Michigan Energy Policy Simulator (EPS) Summary Documentation

Estimating Economy-wide Emissions for Michigan

The Michigan 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). 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 and EIA's Form 860 For imports/exports: EIA's State Electricity Profiles Table 10.	Added all utility-owned generation and capacity instate. No scaling needed. Imports and exports are held constant based on historical data. Emissions calculated by weighing generation of surrounding states.	Emissions - EPA "State CO2 Emissions from Fossil Fuel Combustion, 1990-2017" & AEO "State CO2 Emissions from Fossil Fuel Combustion"
Building Energy Use	All energy use, all building components, residential and commercial buildings	NREL Electrification Futures Study - Reference Scenario	No scaling needed. NREL reports total energy use by fuel type and demand technology in MI for each year 2017-2050.	Energy Use - EIA's "State Energy Data Systems" 2019 CO2 Emissions - AEO "State CO2 Emissions from Fossil Fuel Combustion"

Sector	Subsectors	Source	Methodology	Benchmarking Sources for Comparisons
Industrial Energy Use	All fuel use for industrial sector	Energy Information Association's Annual Energy Outlook tables on Industrial Energy Use & EIA's "State Energy Data Systems"	Scaled down by Census Data (County Business Patterns) employment by industrial subsector and state compared to national employment by industrial sector	Energy Use - NREL Electrification Futures and EIA's "State Energy Data Systems" Emissions - EPA "State CO2 Emissions from Fossil Fuel Combustion, 1990-2017" & AEO "State CO2 Emissions from Fossil Fuel Combustion"
Industrial Process Emissions	Process Emissions	EPA Global Non-CO2 Greenhouse Gas Emissions Projections & Mitigation Potential: 2015-2050	Scaled down US data to state data using a variety of sources, including data from EPA's FLIGHT tool and EPA's State Inventory Tool Output Dataframe	Emissions - EPA "State CO2 Emissions from Fossil Fuel Combustion, 1990-2017"
Agriculture, Land Use and Forestry		EPA "State Inventory and Projection Tool"		Emissions - EPA "State CO2 Emissions from Fossil Fuel Combustion, 1990-2017" & AEO "State CO2 Emissions from Fossil Fuel Combustion"
Transportation	All energy use, vehicle miles	Energy Information Association's Annual Energy Outlook tables on Industrial Energy Use & NREL Electrification Futures Study - Reference Scenario	Scaled down US data, using NREL to find the proportion of national vehicle stock and service demand in MI.	Emissions - EPA "State CO2 Emissions from Fossil Fuel Combustion, 1990-2017" & AEO "State CO2 Emissions from Fossil Fuel Combustion"

Understanding the Business-as-Usual Projection and Additional Policy Scenarios

The Michigan EPS model includes three built-in reference scenarios.

Business-as-Usual: Energy Innovation and RMI built a forecast of Michigan's economy-wide greenhouse gas emissions through 2050 using publicly available, national models of energy consumption (EIA's Annual Energy Outlook, NREL's Electrification Future Study). The BAU Scenario is the model's foundation, capturing projected changes based on economic growth, technology and cost changes, and existing policy commitments.

Michigan Healthy Climate Plan (MIHCP): This scenario designed by 5Lakes Energy with support from RMI projects emissions reductions that may follow from full implementation of the Michigan Healthy Climate Plan released in April 2022.[1]

[1] https://www.michigan.gov/egle/about/organization/climate-and-energy/mi-healthy-climate-plan

US NDC Scenario: The US NDC Scenario was designed by Energy Innovation to result in an emissions pathway that meets the United States' Nationally Determined Contribution to decarbonization broadly consistent with limiting global warming to 1.5°C by 2100.[2] This pathway puts the US on track to reducing emissions 50 percent below a 2005 baseline by 2030 and achieving net zero emissions by 2050. This national scenario has been downscaled to each state, adjusting for differences in the state technology mix compared to the national technology mix. This policy scenario is illustrative and is meant to represent one set of policies that could be used to reduce emissions in line with a 1.5°C scenario.

The table below summarizes the policies included in each scenario.

SUMMARY OF POLICY ASSUMPTIONS

Sector	BAU Scenario	Michigan Healthy Climate Plan (MIHCP) Scenario	US NDC Scenario
Electricity	• Does not include recent federal policy (Energy Act of 2020/ Infrastructure Investment and Jobs Act) • Assumes all currently planned retirements are completed on time	• Clean Electricity Standard of 70% by 2050, reaching 61% by 2030 • Power plant retirements eliminate in-state coal by 2030 • Accelerate deployment of grid-scale electricity storage to roughly 2,000 MW by 2030, 3,000 MW by 2050	• Clean Electricity Standard of 80% by 2030, 100% by 2035 • Accelerate deployment of storage, transmission, and demand response • No new construction of coal and natural gas plants • Power plant retirements eliminate coal by 2030 • Electricity Sector CCS applied to remaining gas plants run for occasional balancing and reliability
Buildings	• From EIA's Annual Energy Outlook and NREL • Assumes some equipment performance improvements over time, based on market data (described here)[3]	• Reflecting multiple components of MICHP, assume 21% of newly sold appliances are electric by 2030 • Accelerate energy efficiency improvement through energy waste reduction standards • Retrofit all existing buildings by 2050, in addition to natural turnover. • Assume support for contractor training, rebates for more efficient appliances, and improved labeling of energy performance of appliances	• 100% electric new appliances and buildings by 2030 ("building component electrification") • 15% of existing buildings are retrofit by 2050, in addition to natural turnover • Efficiency improvement with ambition extended to 2050, plus additional efficiency improvements for building heating equipment and appliances

[2] Energy Innovation, "A 1.5°C NDC For Climate Leadership By The United States", 2021. https://energyinnovation.org/publication/a-1-5-celsius-pathway-to-climate-leadership-for-the-united-states/

[3] Efficiency improvements are derived from NREL electrification futures study Reference Case. Energy Efficiency policies – including utility or locality specific building rebates-- are not explicitly included in the BAU.

Sector	BAU Scenario	Michigan Healthy Climate Plan (MIHCP) Scenario	US NDC Scenario
On-Road Transportation	• From EIA's Annual Energy Outlook and NREL • Includes 2012 Federal Corporate Average Fuel Economy Standards (CAFE) standards (full text via AEO) • Federal EV subsidies • Economic adoption of EVs[4]	• Electric vehicle purchase subsidy of $2,500 • 50% electric new light-duty vehicle sales by 2030 • 30% electric new medium- and heavy-duty trucks by 2030 • 5% low carbon fuel standard by 2030 • 3% reduction in light-duty vehicle miles traveled from BAU by 2050	• 100% electric new light-duty vehicle, motorbike, and bus sales by 2035 • 100% electric new medium- and heavy-duty truck sales by 2045 • 60% improvement in fuel economy standards for internal combustion engine light-duty vehicles by 2035, as well as a 50% improvement for buses, a 50% improvement for medium- and heavy-duty freight vehicles, a 60% improvement for aircraft, and a 25% improvement for rail and ships • 20% light-duty vehicle miles traveled reduced or shifted from BAU by 2050 • 6.3% reduction in truck freight transport by 2050
Industry	• From EIA's Annual Energy Outlook and NREL • Assumes equipment performance improvements over time (described here) • Does not include implementation of the Kigali Amendment to the Montreal Protocol.	• Increased use of cogeneration and waste heat recovery in industrial facilities • Reduced demand for materials through efficiency, longevity, and re-use	• 100% achievement of cement clinker substitution by 2030 • 100% achievement of HFC emissions reductions from the Kigali Amendment to the Montreal Protocol • 14% improvement in industrial energy intensity/efficiency by 2050 • 100% by 2050 shift from fossil fuels to a mix of electricity and hydrogen, varying by industrial potential for each fuel type, by 2050 • 10% reduction in cement demand and 15% reduction in iron and steel demand from improved material efficiency policies by 2050 • 100% achievement of potential emissions reductions from methane capture and destruction in natural gas and oil, coal mining, water, and waste sectors by 2030 • 100% of hydrogen is produced via electrolysis by 2050 • 50% remaining industrial CO2 emissions captured and sequestered through CCS by 2050

[4] Electric vehicle adoption in the BAU case is based on economic adoption modeled in the EPS, with more details available here: https://us.energypolicy.solutions/docs/transportation-sector-main.html. EPS transportation data, such as vehicle prices, is largely taken from EIA, and the resulting EV adoption curve rates are similar to other studies, including the "Electric Vehicle Outlook 2020": https://about.bnef.com/electric-vehicle-outlook/#toc-viewreport.

Sector	BAU Scenario	Michigan Healthy Climate Plan (MIHCP) Scenario	US NDC Scenario
Land use/Agriculture	• Agriculture, biomass, and forestry projections	• Modest additional carbon uptake from improved practices in forest and croplands management	• 100% achievement of potential additional carbon uptake from afforestation/reforestation measures, improved forest management, cropland measures, and livestock measures (such as requiring anaerobic digesters) by 2030
Imports/Exports	• Imported electricity emissions held constant		

About the EPS

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.[5] 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 45 U.S. states.

For additional information on Energy Innovation's Energy Policy Simulator, please view the tutorial here.

The EPS model is available for download online here.[6] And full documentation on methodology and assumptions are available online here.[7]

Contact

If you have questions about using the EPS, we recommend first watching our video series, available here.[8] For further information on the EPS, contact us at policy@energyinnovation.org. For more information on RMI analysis and our state advocacy support network contact us at USAnalysis@rmi.org.

The Michigan EPS is developed as a partnership between Energy Innovation and RMI (formerly Rocky Mountain Institute).

[5] https://energyinnovation.org/2020/07/28/hal-harveys-insights-and-updates-congressional-climate-plan-is-a-bet-your-country-moment/
[6] https://us.energypolicy.solutions/docs/download.html
[7] https://us.energypolicy.solutions/docs/index.html
[8] https://us.energypolicy.solutions/docs/video-series.html