**Minnesota Energy Policy Simulator (EPS) Explainer**

# Estimating Economywide Emissions for Minnesota

Energy Innovation and RMI built a forecast of Minnesota’s economywide greenhouse gas emissions using reputable, national models of energy consumption and direct emissions data from Minnesota Pollution Control Agency’s Greenhouse Gas Inventory.[[1]](#footnote-1) The Energy Policy Simulator (EPS) accounts for emissions produced in the following sectors: electricity generation, building energy consumption, industrial energy consumption, industrial process emissions, agriculture process emissions, land use change, and transportation. Our primary sources are federal data sets from the Environmental Protection Agency (EPA), Energy Information Association (EIA), and the National Renewable Energy Lab (NREL). We supplemented national data with state-specific estimates of agricultural emissions and emissions associated with land use change. The table below summarizes our data sources and methodology.

## Data Sources

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sector** | **Subsectors** | **Source** | **Methodology** | **Benchmarking Sources for Comparisons** |
| ELECTRICITY | In-state capacity and generation; out of state imports | For capacity and generation: EIA’s [Form 923](https://www.eia.gov/electricity/data/eia923/) and EIA’s [Form 860](https://www.eia.gov/electricity/data/eia860/)  For imports/exports: EIA’s State Electricity Profiles [Table 10.](https://www.eia.gov/electricity/state/minnesota/state_tables.php) | No scaling needed. Added all utility-owned generation and capacity in-state. | **Emissions -** EPA “[State CO2 Emissions from Fossil Fuel Combustion, 1990-2017](https://www.epa.gov/statelocalenergy/state-co2-emissions-fossil-fuel-combustion-1990-2017)” &  AEO “[State CO2 Emissions from Fossil Fuel Combustion](https://www.epa.gov/statelocalenergy/state-co2-emissions-fossil-fuel-combustion-1990-2017)” & Minnesota’s GHG Inventory |
| BUILDING ENERGY USE | All energy use, all building components, residential and commercial buildings | [NREL Electrification Futures Study - Reference Scenario](https://www.nrel.gov/analysis/electrification-futures.html) | No scaling needed. NREL reports total energy use by fuel type and demand technology in MN for each year 2017-2050. | **Energy Use -** EIA’s “[State Energy Data Systems](https://www.eia.gov/state/seds/seds-data-fuel.php?sid=US)” 2018  **CO2 Emissions -** AEO “[State CO2 Emissions from Fossil Fuel Combustion](https://www.epa.gov/statelocalenergy/state-co2-emissions-fossil-fuel-combustion-1990-2017)” & Minnesota’s GHG Inventory |
| INDUSTRIAL ENERGY USE | All fuel use for industrial sector | [Energy Information Association’s Annual Energy Outlook tables on Industrial Energy Use](https://www.eia.gov/outlooks/aeo/tables_ref.php) &  EIA’s “[State Energy Data Systems](https://www.eia.gov/state/seds/seds-data-fuel.php?sid=US)” | Scaled down by Census Data ([County Business Patterns](https://www.census.gov/programs-surveys/cbp/data/tables.html)) employment by industrial subsector and state compared to national employment by industrial sector | **Energy Use -** NREL Electrification Futures and SEDS  **Emissions -** EPA “[State CO2 Emissions from Fossil Fuel Combustion, 1990-2017](https://www.epa.gov/statelocalenergy/state-co2-emissions-fossil-fuel-combustion-1990-2017)” &  AEO “[State CO2 Emissions from Fossil Fuel Combustion](https://www.epa.gov/statelocalenergy/state-co2-emissions-fossil-fuel-combustion-1990-2017)” & Minnesota’s GHG Inventory |
| INDUSTRIAL PROCESS EMISSIONS | Process Emissions | [EPA Global Non-CO2 Greenhouse Gas Emissions Projections & Mitigation Potential: 2015-2050](https://www.epa.gov/global-mitigation-non-co2-greenhouse-gases/global-non-co2-greenhouse-gas-emission-projections) | Scaled down US data to state data using a variety of sources, including data from EPA’s [FLIGHT](https://ghgdata.epa.gov/ghgp/main.do) tool and [EPA’s State Inventory Tool Output Dataframe](https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool) | **Emissions** - Minnesota’s GHG Inventory and [E3’s Pathways Report](https://www.ethree.com/wp-content/uploads/2020/01/MN_PATHWAYS_Final-Report_2019-06-26.pdf) |
| AGRICULTURE | Process Emissions | [Minnesota’s Greenhouse Gas Inventory Data](https://www.pca.state.mn.us/air/greenhouse-gas-emissions-data) | Note that for agricultural emissions we took an average of emissions for years 2005, 2010, 2015, 2016 and reallocated emissions from “cultivated histosols” to the land use sector | **Emissions** - Minnesota’s GHG Inventory and [E3’s Pathways Report](https://www.ethree.com/wp-content/uploads/2020/01/MN_PATHWAYS_Final-Report_2019-06-26.pdf) |
| LAND USE AND FORESTRY |  | [Minnesota’s Greenhouse Gas Inventory Data](https://www.pca.state.mn.us/air/greenhouse-gas-emissions-data) | Include forestry, land use sector emissions and “cultivated histosols” from the agricultural sector | **Emissions** - Minnesota’s GHG Inventory |
| TRANSPORTATION | All energy use, vehicle miles | [NREL Electrification Futures Study - Reference Scenario](https://www.nrel.gov/analysis/electrification-futures.html) | No scaling needed. NREL reports miles by vehicle type and total energy use by fuel type in MN for each year 2017-2050. | **Emissions -** EPA “[State CO2 Emissions from Fossil Fuel Combustion, 1990-2017](https://www.epa.gov/statelocalenergy/state-co2-emissions-fossil-fuel-combustion-1990-2017)” &  AEO “[State CO2 Emissions from Fossil Fuel Combustion](https://www.epa.gov/statelocalenergy/state-co2-emissions-fossil-fuel-combustion-1990-2017)” & Minnesota’s GHG Inventory |

# Policies Included in the Business-as-Usual, Reference, and 1.5 Scenarios

The Minnesota EPS model includes three built-in policy scenarios. The first is a **business-as-usual scenario**, which represents all policy that is currently enacted in Minnesota. The **reference** **scenario** includes planned policy and utility IRPs that are not yet implemented but are in progress. Once these policies are implemented, they will become part of the **BAU** **scenario**. The **1.5 scenario** is an example of policies that would enable Minnesota to meet 2030 greenhouse gas reduction targets that comply with global climate agreements. The table below summarizes the policies included in the BAU, reference, and 1.5 scenarios.

## Summary of Policy Assumptions

|  |  |  |  |
| --- | --- | --- | --- |
| **Sector** | **BAU Scenario** | **Reference Scenario** | **2030 1.5C Targets Scenario (2030 metrics)** |
| Industry | * Assumes equipment performance improvements over time | *Same as BAU* | * 8% efficiency gains in all industries (by 2035) * 100$/ton carbon tax * 70% reduction of methane leakage * 77% reduction of F-gas emissions by 2050 |
| Electricity | * Assumes all currently planned retirements are completed on time * Assumes nuclear plants are retired at the end of their existing licenses | * Implements Xcel’s 2019 Integrated Resource Plan (IRP) | * 90% Clean Energy Standard * $100/ton carbon tax * Increase demand response and transmission * No new natural gas plants after 2030 |
| Buildings | * Assumes equipment performance improvements over time | * Includes energy efficiency savings included in Xcel’s IRP | * All new appliance sales are electric * Retrofit 25% of existing buildings |
| On-Road Transportation | * Includes 2012 Federal Corporate Average Fuel Economy Standards (CAFE) standards * Federal EV subsidies * Economic adoption of EVs | *Same as BAU* | * 100% new light duty vehicles & buses are electric * 40% of all new freight HDVs electric and 20% hydrogen * 13% reduction of vehicles miles traveled from 2020 levels |
| Land use/Agriculture | * Agriculture, biomass, and forestry projections | *Same as BAU* |  |
| Imports/Exports | * Imported electricity emissions held constant | Assume no reductions in production, reductions in state consumption increase exports | * Reduce imports from coal and gas plants |

## Detailed Policy Assumptions in the BAU Case

### Buildings

* **Energy efficiency:** BAU data includes some endogenous improvement in equipment performance based on external market data (as described [here](https://www.nrel.gov/docs/fy18osti/70485.pdf)). It is unclear which, if any, EE policies are explicitly included. Minnesota’s EE policies are **not** explicitly modeled, included things like building rebates.

### Transportation

* **Fuel efficiency:** Includes Corporate Average Fuel Economy Standards (CAFE) including the 2021-2025 phase 2 standards. Full text from [AEO](https://www.eia.gov/outlooks/aeo/assumptions/pdf/summary.pdf): CAFE standards are increased for model years 2011 through 2016 to meet the final CAFE rulemakings for model years 2011 and 2012 to 2016. CAFE standards are increased for model years 2017 to 2025 to meet final CAFE joint rulemakings for model year 2017 to 2021 and to meet augural CAFE standards for model year 2022 to 2025, which will undergo a midterm evaluation to finalize. CAFE standards are held constant through the end of the projection period. Includes Phase I and Phase II standards for HDVs. Full text from AEO: HD National program Phase I and Phase II standards are modeled, with both engine and chassis technologies; compliance is modeled among 13 heavy-duty vehicle V regulatory classifications that represent the discrete vehicle categories set forth in the rule; the standards are held constant in model years after 2027.
* **EV subsidies:** Includes federal subsidies for EVs, weighted based on available credits and model availability.

**Industry**

* **Non-energy emissions:** No implementation of Kigali Amendment to the Montreal Protocol.
* **Industry energy:** Data includes some endogenous improvement in equipment performance based on external market data (as described [here](https://www.nrel.gov/docs/fy18osti/70485.pdf)). It is unclear which, if any, EE policies are explicitly included. We can assume Minnesota’s EE policies are **not** explicitly modeled, included things like building rebates.

**Electricity**

* **Renewable portfolio standard**: Minnesota’s [Renewables Portfolio Standard](https://programs.dsireusa.org/system/program/detail/2401) is included in the BAU case
* **Retirements:** Assume existing nuclear power plants are retired at the time their current permits expire (Monticello 2030 and Prairie Island 2033/34). We retire Sherco 3 in 2034 the BAU scenario.

## DETAILED Policy Assumptions in the Reference Case

The **Reference** policy scenario includes assumptions about energy efficiency and renewable energy in Xcel’s IRP.

**Electricity:**

* Assumes nuclear power plants are extended additional 10 years: Monticello unit operates through 2040, Prairie Island through 2033 (Unit 1) and 2034 (Unit 2)
* Retire 2 coal units early: King in 2028, Sherco 3 in 2030
* We assume additional 1500 MW of demand response by 2034 above the BAU case
* Clean energy standard adds 1200 MW wind by 2034, 4000 MW of solar by 2034

**Buildings**

* **Energy efficiency:** Annual BTU electricity savings were calculated based on the energy efficiency improvement forecasted in Xcel’s IRP (about 2-2.5% per year through 2034). The scenario meets these annual BTU targets through the building component and industrial efficiency and retrofit policy levers. Efficiency savings are applied to the residential, commercial, and industrial sectors. We assume efficiency requirements are held constant after 2034, at about 20% below BAU electricity consumption.

# Defining Targets shown in the tool

The EPS model shows two greenhouse gas reduction targets.

1. **Minnesota’s targets:** Minnesota’s Next Generation Energy Act sets economy-wide greenhouse gas reduction targets. The act requires the state to reduce greenhouse gas emissions 30% below 2005 levels by 2025 and 80% by 2050.
2. **1.5 targets:** To meet greenhouse gas reduction goals established by the Paris climate accords to cap warming at 1.5 degrees, Minnesota needs to reduce economy-wide greenhouse gas emissions by 60% by 2030. The following table summarizes the assumptions embedded in the 2030 1.5 target.

|  |  |
| --- | --- |
| **Sector** | **2030 1.5C Targets Scenario (2030 metrics)** |
| Industry | * 8% efficiency gains in all industries (by 2035) * 100$/ton carbon tax * 70% reduction of methane leakage * 77% reduction of F-gas emissions by 2050 |
| Electricity | * 90% Clean Energy Standard * $100/ton carbon tax * Increase demand response and transmission * No new natural gas plants after 2030 |
| Buildings | * All new appliance sales are electric * Retrofit 25% of existing buildings |
| On-Road Transportation | * 100% new light duty vehicles & buses are electric * 40% of all new freight HDVs electric and 20% hydrogen * 13% reduction of vehicles miles traveled from 2020 levels |
| Land use/Agriculture | *Same as BAU* |
| Imports/Exports | * Reduce imports from coal and gas plants |

# Calculating Policy Impacts

The Energy Policy Simulator is a non-partisan, open-source, and peer-reviewed model. The EPS was developed to evaluate the impacts of climate and energy policies on emissions, costs and savings, and fuel consumption. The EPS model is used by policymakers to select and refine climate legislation. For example, the EPS model was used to assess the impact of climate policies for the U.S. House Select Committee on the Climate Crisis.[[2]](#footnote-2) EPS users input climate policies and the model then analyzes interacting policy impacts to forecast environmental and economic outcomes. The model generates a variety of data outputs including greenhouse gas emissions, criteria pollutant emissions, capital and operating cash flow changes, and macroeconomic changes to GDP and jobs. RMI and Energy Innovation are currently developing EPS models for 20 U.S. states.

The EPS model is available for download online [here](https://us.energypolicy.solutions/docs/download.html).[[3]](#footnote-3) And full documentation on methodology and assumptions are available online [here](https://us.energypolicy.solutions/docs/index.html).[[4]](#footnote-4)

# Contact

For further information on the EPS, contact us here [policy@energyinnovation.org](mailto:policy@energyinnovation.org). If you have questions about using the EPS, we recommend first watching our video series, available [here](https://us.energypolicy.solutions/docs/video-series.html).[[5]](#footnote-5)

1. https://www.pca.state.mn.us/air/greenhouse-gas-emissions-data [↑](#footnote-ref-1)
2. https://energyinnovation.org/2020/07/28/hal-harveys-insights-and-updates-congressional-climate-plan-is-a-bet-your-country-moment/ [↑](#footnote-ref-2)
3. https://us.energypolicy.solutions/docs/download.html [↑](#footnote-ref-3)
4. https://us.energypolicy.solutions/docs/index.html [↑](#footnote-ref-4)
5. https://us.energypolicy.solutions/docs/video-series.html [↑](#footnote-ref-5)