TOP STATE ENERGY POLICIES TO CUT CARBON EMISSIONS

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FEBRUARY 2023[i]

INTRODUCTION

The Inflation Reduction Act (IRA) marked a historic investment in the United States' clean energy transition, and 2023 will be the year its historic funding starts to flow in earnest. IRA funding is already generating new opportunities for state policymakers to accelerate the clean energy economy, creating high-quality jobs and cutting greenhouse gas (GHG) emissions. Many states are already considering new emissions reduction goals or ways to increase ambition. California, Colorado, Minnesota, Michigan, Pennsylvania, Rhode Island, New York, and Washington, among others, have ongoing processes to cut carbon emissions that may be strengthened with the IRA on the books and new state leadership.

However, determining which policies can most effectively meet emissions targets and the tradeoffs between different policies can be challenging. For that reason, many state climate plans rely on technology forecasts—which simply assume technology adoption happens—rather than identifying the *policies* that drive technology adoption.

With the release of state-level Energy Policy Simulators (EPS) for the contiguous 48 states, Energy Innovation Policy & Technology LLC® and RMI aim to solve this challenge. The free, open-access EPS can be used to identify the strongest

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climate policies across states and create a comprehensive policy roadmap for decarbonizing the economy.

In this research note we evaluate emissions trajectories and policy impacts for six states: Louisiana, Michigan, Minnesota, New Mexico, Pennsylvania, and Wisconsin. These states have widely varying emissions profiles. For example, Louisiana's emissions are dominated by the industrial sector, while in Michigan, the building sector is a significant contributor. In New Mexico, home to significant oil and gas extraction, methane is a major source of GHG emissions.

Despite the differences in state emissions composition, this modeling shows how just five policies across the economy—clean electricity standards; zero-emission vehicle standards; clean building equipment standards; industrial efficiency and emissions standards; and standards for methane detection, capture, and destruction—can dramatically cut state GHG emissions.

Five Policies Scenario Emissions Reductions by State

State	Reductions	2020	2030	2050
Louisiana	$MMTCO_2e$	197	143	40
	Percent reduction in scenario		31%	**82%**
Michigan	$MMTCO_2e$	153	99	31
	Percent reduction in scenario		35%	**78%**
Minnesota	$MMTCO_2e$	132	118	63
	Percent reduction in scenario		11%	**49%**
New Mexico	$MMTCO_2e$	73	52	30
	Percent reduction in scenario		23%	**48%**
Pennsylvania	$MMTCO_2e$	228	153	31
	Percent reduction in scenario		39%	**87%**
Wisconsin	$MMTCO_2e$	106	74	26
	Percent reduction in scenario		24%	**72%**

STATE ENERGY POLICY SIMULATORS

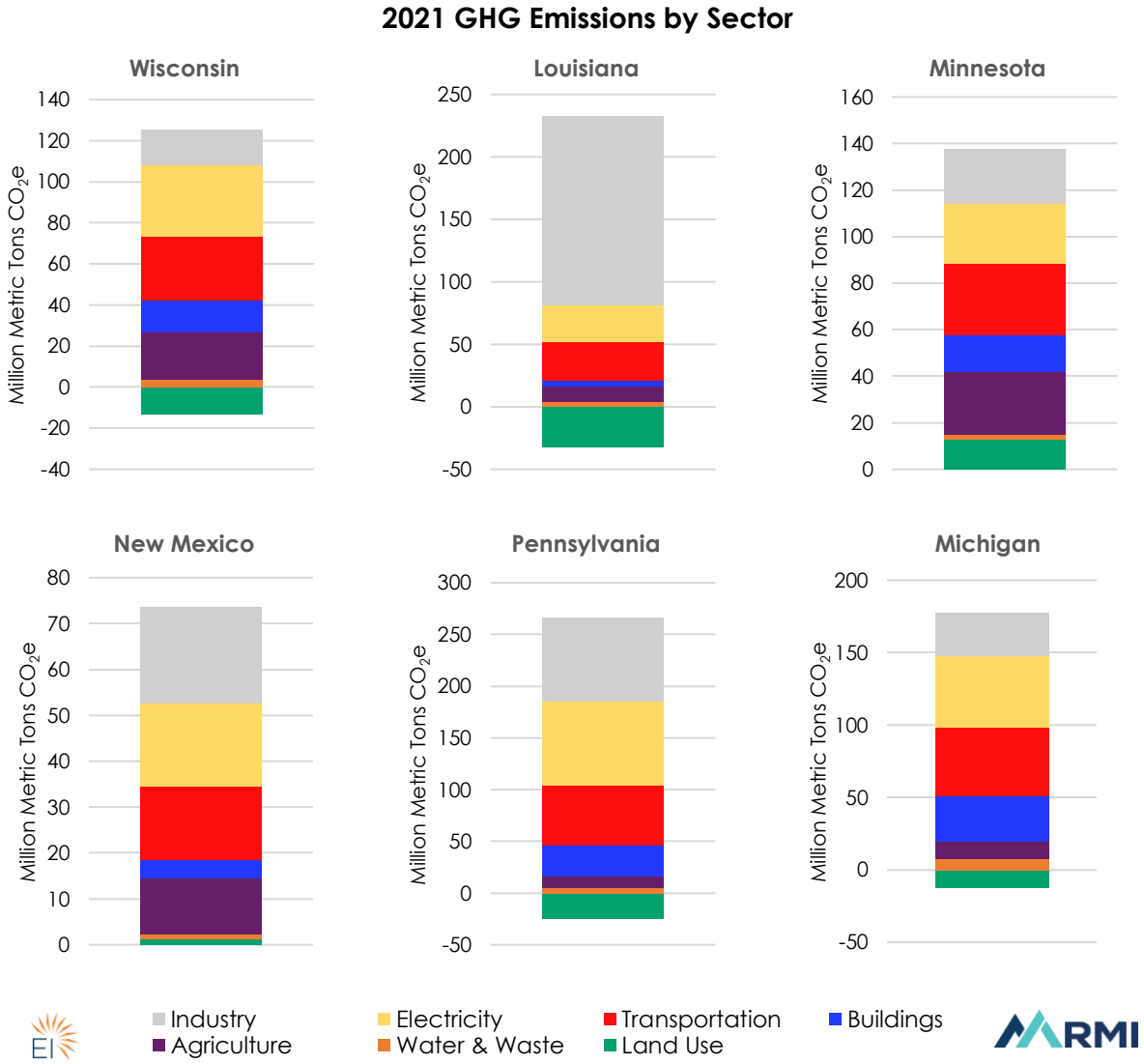
The state EPS models empower policymakers, advocates, and other stakeholders to evaluate a wide range of state policies and their combined impact on GHG emissions, public health, employment, and economic growth within a single state. In the last two years, Energy Innovation® and RMI have used the EPS to support climate action planning in nearly a dozen states, working with policymakers, advocates, and researchers.

The state EPS models are built using publicly available state and downscaled federal data from sources such as the U.S. Energy Information Administration, the U.S. Environmental Protection Agency (EPA), the U.S. Bureau of Labor Statistics, the U.S. Bureau of Economic Analysis, the National Renewable Energy Laboratory, and others. The models incorporate existing federal and state policy as of January 2023, excluding the IRA. Only state policy that is legislated or regulated is currently included in the models. In

other words, targets and proposed legislation or rules are not integrated, but the model can be used to identify pathways to achieve targets and assess the impacts of proposed policies.

More information on our sources and methodology is available as part of our documentation at https://docs.energypolicy.solutions/us-state-eps-methodology. The state EPS models are publicly available at https://energypolicy.solutions/us-states and can be run online and downloaded to run locally using free software. GHG emissions are reported in carbon dioxide equivalent (CO_2e) using 100-year global warming potential values from the Intergovernmental Panel on Climate Change's Fifth Assessment Report.

As states develop climate targets and policies to achieve those targets, the state EPS models can help identify how effective proposed policies will be in cutting emissions, what additional policies can be used, and the impact on the economy and public health.

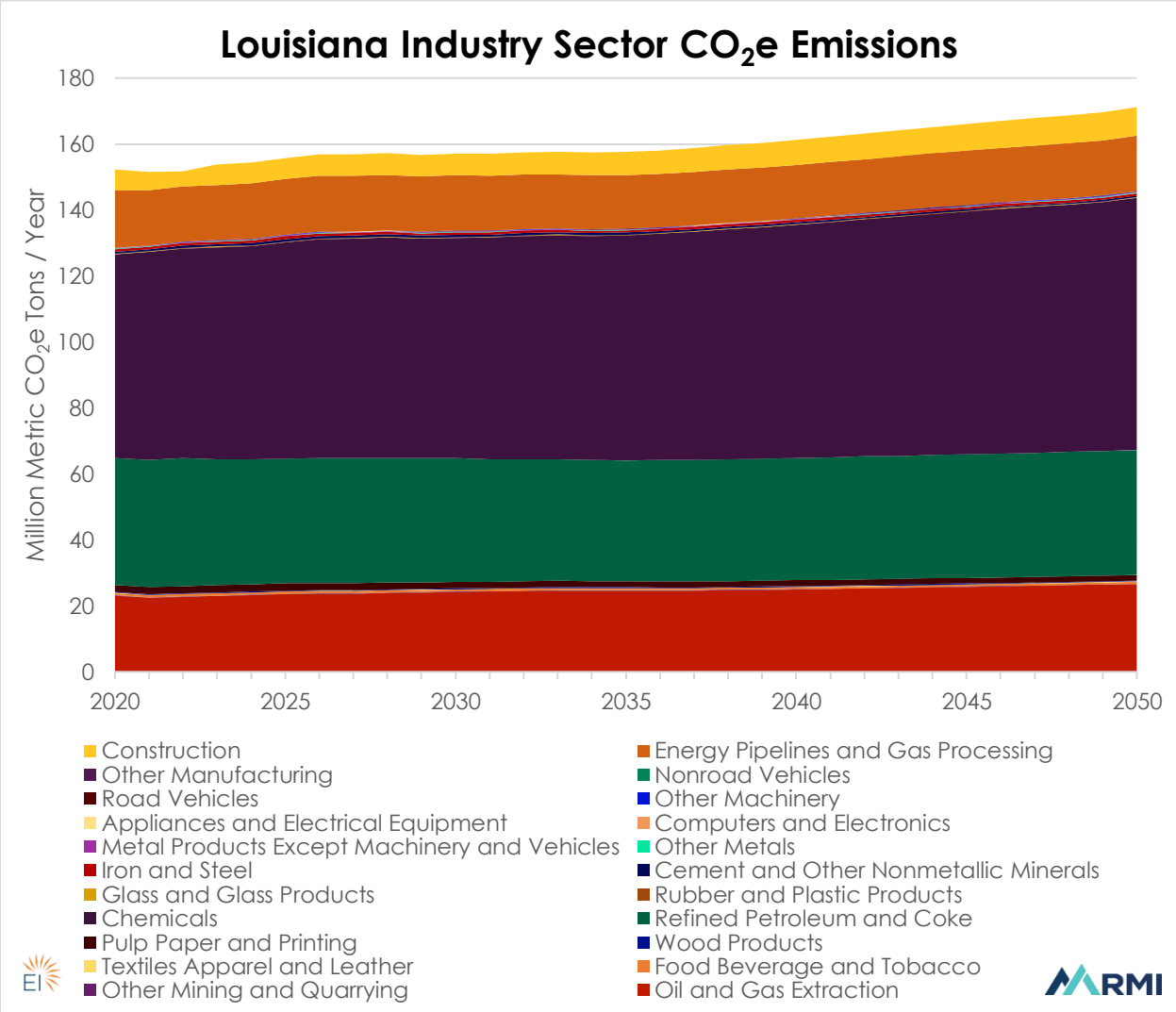


CARBON EMISSIONS WITHOUT ADDITIONAL POLICY

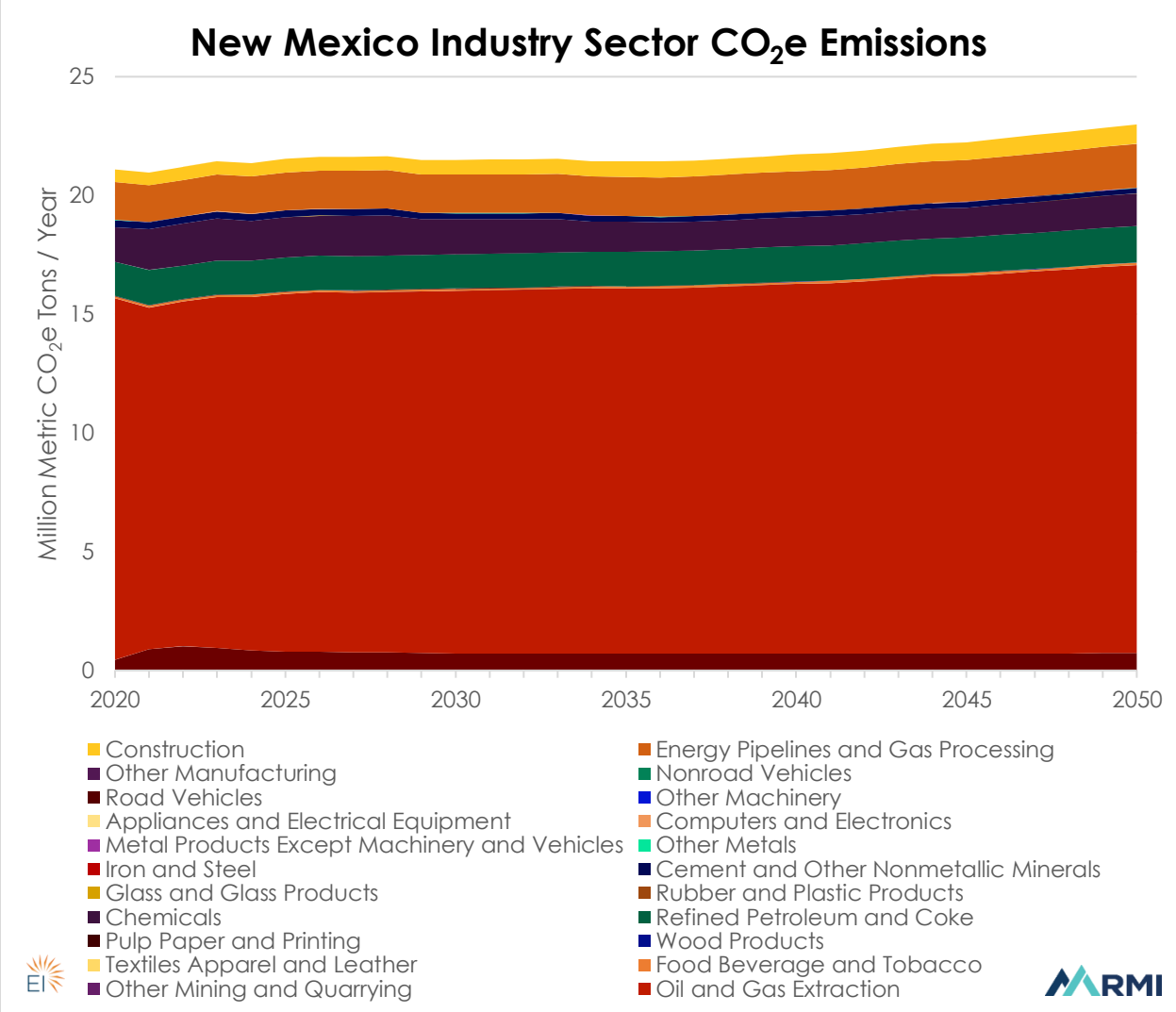
The state EPS models include detailed projections of energy consumption, technology shares, and emissions across the economy, starting from a business-as-usual (BAU) reference scenario. In this section, we profile six states—Michigan, Pennsylvania, New Mexico, Minnesota, Louisiana, and Wisconsin—with significant emissions and varying emissions profiles. Most of these states also have legislatures or governors' offices who have shown interest in implementing climate policy in 2023.

For the most part, emissions across all six states are expected to remain relatively constant, without significant decreases. However, the source of emissions varies dramatically across these six states.

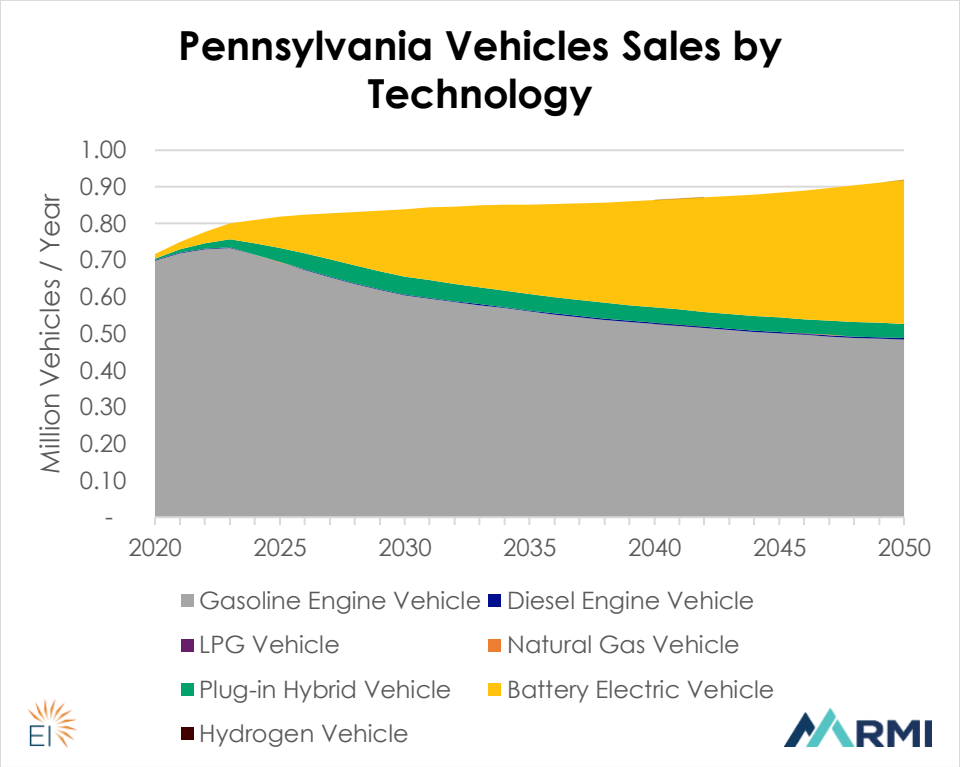
In Louisiana, for example, emissions are dominated by the industry sector, which accounts for nearly two-thirds of gross GHG emissions. Industrial emissions are primarily from the oil and gas extraction, refining, gas processing and pipelines, and chemicals sectors.

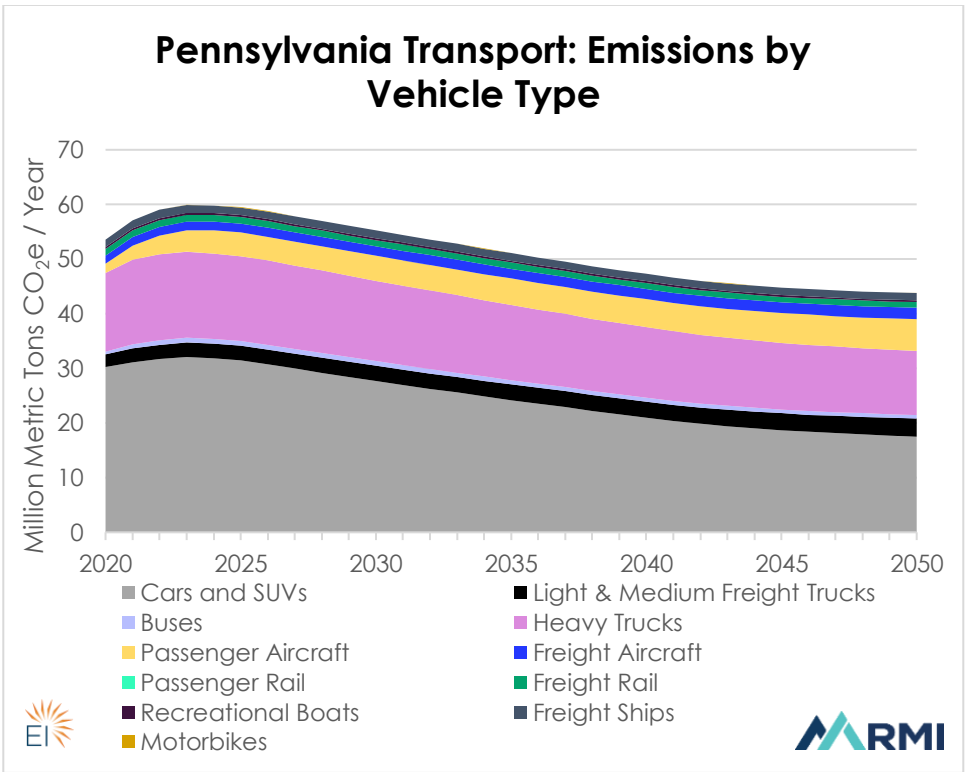


While New Mexico has significantly less industrial output than Louisiana, industrial emissions also represent a large share of total GHG emissions, primarily due to methane emissions from oil and gas extraction.



But many states have smaller contributions from industry and larger contributions from other sectors. In Michigan, emissions from buildings exceed those from the industrial sector, due in large part to the colder climate and different industrial composition. Transportation emissions are significant across all states, though we project steady decreases over time due to growing sales of zero-emission cars and trucks. For example, in Pennsylvania, emissions from passenger cars are expected to drop from 30.2 million metric tons (MMT) CO_2e in 2020 to 17.5 MMT CO_2e by 2050.


Pennsylvania Vehicles Sales by Technology
Million Vehicles / Year
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
-
2020
2025
2030
2035
2040
2045
2050
Gasoline Engine Vehicle
Diesel Engine Vehicle
LPG Vehicle
Natural Gas Vehicle
Plug-in Hybrid Vehicle
Battery Electric Vehicle
Hydrogen Vehicle
EI
RMI


Pennsylvania Transport: Emissions by Vehicle Type
Million Metric Tons CO_2e / Year
70
60
50
40
30
20
10
0
2020
2025
2030
2035
2040
2045
2050
Cars and SUVs
Light & Medium Freight Trucks
Buses
Heavy Trucks
Passenger Aircraft
Freight Aircraft
Passenger Rail
Freight Rail
Recreational Boats
Freight Ships
Motorbikes
EI
RMI

In states with substantial agriculture, especially livestock, agricultural emissions can significantly contribute to total GHG emissions. In Minnesota and Wisconsin, for example, agricultural emissions account for 19 percent and 18 percent of gross GHG emissions, respectively, compared to just 7 percent in Michigan.

As demonstrated above, states differ widely in their emissions totals and sources of emissions based on population, economic specialization, and size. Yet despite these differences, just five state policies can dramatically cut emissions across all states and make significant progress toward net-zero emissions nationally.

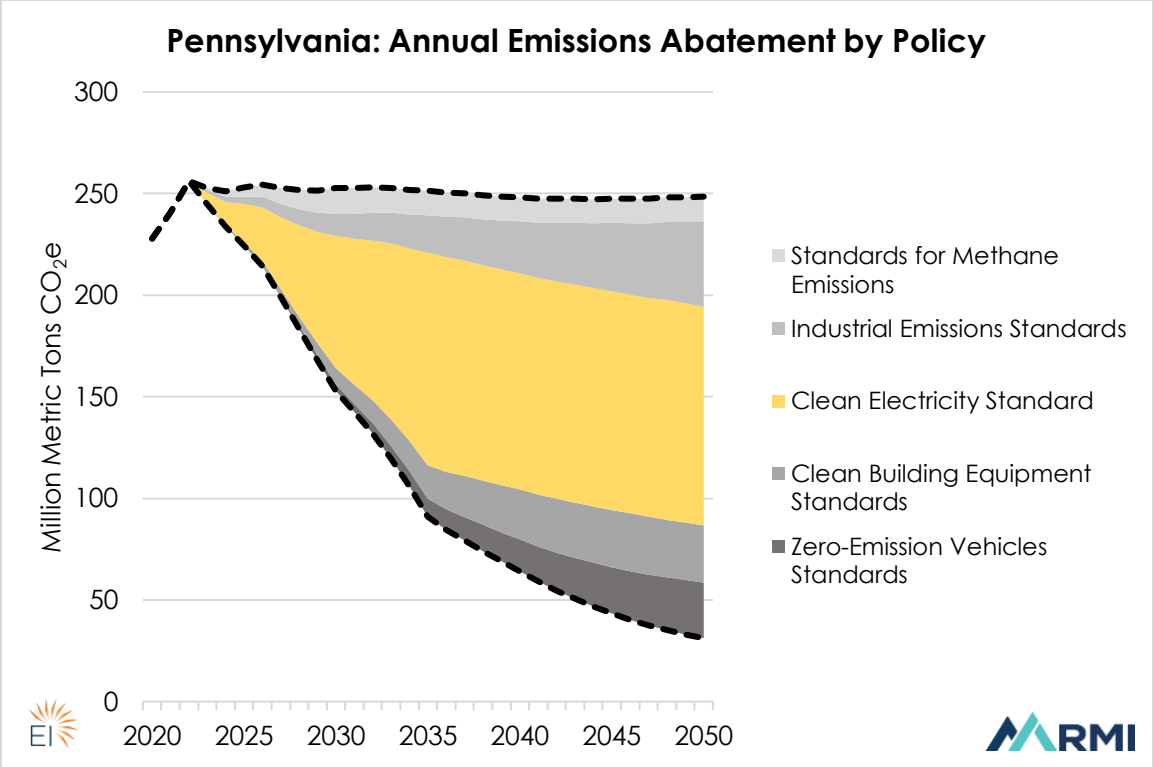
FIVE POLICIES TO SLASH EMISSIONS, GROW THE ECONOMY, AND IMPROVE HEALTH

As stakeholders from different states develop strategies to cut emissions, the state EPS models show how that five key policies across different sectors of the economy can significantly cut emissions. These five policies are clean electricity standards, zero-emission vehicle standards, clean building equipment standards, industrial efficiency and emissions standards, and standards for methane detection, capture, and destruction. Together, these policies constitute an aggressive, economywide policy plan to slash emissions while delivering noteworthy economic and public health benefits.

Clean Electricity Standards

To cut emissions from the electricity sector, clean electricity standards (CES) are a widely used and highly successful policy to boost the share of electricity from clean sources. CESs require retail electricity utilities to meet an increasing share of their electricity sales with qualified clean electricity sources, which typically include solar, wind, hydro, and nuclear power, with some variation depending on the state. Utilities demonstrate compliance by acquiring tradable credits associated with the clean electricity generated.

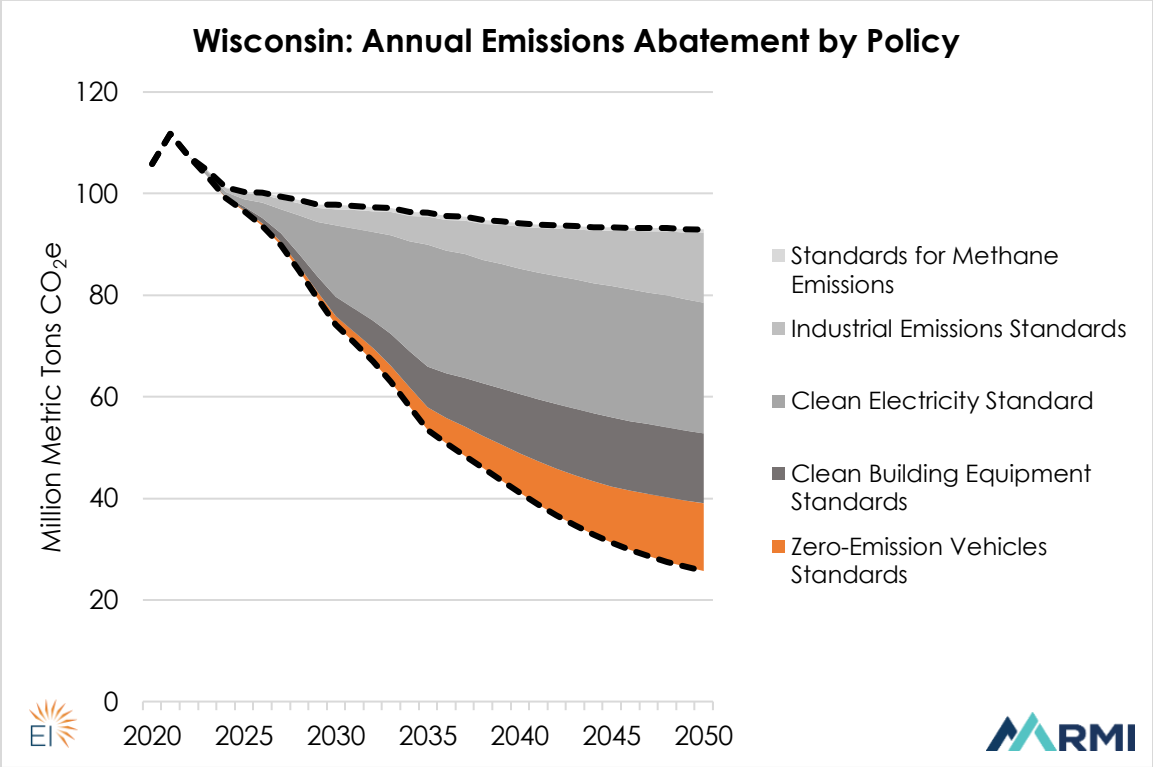
CESs, and their cousin renewable portfolio standards, are in place in 29 states already and are a successful tool to drive decarbonization of the power sector.[1] With the clean electricity incentives from the IRA, a CES is a cost-effective way to cut carbon emissions while lowering consumer bills. The CES modeled here requires 80 percent clean electricity by 2030 and 100 percent clean electricity by 2035, which is broadly aligned with the U.S. 2030 Nationally Determined Contribution of an economy-wide net emissions reduction to 50 to 52 percent below 2005 levels and the goal of net-zero GHG emissions by 2050.



Zero-Emission Vehicle Standards

Most transportation-sector emissions are from on-road vehicles such as passenger cars, pickup trucks, delivery trucks, and tractor-trailers. Cutting emissions from these sources requires replacing gasoline and diesel engine vehicles with zero-emission vehicle (ZEV) alternatives. ZEV standards require that an increasing share of newly sold vehicles are ZEVs, such as battery electric vehicles. Different standards may apply for different vehicle types. For example, California's Advanced Clean Cars rule sets sales requirements for light-duty vehicles, while the Advanced Clean Trucks rule governs sales of medium- and heavy-duty vehicles, such as trucks and tractor-trailers. Compliance can be demonstrated through a system of tradable credits, allowing flexibility for manufacturers and retailers (such as dealers).

Some form of ZEV standards are already in place in 15 states, though they are typically not ambitious for light-duty vehicles.[2] California recently enacted the Advanced Clean Cars II rule, which requires 100 percent ZEV sales for light-duty vehicles by 2035, and which several states are considering adopting. The ZEV standards modeled here align with Advanced Clean Cars II and with Advanced Clean Trucks, which ramps up requirements to 2035 for smaller and lighter trucks and to 2045 for tractor-trailers and the heaviest vehicles.



Clean Building Equipment Standards

Nearly all direct emissions from buildings (meaning emissions generated onsite, not upstream from power generation, for example) are from burning gas or oil for space heating, water heating, and cooking. To address these emissions, newly installed building equipment should be electric, beginning with space heating and water heating in new construction, but eventually moving to all end uses in new and existing buildings.

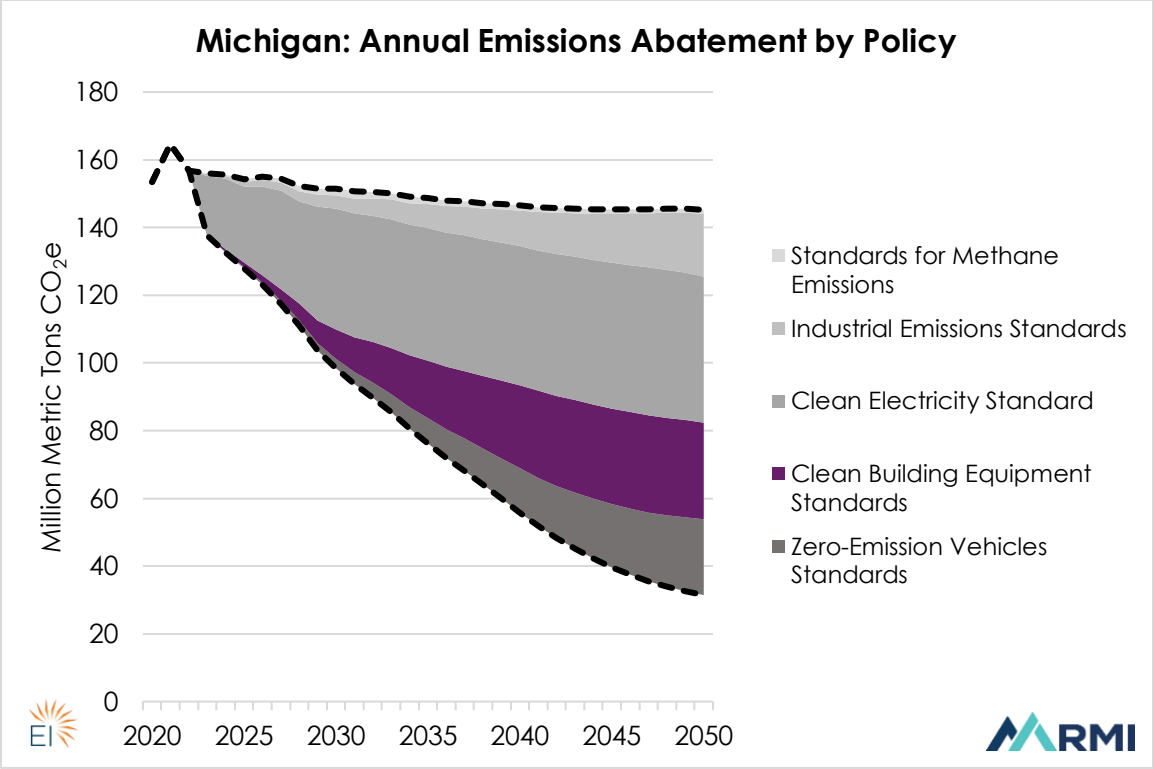
Electric heating offers many benefits over fossil fuel heating. For starters, all-electric heat pumps are three to five times more efficient than gas space and water heating, meaning they require less energy and typically lead to cost savings. Because they also require no on-site combustion, they avoid creating indoor pollution, like NO_x and carbon monoxide, which can lead to adverse health impacts like asthma.

State building codes set requirements addressing the types of equipment that can be used in new construction and renovations and can require developers and contractors to use electrified equipment. For existing buildings, appliance standards can require a growing share of replacement equipment to be electrified. Several states and municipalities have building codes and regulations that require increasing use of electric equipment in new buildings. Some states and municipalities are considering appliance standards that would similarly increase the use of electrified equipment in existing buildings.

Today, it is economic to install electrified equipment in new construction, but it is often still costly to retrofit existing buildings to replace gas equipment with electrified equipment. Therefore, incentives are also a necessary component of building codes and appliance standards that aim to electrify buildings.

A similar policy that is being tested in several states is a clean heat standard, which requires utilities to deliver increasingly clean heat fuels to customers.[3] If designed in a way that encourages fuel switching from gas to electricity, a clean heat standard can achieve outcomes similar to an appliance standard.

Here, we modeled steadily increasing standards that require electric-only equipment in new and existing buildings by 2035.



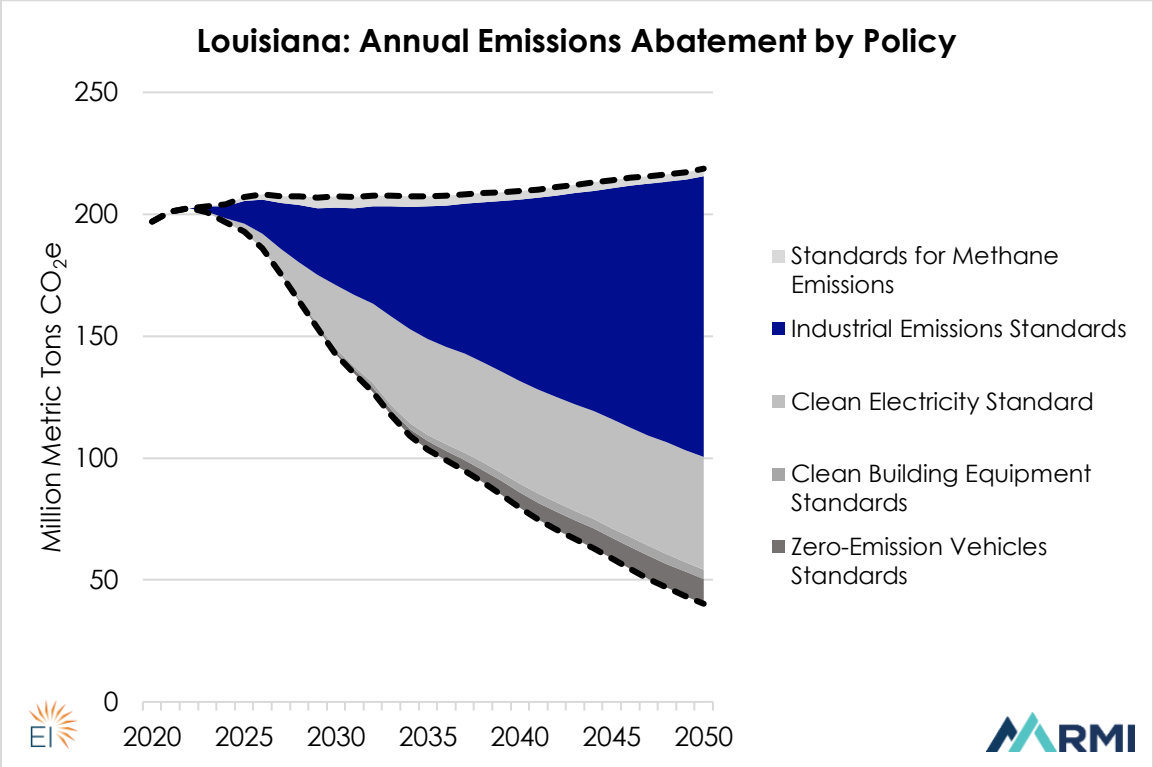
Industrial Emissions Standards

Industrial activity, including steel, cement, and petrochemical production, generates about 30 percent of national emissions through fuel combustion and process emissions.[4] States can have widely varying levels of industrial emissions based on manufacturing activity levels and regional specializations. However, an industrial emissions standard for all states with industrial activity can be an effective policy for cutting emissions from these often-overlooked industries. A similar policy is a carbon cap for manufacturing energy emissions, provided it doesn't allow for offsets.

Industrial facilities can meet these standards through several mechanisms. Facilities can shift away from burning fossil fuels to electrification, for example, using heat pumps for low- and some medium-temperature processes. In fact, 15 percent of national industry sector emissions could be cut through heat pumps alone by 2050.[5] For high-temperature processes, other electric technologies and decarbonized fuels, such as green hydrogen, can be used to decarbonize fuels and feedstocks. In addition, facilities can

consider equipment upgrades that improve energy efficiency, which can save up to 15 to 20 percent of the fuel used to generate energy for their processes.[6]

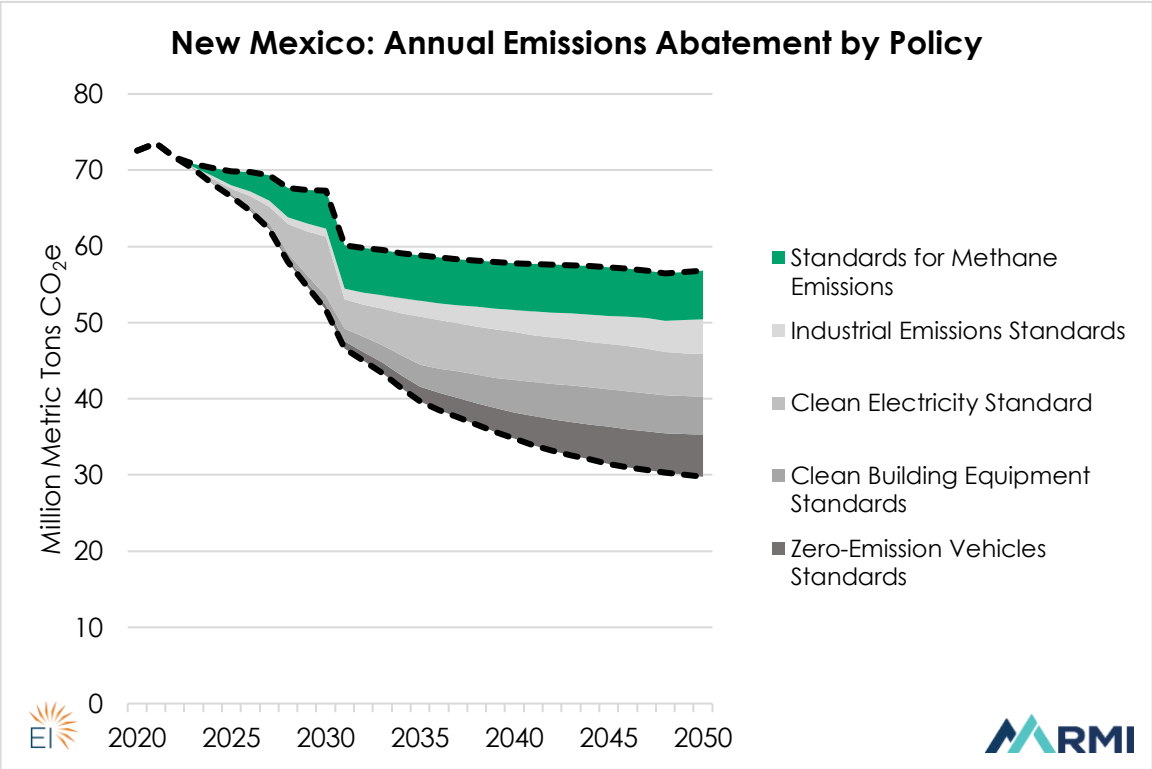
In this modeling, we included an industrial emissions standard that shifts about 30 percent of fossil fuel use to a mix of electricity and hydrogen for low-temperature and medium- to high-temperature heat processes, respectively, by 2030, with continued progress to 100 percent by 2050. The modeling also assumes about a 5 percent reduction in fuel use relative to BAU by 2030 with continued progress to 14 percent by 2050 through energy efficiency improvements that help comply with the emissions standard.



Standards for Methane Emissions

Methane emissions account for nearly 15 percent of national emissions from sources such as fossil fuel extraction, processing, transport, and abandoned infrastructure; agriculture; and landfills.[7] Similar to other industrial emissions, methane emissions can vary widely across states depending primarily on their fossil fuel infrastructure and livestock abundance. It is critical for states with high levels of oil and gas production—such as Colorado, New Mexico, and Pennsylvania—to set strong regulations and standards to reduce methane emissions. Examples of strong regulations include Colorado's recently enacted rules requiring regular site inspections for leak detection and repair and establishing a GHG intensity standard for production facilities (pending a verification rule to be completed in 2023).[8]

We include a strong set of standards on oil and gas methane that result in emissions reductions equal to 100 percent of the potential identified by the U.S. EPA by 2030 and beyond.[9]



Health and Economic Benefits of Top Five Policies

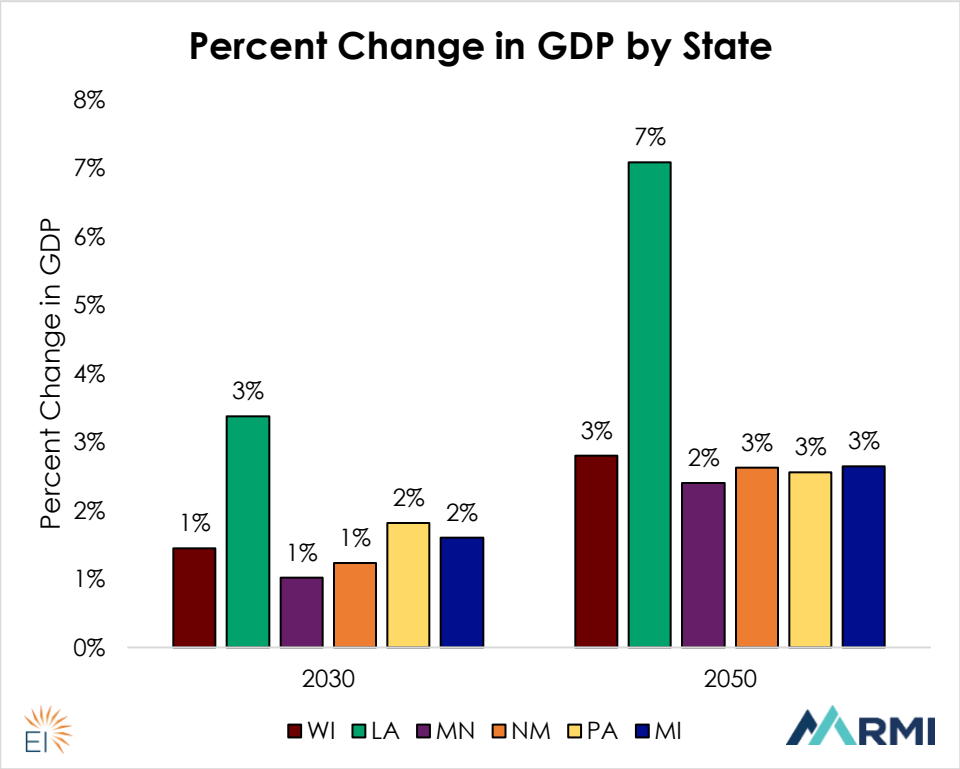
Jobs and GDP

The five policies modeled yield significant economic benefits, including hundreds or thousands of new jobs, significant increases in state gross domestic product, and consumer savings through reduced spending on energy. The increased deployment of clean energy technologies leads to growth in construction and service jobs as well as manufacturing jobs for states with clean energy technology manufacturing.

Job Growth in 2030 in Five Policies Scenario

	Fossil Fuel and Utility Jobs	Manufacturing and Construction Jobs	Other Jobs	Total
Louisiana	8,190	21,654	33,081	62,925
Michigan	8,404	30,942	33,490	72,836
Minnesota	4,077	12,601	14,021	30,699
New Mexico	941	5,580	6,620	13,141
Pennsylvania	4,825	46,112	67,198	118,135
Wisconsin	2,766	19,176	15,954	37,896

Our modeling shows that the six states analyzed—Louisiana, Michigan, Minnesota, Pennsylvania, New Mexico, and Wisconsin—could see between 13,000 and 118,000 net new jobs and 1 to 3 percent growth in GDP relative to BAU in 2030.



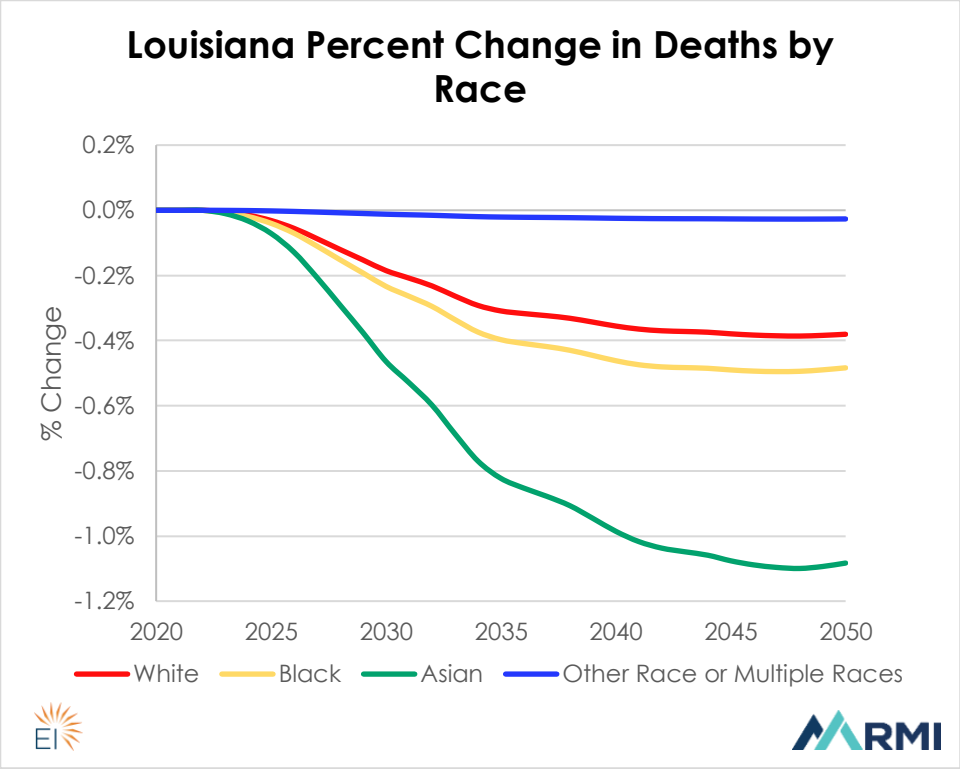
Avoided Death and Illness

Policies that transition to clean energy technologies also provide public health benefits by cutting harmful pollutants such as $PM_{2.5}$, SO_x, and NO_x. Emissions of these pollutants would be significantly reduced under the policies modeled as fossil-fuel facilities are replaced with clean resources, ZEVs displace gasoline and diesel vehicles, and electrified appliances displace oil and gas appliances in our buildings as they reach their normal end of life.

Avoided Premature Deaths per Year

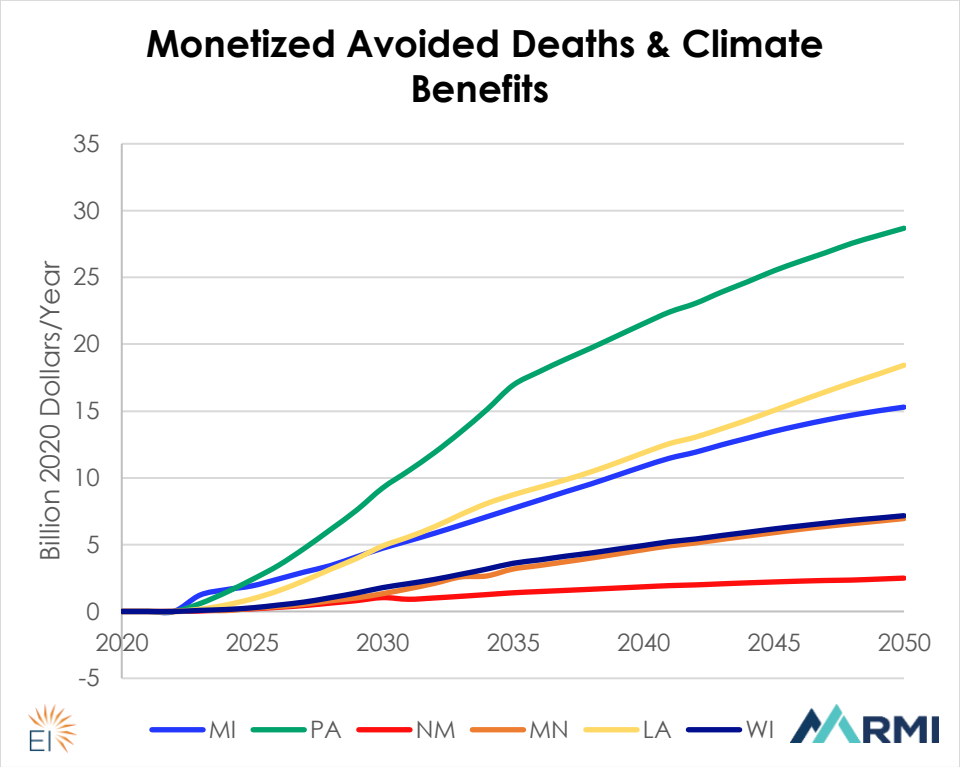
	2030	2050
Louisiana	88	319
Michigan	149	576
Minnesota	41	186
New Mexico	6	17
Pennsylvania	316	1045
Wisconsin	33	144

Our modeling shows that the six states analyzed could avoid between five and 300 premature deaths in 2030, in addition to preventing between 90 and 3,800 asthma attacks and 400 to 20,000 lost workdays. Fossil-fuel infrastructure is typically close to historically disadvantaged communities, and our modeling shows the health benefits of these policies would be most prominent in communities of color.



Monetized Social Benefits

Avoiding emissions of GHGs and health-damaging pollutants delivers enormous social benefits, as outlined above. Based on the latest social cost of carbon estimates and the value of a statistical life from the U.S. EPA, the economic value of the five policies modeled in these six states could range from $1 billion to $9 billion in 2030. Cumulatively, between 2023 and 2030, this range could be as high as $3.6 billion to $35 billion.



CONCLUSION

The IRA's passage in 2022 means states will soon be on the receiving end of historic federal investments in clean energy, while many clean energy technologies are now more affordable than fossil fuel alternatives. With this new funding and landscape, states are primed to lead the way on cutting emissions and state climate policy is more important than ever.

The newly released state EPS models can help stakeholders identify which policies can most quickly and effectively reduce emissions and what economic and health benefits they will deliver. The open-source EPS allows for rapid scenario evaluation and comparison, as well as customization of the input data. All figures in this report are built into the model and can be created for any state with an EPS.

One early finding of the EPS models is that while every state is different, five core policies across the economy—clean electricity standards, zero-emission vehicle standards, clean building equipment standards, industrial energy and emissions standards, and methane standards—can drive significant emissions reductions while generating large jobs gains, increasing GDP, and reducing premature deaths and ill health caused by air pollution.

As states move forward with developing climate action plans and evaluating how to achieve state targets, the newly released state EPS models are an indispensable, freely available tool. Policymakers and other stakeholders can contact Energy Innovation® and RMI for assistance by emailing policy@energyinnovation.org.

[1] 'U.S. State Electricity Portfolio Standards', *Center for Climate and Energy Solutions* (blog), accessed 23 January 2023, https://www.c2es.org/document/renewable-and-alternate-energy-portfolio-standards/.
[2] 'U.S. State Clean Vehicle Policies and Incentives', *Center for Climate and Energy Solutions* (blog), accessed 23 January 2023, https://www.c2es.org/document/us-state-clean-vehicle-policies-and-incentives/.
[3] 'Policy Win: Colorado's Innovative Clean Heat Standard Will Force Gas…', Canary Media, 11 August 2021, https://www.canarymedia.com/articles/policy-regulation/policy-win-colorados-innovative-clean-heat-standard.
[4] 'U.S. Energy Policy Simulator', accessed 23 January 2023, https://us.energypolicy.solutions.
[5] Jeffrey Rissman, 'Decarbonizing Low-Temperature Industrial Heat in the U.S.', n.d.
[6] Sarah Ladislaw and Stephen J. Naimoli, 'Climate Solutions Series: Decarbonizing Heavy Industry', 10 May 2020, https://www.csis.org/analysis/climate-solutions-series-decarbonizing-heavy-industry.
[7] 'U.S. Energy Policy Simulator'.
[8] 'New Rules to Speed Reduction of Oil and Gas Emissions in Colorado OK'd', accessed 23 January 2023, https://coloradosun.com/2021/12/20/greenhouse-gas-reduction-oil-gas-colorado/.
[9] OAR US EPA, 'U.S. State-Level Non-CO2 GHG Mitigation Report', Reports and Assessments, 4 March 2022, United States, https://www.epa.gov/global-mitigation-non-co2-greenhouse-gases/us-state-level-non-co2-ghg-mitigation-report.