Minnesota's Climate Action Framework

Greenhouse gas analysis

An analysis of greenhouse gas reductions and carbon sequestration in Minnesota's Climate Action Framework

MINNESOTA

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GREENHOUS GAS EMISSION REDUCTIONS AND CARBON SEQUESTRATION ANALYSIS

Staff supporting the Climate Change Subcabinet analyzed the GHG emission and sequestration impacts of some of the actions proposed in the State Action Steps. Many activities that were not quantified will also have GHG emissions reductions. Actions to sequester carbon in our lands will have significant benefits but are not quantifiable now. Further work will be done to measure the impacts of our actions.

ACTIONS MODELED IN ENERGY POLICY SOLUTIONS SIMULATOR

The primary analysis tool for the Framework is the Minnesota Energy Policy Solutions tool created by Energy Innovation LLC and Rocky Mountain Institute.[1] It is a free, open-source computer model developed with input from the Minnesota Pollution Control Agency, Fresh Energy, and MN Center for Energy and Environment. All input data and assumptions are published online, along with the logic of model calculations.[2] To investigate the impact of policy options, anyone may access the model and choose from various settings. The Energy Policy Solutions model with settings matched to the analysis produced for the Framework is available at: https://minnesota.energypolicy.solutions/scenarios/run?locale=en&id=3eyqvc9t.

The climate actions in the model do not precisely match the actions identified by the state in the Framework. Therefore, to estimate the impact of proposed Framework actions, the model inputs had to be translated and generalized, and in some cases, grouped. Estimated cumulative GHG emissions reductions are displayed separately from the Framework actions because the model is not an exact fit to the structure of proposed actions. There are also many proposed actions where the model could not quantify the GHG emission benefit.

CUMULATIVE GHG REDUCTIONS 2023-2050

Despite the structural mismatch between the model and the proposed Framework actions, the modeling offers an understanding of the relative impacts of proposed actions. The modeled actions are reported with cumulative estimated reductions (2023-2050) and sorted into categories of high (greater than 100 Million metric tons CO_2e), medium (10-100 Million metric tons CO_2e), or low (less than 10 Million metric tons CO_2e) GHG reductions. This scale is sufficient to indicate the magnitude of possible GHG reductions as one of many criteria used to prioritize actions without requiring precise modeling inputs.

To fit closer to the intent of the proposed low carbon fuel standard identified in the Framework, we combined the results for policies 3, 4, and 6. Also, to fit closer to the intent of multiple proposed Framework actions addressing existing buildings and a net-zero building goal, we combined the results for policies 8, 9, and 10. Estimates of cumulative impacts from natural and working land policies will be added when available.

MAGNITUDE OF CUMULATIVE GHG EMISSION REDUCTIONS 2023-2050
High **> 100 Million Metric Tons CO_2-e**
Clean Electricity Standard
Building efficiency, electrification, and retrofitting
Medium **10-100 Million Metric Tons CO_2-e**
Low Carbon Fuel Standard, EV Sales, EV Subsidy
Vehicle Fuel Economy
Mode Shifting
Low **0-10 Million Metric Tons CO_2-e**
EV Charger Deployment
Increase Transmission
Material Efficiency Longevity & Re-Use
EV Range & Charge Time
Industry Energy Efficiency Standards

[1] Minnesota Energy Policy Solutions tool: https://minnesota.energypolicy.solutions/

[2] Documentation of original model assumptions is available here: https://github.com/Energy-Innovation/eps-minnesota/blob/main/MN%20Policy%20Assumptions_FINAL.pdf

While the results show the cumulative impact over 2023-2050, the timing of the effects can also be important to understand. Increasing transmission capacity has the most significant impact in the near term because it facilitates bringing early renewable expansion online. The biofuel component of the low carbon fuel standard has a more substantial effect in the near term because it reduces the carbon intensity of fuel in internal combustion engine vehicles. These vehicles will be increasingly replaced by electric cars, reducing the impact of a low carbon fuel standard. Changing the timing of fully achieving a goal would also impact the effectiveness of the action, and early action will achieve greater emission reductions. For example, if the EV charging stations are installed earlier, it will shift more people to choose EVs.

The modeled policies are listed in the following table with the model inputs. Detailed descriptions of each policy are also included. The implementation trajectory is assumed to be linear from 2023-2050 unless interim goals are specified.

MODELED POLICY LIST

Magnitude of Cumulative GHG 2023-2050	Number	Model Policy	Early target year	Early target Goal	2050 goal	Units
Low	1	Electric vehicle (EV) charger deployment			100	chargers per 100k population (additional)
Low	2	EV range and charging time			10%	% reduction in concern
Medium - combined	3	EV sales: Passenger and light-duty commercial vehicles (LDVs) and heavy-duty vehicles (HDVs)	2030	LDVs: 50% HDVs: 7%	LDVs: 75% HDVs: 10%	% of new sales
	4	Electric vehicle subsidy: Passenger LDV	2024-2040[3]	1%		% of purchase price
	6	Low Carbon Fuel Standard (LCFS)[4]	2030	8%	15%	% reduction in emissions
Medium	5	Fuel Economy Standard: Passenger and commercial LDVs and HDVs[5]			LDVs: 88% Passenger HDVs: 45% Freight HDVs: 56%	% increase in miles per gallon (mpg)
Medium	7	Mode Shifting: Passenger LDVs	2025 2030 2035 2040	4% 8% 11% 14%	20%	% of trips shifted
High - combined	8	Building component electrification			85%	% of components sold
	9	Building energy efficiency standards			25%	% reduction in energy use
	10	Retrofit existing buildings			20%	% of existing buildings
High	11	Clean electricity standard	2040	100%	100%	% of generation
Low	12	Increase transmission			20%	% increase in capacity
Low	13	Industry energy efficiency standards: water and waste			20%	% reduction in energy use
Low	14	Material efficiency, longevity, and re-use			10%	% demand reduction

[3] The EV subsidy is modeled fully in place for 2024-2040.
[4] Only addresses liquid fuels used in conventional vehicles. Electric vehicles are separate policies in the model and combined for evaluation to better match the proposed LCFS.
[5] Used to model Clean Car Standards impact. See setting recommendations in policy description.

POLICY DESCRIPTIONS

The following describes each of the policies modeled in the Energy Policy Simulator. The description includes the policy lever the model uses, what was actually modeled, and some context for existing conditions and setting the modeled level.

1 Electric Vehicle Charger Deployment

- Policy lever: 0-300 chargers / 100k population
- **Modeled: 100 chargers / 100k population**

This policy represents increasing the deployment of EV charging stations, including DC Fast and Level 2 charging stations. It is set in chargers per 100,000 people (cumulative, not per year), and is additive to chargers in the business as usual (BAU) case.

2 Electric Vehicle Range & Charging Time

- Policy lever: 0-100% reduction in concern
- **Modeled: 10% reduction in concern**

This policy specifies a percentage reduction in vehicle buyers' aversion to electric vehicles due to concerns over the vehicles' range (how far the EV can travel on a charge) and charging time. A 100% setting implies consumers are no more concerned about EV range and charging time than they are about range and fueling time of gasoline vehicles.

3 Electric Vehicle Sales: Passenger and Commercial LDVs and HDVs

- Policy lever: 0-100% of new vehicles sold
- **Modeled: 2030: 50% of new light-duty vehicles sold, 7% of heavy-duty vehicles sold**
  2050: 75% of new light-duty vehicles sold, 10% of heavy-duty vehicles sold

This policy specifies percentage of new vehicles that consist of battery electric vehicles.

4 Electric Vehicle Subsidy: Passenger LDVs

- Policy lever: 0-50% of vehicle cost
- **Modeled: 1% of vehicle cost (2024-2040)**

This policy causes government to pay for the specified percentage of the purchase price of new battery electric passenger LDVs. This is in addition to EV subsidies that exist in the BAU case.

5 Fuel Economy Standard: Passenger and Commercial LDVs and HDVs

- Policy lever: Freight or passenger: HDVs: 0-66% increase in miles/gal, LDVs: 0-100% increase in miles/gal
- **Modeled: light duty vehicles: 88% increase in mpg**
  Passenger HDVs: 45% increase in mpg
  Freight HDVs: 56% increase in mpg

This policy specifies a percentage improvement in fuel economy (distance traveled on the same quantity of fuel with the same cargo or passenger loading) due to fuel economy standards for new vehicles.

6 Low Carbon Fuel Standard

- Policy lever: 0-20% reduction in carbon emissions
- **Modeled: 8% reduction in carbon emissions by 2030**
  20% reduction in carbon emissions by 2050

This policy specifies the percentage of additional reduction in carbon emissions from the transportation sector that must be achieved via fuel switching in conventional vehicles (not switching to electricity).

7 Mode Shifting: Passenger LDVs

- Policy lever: Passenger: LDVs: 0-26% of trips shifted
- **Modeled: 4% of trips shifted by 2024, 8% of trips shifted by 2030, 11% of trips shifted by 2035, 14% of trips shifted by 2040, 20% of trips shifted by 2050**

This policy represents a set of measures aimed at reducing demand for passenger travel in light-duty vehicles (cars and SUVs) by shifting to other travel modes, such as buses, rail, walking, biking, or eliminating trips through technology such as videoconferencing.

8 Building Component Electrification: Urban and Rural Residential Heating and Appliances

- Policy lever: 0-100% of newly sold non-electric building components
- **Modeled: 85% of new components (i.e. 85% of new components ARE electric) by 2050**
  This policy replaces the specified fraction of newly sold non-electric building components in buildings with electricity-using appliances. In the BAU case, in Minnesota, the share of electric appliances in urban, residential buildings will remain constant at roughly 52% through 2050. In MN, approximately 17% of residential homes use electricity as a primary space heating fuel. In the BAU case, this is expected to grow to 40% by 2050.

9 Building Energy Efficiency Standards: Commercial, Urban and Rural Residential Heating, Cooling, Ventilation, Envelope, Lighting, Appliances, and Other Components

- Policy lever: 0-38% reduction in energy use (all lighting 0-40% reduction, all residential heating 0-20% reduction, all other residential 0-30% reduction)
- **Modeled: 25% reduction in energy use by 2050**
  This policy tightens energy efficiency standards in buildings. The policy only applies to newly sold appliances each year (whether for new buildings or replacement of old appliances in existing buildings). Minnesota has a legislative goal to achieve 1.5% annual energy savings, under the "Energy Savings Policy Goal" (2007). Note that energy efficiency applies to both gas and electric appliances.

10 Retrofit Existing Buildings: Commercial, Urban and Rural Residential

- Policy lever: 0-50% of existing buildings
- **Modeled: 20% of existing buildings by 2050**
  Each year, the specified percentage of commercial buildings that existed at the start of the model run will be retrofit with more efficient heating, cooling, and envelope components. By 2050, roughly 37% of the preexisting buildings will exist without major renovations, so a value of 37% will retrofit all such surviving buildings by 2050.

11 Clean Electricity Standard

- Policy lever: 0-100% of electricity generation
- **Modeled: 100% by 2040**
  This policy specifies an increase in the fraction of electricity generation that must come from qualifying carbon-free sources (wind, solar, biomass, hydro, or geothermal).

12 Increase Transmission

- Policy lever: 0-113% increase in transmission capacity
- **Modeled: 20% increase in capacity by 2050**
  This policy causes additional transmission capacity to be built relative to the BAU case. Transmission increases the flexibility of the grid, allowing for the integration of more wind and solar PV, if the electricity system is flexibility-constrained. In a BAU case, Minnesota's transmission capacity is expected to increase by 3%.

13 Industry Energy Efficiency Standards: Water & Waste

- Policy lever: 0-33% reduction in energy use
- **Modeled: 20% reduction in energy use**
  This policy reduces fuel consumption by the selected industry by increasing the efficiency of industrial equipment through stronger standards. The policy setting refers to overall energy use reduction, not the reduction in energy use of newly sold equipment.

14 Material Efficiency, Longevity, & Re-Use: Building materials

- Policy lever: 0-100% demand reduction
- **Modeled: 10% demand reduction**
  This policy reduces demand for building materials through techniques such as material-efficient building codes, requirements for greater infrastructure and product longevity, and greater re-use, repair, and re-purposing of buildings and products, etc.