits/Approvals

There is none.

## Legal Basis

| ***Description Code*** | ***Code*** |
|---|---|
| National Environmental Policy Act (NEPA) of 1969 | 42 U.S.C. 4321 et seq.; see also 23 CFR 771 (FHWA regulations), and 40 CFR 1500-1508 (CEQ regulations) |
| Minnesota Environmental Policy Act<br><br>Minnesota Statute 116D | Minnesota Statute 116D |
| Next Generation Energy Act (2007) | https://www.revisor.mn.gov/data/revisor/slaws/2007/0/136.pdf |

## Guidelines

| *Creator (Agency/Author)* | *Subject of guideline/regulation* | *Date* |
|---|---|---|
| FHWA | Infrastructure Carbon Estimator version 2.0: Final Report and User's Guide | TBD |

## Maps/Resources

N/A

## Glossary

**CO2** - Carbon Dioxide

**$CO2_e$** – Carbon Dioxide equivalent, or the emissions of multiple GHGs expressed in terms of their relative emissions if they were all carbon dioxide.

**Greenhouse Gas (GHG)** – A gas that contributes to climate change by causing atmospheric warming. Transportation-related greenhouse gases include carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons (air conditioning gases).

**Metric Tons (MT)** – Common unit for reporting GHG emissions; a metric ton is 1,000 kilograms, or about 2200 US pounds.

**MICE** – Minnesota Infrastructure Carbon Estimator (Minnesota-specific version of FHWA's Infrastructure Carbon Estimator.

**MOVES** – Motor Vehicle Emissions Simulator, an EPA model for estimating GHG and other emissions from motor vehicles.

**MSAT** - Mobile Source Air Toxics - The Clean Air Act identified 188 air toxics, also known as hazardous air pollutants. FHWA has issued guidance and frequently asked questions for addressing MSATs in the NEPA process, and these FAQs are a helpful resource for analyzing GHG emissions with the MOVES emissions model, if that approach is used.

**MPCA** - Minnesota Pollution Control Agency - Administers and enforces all federal and state laws relating to air pollution in Minnesota.

**MPO** - Metropolitan Planning Organization – Is the forum for cooperative decision making and the organization designated, together with the state, as being responsible for conducting the continuing, cooperative, and comprehensive planning process under 23 U.S.C. 134 and 49 U.S.C. 5303.

**NEPA** - The National Environmental Policy Act (NEPA):

Title I of NEPA contains a Declaration of National Environmental Policy. This policy requires the federal government to use all practicable means to create and maintain conditions under which man and nature can exist in productive harmony.
Section 102 in Title I of the Act requires federal agencies to incorporate environmental considerations in their planning and decision-making through a systematic interdisciplinary approach. Specifically, all federal agencies are to prepare detailed statements assessing the environmental impact of and alternatives to major federal actions significantly affecting the environment. These statements are referred to as Environmental Impact Statements (EIS) and Environmental Assessments (EA).

Title II of NEPA established the President's Council on Environmental Quality (CEQ) to oversee NEPA implementation. The duties of CEQ include:

- Ensuring that federal agencies meet their obligations under NEPA
- Overseeing federal agency implementation of the environmental impact assessment process
- Issuing regulations and other guidance to federal agencies regarding NEPA compliance.