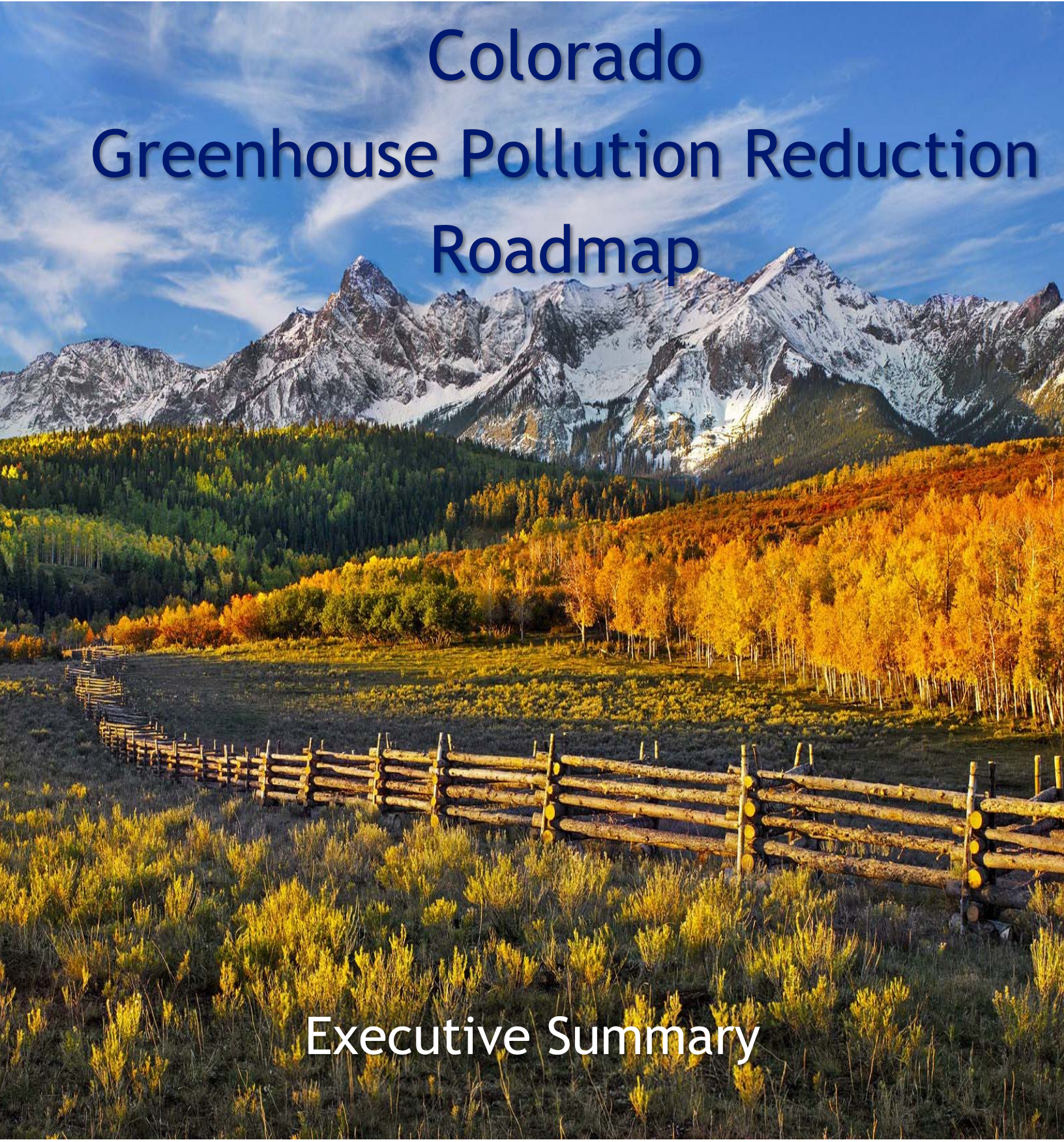
Colorado Greenhouse Pollution Reduction Roadmap



Executive Summary

COLORADO

Governor Jared Polis

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FREQUENTLY USED ABBREVIATIONS AND ACRONYMS

ACRE3	Advancing Colorado's Renewable Energy and Energy Efficiency Program
ACRO	Agricultural Climate Resilience Office of the Colorado Department of Agriculture
AgEE	Agricultural Energy Efficiency program of the Colorado Energy Office
APCD	Air Pollution Control Division of the Colorado Department of Public Health and Environment
AQCC	Air Quality Control Commission
BE	Beneficial Electrification
CCEF	Colorado Clean Energy Fund
CCHS	Colorado Collaborative for Healthy Soils
CCUS	Carbon Capture, Use and Sequestration
CDA	Colorado Department of Agriculture
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CEO	Colorado Energy Office
CEP	Clean Energy Plan
CH4	Methane
CFS	Clean Fuel Standard
CO2	Carbon Dioxide
$CO2_e$	Carbon Dioxide Equivalent

COGCC	Colorado Oil and Gas Conservation Commission
CRO	Colorado Resiliency Office
CSG	Community Solar Garden
CCUS	Carbon Capture Utilization and Storage
DER	Distributed Energy Resource
DNR	Colorado Department of Natural Resources
E3	Energy + Environmental Economics Consulting Firm
EERS	Energy Efficiency Resource Standard
EPA	Environmental Protection Agency
ERP	Electric Resource Plan
EV	Electric Vehicle
HB 19-1261	Colorado House Bill 1261 (2019), the Climate Action Plan
HDV	Heavy Duty Vehicle
IECC	International Energy Conservation Code
IPCC	The United Nations Intergovernmental Panel on Climate Change
JTAC	Just Transition Advisory Committee
LDAR	Leak Detection and Repair
LDV	Light Duty Vehicle
MDV	Medium Duty Vehicle
NOAA	National Oceanic and Atmospheric Administration
NWL	Natural and Working Lands

OJT	Colorado Office of Just Transition
PRPA	Platte River Power Authority
PUC	Public Utilities Commission
RPS	Renewable Portfolio Standard
SB19-077	Colorado Senate Bill 077 (2019)
SB19-181	Colorado Senate Bill 181 (2019)
SIP	Colorado's Regional Haze State Implementation Plan
SLB	State Land Board
STIP	Statewide Transportation Improvement Program
TAG	Technical Advisory Group
TDM	Transportation Demand Management
VMT	Vehicle Miles Traveled
WAP	Weatherization Assistance Program
ZEV	Zero Emission Vehicle

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EXECUTIVE SUMMARY

To address climate change, the Polis Administration has prioritized action on a just and equitable transition to renewable energy and pollution reduction that diversifies and strengthens our economy, creates good-paying, local jobs, and improves the health and well-being of our communities. **This work is motivated by an imperative to protect the health and safety of all Coloradans, as well as the unprecedented opportunity to drive innovation and ensure prosperity for future generations.**

In the 2019 legislative session Colorado passed House Bill 19-1261, the *Climate Action Plan to Reduce Pollution* ("Climate Action Plan"), which includes science-based targets of reducing statewide greenhouse gas pollution 26% by 2025, 50% by 2030, and 90% by 2050 from 2005 levels. To ensure that

Colorado continues to make progress toward these targets, Governor Polis directed state agencies to develop this comprehensive *Greenhouse Gas Pollution Reduction Roadmap* ("Roadmap").

As a result of prior policies, economic shifts, and legislative, regulatory, and other actions taken by this administration, Colorado is already on a pathway to achieving half of the emissions reductions needed to meet the 2025 and 2030 targets. The Roadmap delivers a list of near term actions the state will pursue over the next one to two years to make significant progress toward the 2025 and 2030 Climate Action Plan goals. The Roadmap also analyzes further actions that can help put the state on a solid path to meeting the 2050 goal.

Reducing greenhouse gas pollution across our economy to meet the state's science-based goals will be no small task. While we have taken a number of historic steps, we have much work to do to protect the Colorado way of life for generations to come. This work will continue to be multi-faceted and will require the ongoing expertise and engagement of all Coloradans.

The Roadmap represents the work of many state agencies including the Colorado Energy Office and the Departments of Agriculture, Natural Resources, Public Health and Environment, and Transportation. Additional support was provided by the Department of Local Affairs, the Colorado Resiliency Office and the Office of Just Transition. Colorado hired Energy + Environmental Economics ("E3"), a leading national consulting firm with expertise in GHG modeling, to develop a model of the state's economy-wide emissions by sector. Technical staff from the Climate Change Unit at the Colorado Department of Public Health and Environment provided additional analysis of projected emissions reductions from near term policy recommendations.

The development of the Roadmap started in late 2019 with a review of Colorado's 2015 Greenhouse Gas Inventory, which was updated in 2019, and an evaluation of the data used to project future GHG emissions for Colorado in the Environmental Protection Agency's State Inventory Tool. The state agencies, in consultation with E3 and other outside experts from a Technical Advisory Group, began gathering updated state-level data and refining modeling methods to establish a more accurate accounting of greenhouse gas emissions in Colorado in 2005. Among other changes to prior analyses, the state agencies revised estimates of 2005 emissions from oil and gas operations upwards from EPA stock assumptions to reflect more recent scientific information about methane emissions.

Using this updated data and E3's modeling tools, the Roadmap team constructed a **Reference Case**, which represents a projection of the state's GHG emissions based on policies that were in place prior to 2019. The Reference case assumes no new policies or actions to reduce emissions. That assessment found that the four largest emitting sectors were the same in 2020 as 2005. As shown below in Figure 1, in 2020 transportation displaced electricity generation as the largest source of pollution. Electricity generation, oil and gas production, and fossil methane use in the residential, commercial and industrial sectors remain the other three largest emitters. In the transportation sector, passenger vehicles are the largest contributor to emissions in the state. Electricity generation emissions largely come from coal-fired power plants with a small portion from fossil methane gas-fired

Roadmap Modeling Cases

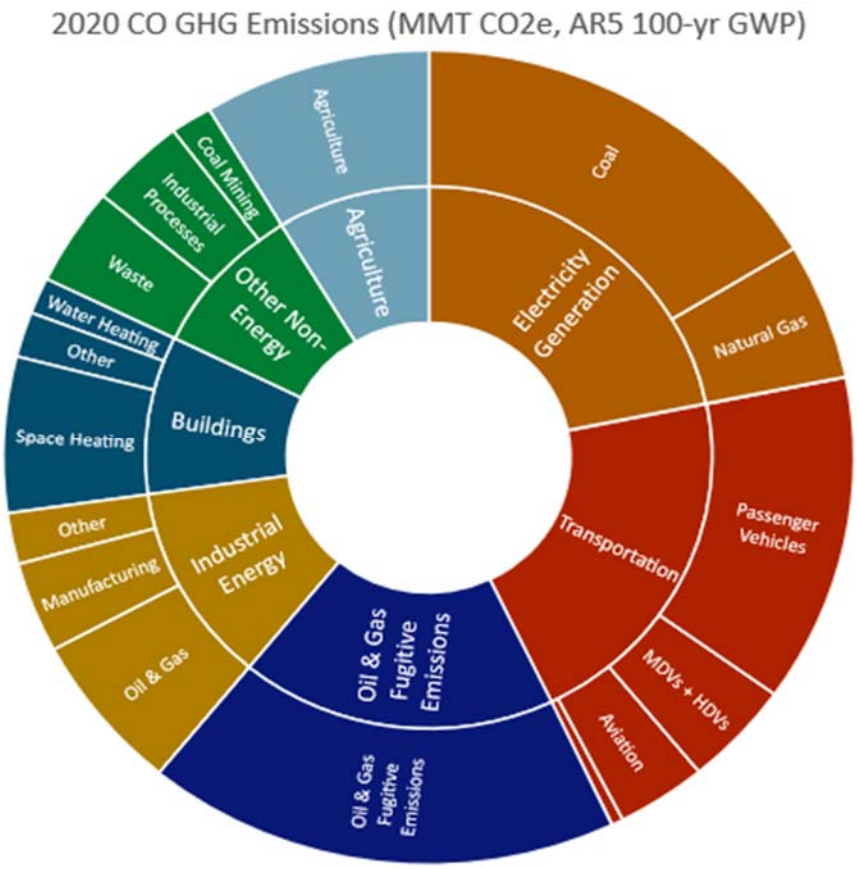
Reference Case
Modeled emissions reductions based on all existing state policy prior to 2019

2019 Action Scenario
Modeled emissions reductions based on prior state policy and legislative, administrative, and voluntary actions adopted in 2019

1261 Targets Scenario
Modeled an illustrative path Colorado could take to meet the GHG reduction targets in HB 19-1261,

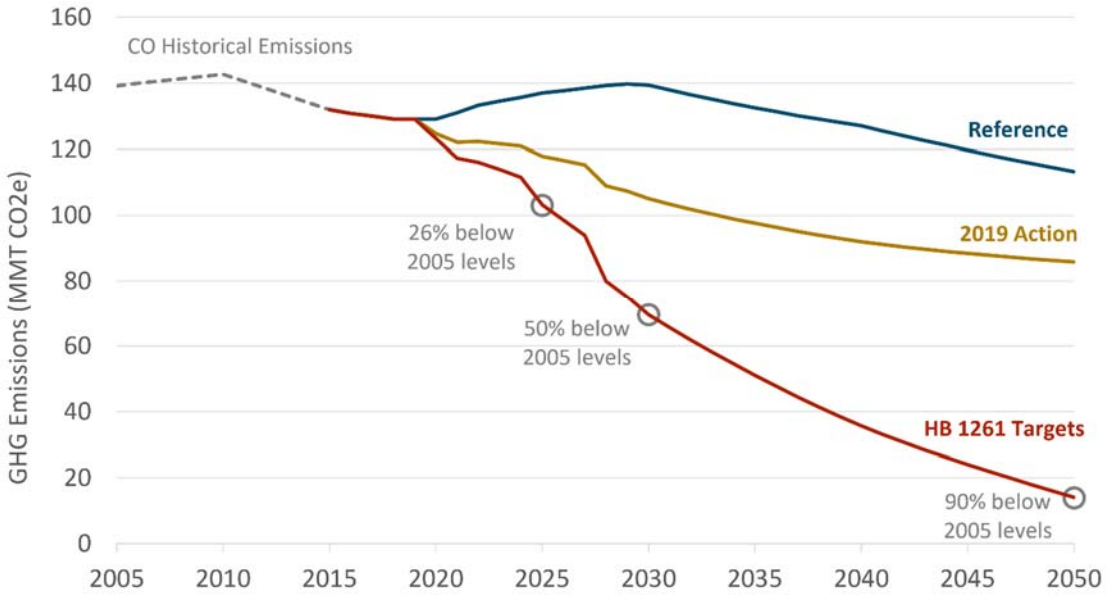
power plants. Emissions from the oil and gas sector include fugitive methane emissions from upstream and downstream operations in Colorado as well as on-site combustion of fossil fuels in industrial operations.

Figure 1: 2020 CO GHG Emissions (MMT CO2e, AR5 100-yr GWP)



To better understand the impacts of recent policy changes, E3 evaluated projected pollution reductions resulting from legislation passed in 2019 and 2020 and from administrative actions to date by the Polis Administration— *The 2019 Action Scenario. This evaluation showed that the state's actions in the last two years to address climate change, when added to prior actions, put Colorado on trajectory to achieve approximately half of the emissions reduction needed to meet the 2025 and 2030 goals.*

Figure 2: Scenario Projections of Colorado's Potential GHG Emissions



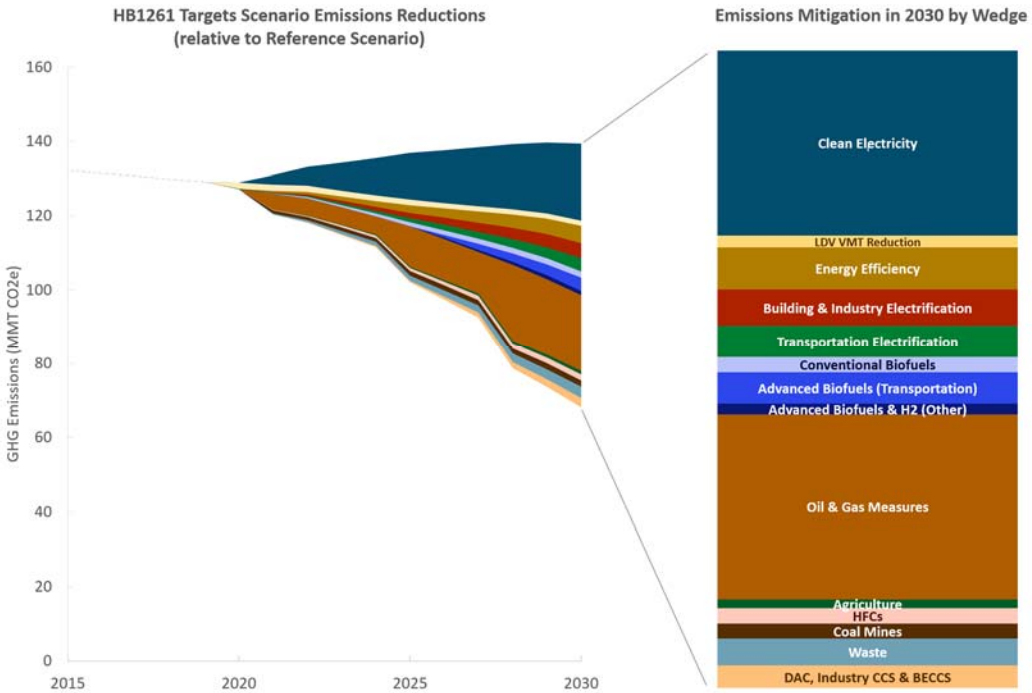
While the state has made significant progress toward meeting the 2025 and 2030 goals, the analysis showed that additional actions are needed to reach the targets. E3 modeled an illustrative scenario, the **HB 1261 Targets Scenario,** to represent one approach Colorado could take to meet the Climate Action Plan targets through 2050. Based on these analyses, the Roadmap proposes administrative, regulatory, legislative, procurement, incentive-based, and other measures to reduce emissions in different sectors of the state's economy to achieve GHG pollution reductions in a cost-effective and equitable way.

That path to reaching the state's emissions goals builds on the significant transition that is already underway toward clean, low-cost renewable energy and will accelerate as we implement policies to shift the way we move people and goods, and light and heat our homes and businesses from fossil fuels to clean energy. A key to making equitable progress toward our goals is to promote investments needed to modernize our economy more

quickly in disproportionately and historically impacted communities. Transitioning toward a resilient, low carbon economy will require investments, regulations, and other measures by the state as well as federal and local governments. The transition also will require business investment and leadership and the engagement of the nearly six million Coloradans who own more than five million vehicles and almost 2.5 million housing units. The Climate Action Plan provides the Air Quality Control Commission with authority to consider progress made through all of these means as it considers the need to develop regulations:

"The implementing rules may take into account other relevant laws and rules, as well as voluntary actions taken by local communities and the private sector, to enhance efficiency and cost-effectiveness, and shall be revised as necessary over time to ensure timely progress toward the 2025, 2030, and 2050 goals."

Figure 3: Representative Pollution Reductions in 1261 Target Scenario to Meet 2030 Climate Goals



The Roadmap describes actions Colorado has taken to address climate change, analyzes the current trajectory for GHG emissions, and presents a suite of actions the state can pursue in the near term to make progress toward the Climate Action Plan goals.

KEY FINDINGS

- The largest sources of GHG pollution in Colorado are transportation, electricity generation, oil and gas production, and fuel use in residential, commercial and industrial spaces.
- Achieving Colorado's 2025 and 2030 GHG emissions targets is feasible with existing technologies but will require actions, laws, and policies beyond those Colorado has taken already.
- Achieving the 2030 goals will rely on deep reductions in pollution from electricity generation by continuing the transition to renewable energy, as well as deep reductions in methane pollution from the oil and gas industry, which makes up the largest source of non-combustion emissions in the state.
- Making changes to transportation planning and infrastructure to reduce growth in driving is an important tool.
- Electrification of end uses in buildings and transportation will play an important role in achieving these targets, with action needed in the near term to accelerate the transition.
- By 2050, very high levels of electrification of vehicles will be needed, with nearly 100% of all cars on the road being electric and a 100% market share for zero emissions trucks among new sales.
- Reducing methane emissions from landfills, sewage plants and other sources, and enhancing waste reduction, recycling and diversion efforts, is necessary, especially to reach emissions targets after 2030.
- Protecting, restoring, and enhancing the resilience of Colorado's natural and working lands is critical for sequestering carbon.
- Policy transitions to reduce GHG pollution will reduce air quality burdens that disproportionately impact lower income communities and communities of color.
- Policies will need to be designed carefully to ensure that benefits are distributed equitably.

Air Quality Control Commission Greenhouse Gas Subcommittee

E3 provided a projection of Colorado's GHG emissions and modeled scenarios for how the state could reduce emissions in different sectors of the economy, but was not tasked with developing detailed policy proposals. During the development of the Roadmap, the Air Quality Control Commission convened a GHG subcommittee to investigate near term strategies Colorado could adopt to reduce GHG pollution in different sectors. This level of more detailed policy development was originally intended to occur after the GHG Roadmap was completed, but the state agencies agreed with AQCC and other stakeholders that the presentation of more detailed near term action plans will accelerate the transition and better enable Colorado to make progress toward its goals. Those actions are now included in this Roadmap.

To support the AQCC subcommittee, the Air Pollution Control Division ("APCD") staff evaluated potential GHG reductions resulting from near term AQCC rulemakings, PUC proceedings, legislative actions, and other approaches. This spreadsheet-based analysis provides an assessment of emissions reduction based on how the state is likely to implement policies and adds to the level of analysis E3 provided in its scenario modeling. The APCD's analysis grouped emissions into three broad categories: Energy Production (Electricity and Oil and Gas); Energy Consumption (Transportation and Residential, Commercial, and Industrial fuel use); and Non-Energy (Agriculture, Coal Mine Methane, Waste, HFCs) to evaluate emissions reductions by policy approach in a sector. Energy production and consumption encompass the largest emitting sectors and cover greater than 80% of Colorado GHG emissions.

The APCD staff developed a spreadsheet tool that builds emissions reductions from particular policies and actions based in sectors based on where the greatest short-term emissions reductions were possible. The APCD

approach reflects a more granular approach to developing individual legislation, regulatory policy, and other approaches than E3 used in developing its HB 1261 Targets Scenario.

As a result of the differences in approach, the APCD analysis presents lower potential near term emissions reductions in certain sectors than E3 modeled in the HB 1261 Targets Scenario, but shows greater potential reductions in others. In the residential, commercial, and industrial fuel use sector APCD showed lower potential reductions based on assumptions about the length of the transition for home and business owners to adopt heat pumps and other lower emitting technologies. The difference in achievable potential in transportation emissions is based on APCD using a more conservative assumption about the number of electric vehicles that Colorado consumers will buy under existing policies. APCD also assumed lower reductions from coal mine methane than assumed in the HB 1261 Targets Scenario. However, based on changes in the oil and gas industry and the requirements of Senate Bill 19-181, the APCD tool shows deeper reductions in the oil and gas sector for 2025 than E3 modeled in its scenarios.

The AQCC adopted a resolution establishing a process for review and publication of metrics critical to tracking progress toward the statewide goals established in HB19-1261. The resolution also adopted provisional sector specific targets for 2025 and 2030 that are based on APCD's work. The AQCC is expected to finalize the resolution after the release of the Roadmap. The table below shows the AQCC's provisional targets, which are informed by the near term actions identified in the Roadmap.

NEAR TERM ACTIONS TO REDUCE POLLUTION

Sector	Revised 2005 Baseline (MMT CO2e)	2025 Target (MMT CO2e)	2030 Target (MMT CO2e)
Electricity	40.28	21	8
Oil and Gas	20.17	13	8
Transportation	30.71	23	18
Residential, Commercial, Industrial Energy Use	24.65	26	20
Other	23.42	19.9	15.6
Total	139.22	102.9	69.6
Percent Reduction	--	26%	50%

The E3 scenario analysis and APCD spreadsheet tool show that reductions across multiple sectors of the economy provide pathways to making progress towards the 2025 and 2030 targets. Based on E3's HB 1261 Targets Scenario, this comprehensive approach also helps lay a strong foundation for reaching the deeper reductions needed between 2030 and 2050. There is no single "silver bullet" solution; the modeling shows that a "silver buckshot" approach of reductions across all the major sectors is needed.

The analysis in the Roadmap finds that Colorado can meet its science-based GHG pollution reduction targets with existing technologies. Decarbonizing the leading sources of pollution will require investments and innovation as well as a broad suite of new policies, standards, and partnerships.

Even as the state works toward an 80% pollution reduction in electricity generation by 2030 through utility actions and enforceable electric resource plans, Clean Energy Plans, and Regional Haze rules, there is a need

to create incentives and pathways to spur further investment in pollution reductions beyond 80%. During the rapid transition to clean, renewable energy for the production of electricity, it is important to promote further investment and innovation in the electrification of new sectors, such as transportation and buildings. These efforts, along with increased energy efficiency, will expand the impact of clean electricity across the economy.

With the transportation sector now being the leading source of GHG emissions and a significant contributor to local air pollution that disproportionately impacts lower-income communities and communities of color, a key priority is to increase the number of electric vehicles, including trucks and buses, on Colorado roads. Establishing new standards that stimulate investment and remove barriers to EV ownership will make it easier and more affordable to drive an EV. Additionally, changing the way we make development decisions, including for land use, housing, and infrastructure, can enhance accessibility, cut pollution, and reduce the need to drive. To ensure that this transition is equitable and broad-based, the state needs to develop policies and programs that will benefit communities that have been most heavily impacted by the pollution from transportation infrastructure, including highways and refineries.

Progressing towards the state's GHG goals requires deep methane emissions reduction from the oil and gas industry, landfills, sewage treatment plants, coal mines, and other sources. Methane is a potent contributor to climate change, with each ton creating 28 times more warming than a ton of CO2 over 100 years (and even higher in the short term). Given the importance

of achieving reductions of this potent greenhouse gas, the APCD staff anticipate proposing regulations to the AQCC in 2021 that will achieve over a 30% reduction across the oil and gas sector by 2025 and over 50% (12 million CO2e tons) by 2030. If adopted, these regulations will result in oil and gas sector emissions of roughly 8 million tons in 2030, down from 20 million tons in 2005.

Additionally, regulatory measures, such as those finalized in the Colorado Oil and Gas Conservation Commission Mission Change rulemaking, that eliminate routine flaring, require equity-focused siting analysis, minimize emissions, and prioritize vulnerable populations and disproportionately impacted communities, are designed to make important progress in GHG reductions and equity benefits.

The majority of Colorado homes and businesses use fossil methane gas to heat water and indoor air. Fossil methane use is also a key source of pollution from the industrial sector. To advance near term GHG goals, Colorado needs to reduce fuel use in buildings and industrial processes through increasing energy efficiency, transitioning water and home heating and industrial operations to electricity where it is cost-effective, and reducing the GHG intensity of the gas that serves these uses. In the residential sector, this shift will provide additional co-benefits that include more comfortable homes and better indoor air quality. Requiring utilities to transition to lower emissions gas will create an incentive for investments in the development of biogas from sources such as agricultural operations and sewage treatment plants as well as spur investment in green hydrogen production.

The state will also need to implement its actions to reduce HFCs (refrigerants and aerosols), and advance climate-smart strategies on natural and working lands. Colorado's natural and working lands include our forests, grasslands, agricultural croplands and rangelands, wetlands, riparian areas,

and urban greenspaces. Natural and working lands are both sources of GHG pollution, including emissions from wildfires, agricultural equipment and fertilizer use, and serve as carbon sinks by holding or sequestering carbon in plants and soils. Colorado must work to increase access to energy efficiency and renewable energy on farms and ranches by increasing utilization of the Agricultural Energy Efficiency program and expanding the Advancing Colorado's Renewable Energy and Energy Efficiency program. This program is designed to achieve a number of goals, including supporting voluntary participation in such efforts as Field to Market, Soil Health Partnership, and Precision Agriculture programs, and protecting, restoring, and enhancing carbon sequestration on farms, ranches, and other natural and working lands.

Colorado also needs to continue efforts to better manage waste streams through diversion, composting, and other initiatives, especially for organic wastes that can form methane in landfills. In 2019, recycling and composting in Colorado reduced greenhouse gas emissions by 1.92 million metric tons of CO2e, which is the one-year equivalent of either removing 407,000 cars from the road, or removing 148,000 homes from the grid, or conserving 2.34 million barrels of oil or 113 million gallons of gasoline. Because Colorado's recycling and waste diversion rates have been below the average of other states, recycling and waste diversion provide critical opportunities to reduce emissions.

In coordination with the E3 modeling showing potential pathways to achieve emission reduction targets, APCD and AQCC have engaged in a more granular, bottom up process of evaluating the emissions reductions associated with potential near term strategies and policy actions. The state has used this analysis to develop a set of recommended regulatory, legislative and programmatic strategies for enactment in 2021 and 2022.

Near Term Actions by Sector

The table below summarizes near term actions that the administration will pursue to achieve sector specific GHG emissions reductions that help Colorado make progress toward meeting the state's climate goals. The section on near term actions, starting at page 33 in the report, describes these strategies in greater detail and explains why these strategies were selected. As we pursue these steps, we will continue our commitment to climate equity and environmental just through enhancing engagement with stakeholders in disproportionately impacted communities; building on partnerships with Sovereign Tribal nations through consultation and enhanced engagement; and, reducing barriers to public participation in AQCC rulemaking process. We will also build evaluation of potential equity impacts into rulemaking processes and invest more resources in climate equity and environmental justice.

Table 1: Near Term Actions to Reduce GHG Pollution

Sector	Near Term Actions	Targeted 2030 Emissions Reductions from 2005 baseline Million Metric Tons
Electricity	• **Adopt Clean Energy Plans and Electric Resource Plans, including evaluating plans using the full social cost of carbon emissions.** • **Incorporate coal plant retirements from utility commitments and adopted utility plans into AQCC Regional Haze rulemakings.**	**32.3 mmt**

	• Evaluate mechanisms such as performance based regulation and other tools to create incentives for deeper emissions reductions and serving beneficial electrification loads with zero carbon generation.	
Transportation	• State GHG pollution standards for transportation plans. • Trip reduction/Transportation Demand Management (TDM) requirements and encouraging telecommuting for large employers. • Clean trucking strategy with multiple components including infrastructure investments, incentives for fleet turnover, and evaluation of regulatory options. More details are on page 57 of the report. • Secure new revenue to fund infrastructure and incentives to transition to electric cars, trucks, and buses. • Offer incentives for land use decisions by local governments that reduce vehicles miles traveled, reduce GHG and other pollutants, and support greater access to housing near jobs. • Indirect source standards for some types of new development. • Expand public transit, including front range rail and RTD completing the statutorily	12.7 mmt

	required Fastracks system that voters passed in 2004 including Northwest Rail (2025 Ridership: 8,600-10,100) • Develop an EV Equity study to ensure access to EV's for all Coloradans. • Provide input into development of new clean car standards by both the federal government and for state-based standards.	
Residential, Commercial, and Industrial Fuel Use (Gas utilities)	• Expand energy efficiency investments from gas utilities to support building shell improvements. • Set carbon reduction targets and biogas requirements for gas utilities. • Require large commercial buildings to track energy use and make progress toward energy and pollution performance standards. • Support adoption of advanced building codes. • Require regulated electric utilities to create programs that support customer adoption of electric	4.7 mmt

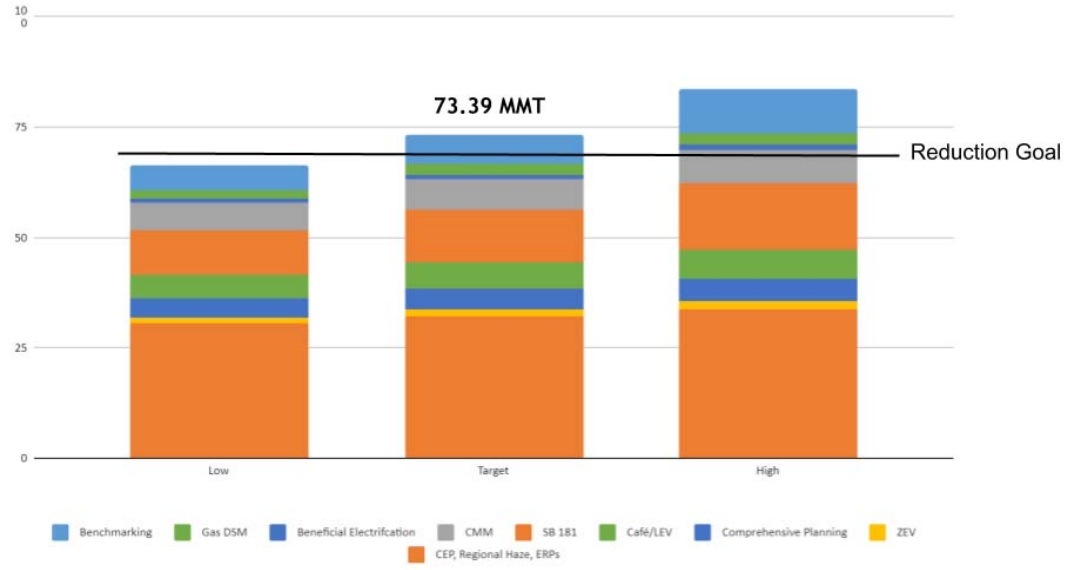
	heat pumps and other forms of beneficial electrification. • Expand access to financing programs for building retrofits by capitalizing a green bank, expanding existing programs and advocating for utility on-bill finance programs. • AQCC action on industrial energy and emission audits requirements and Best Available Control Technology requirements, setting the stage for future performance requirements.	
Oil and Gas	• AQCC rulemaking to achieve methane pollution reductions from the oil and gas industry - at least 33% reduction in total emissions by 2025 and over 50% by 2030. • COGCC implementation of new rules that eliminate routine flaring, require minimizing emissions, and track pre-production and production air emissions.	12.2 mmt
Natural and Working Lands	• Develop a comprehensive emissions inventory. • Develop a Natural and Working Lands Strategic Plan. • Increase producer utilization of Agricultural Energy Efficiency (AgEE) program.	1.0 mmt

	• Expand Advancing Colorado's Renewable Energy and Energy Efficiency (ACRE3) program. • Improve soil function and carbon sequestration through regenerative farming practices. • Support voluntary participation in such efforts as Field to Market, Soil Health Partnership and Precision Agriculture programs.	
Waste	• Reduce methane emissions from coal mines, landfills, sewage treatment plants, and agriculture through continued reductions in coal extraction, utility biogas incentives, potential AQCC rulemaking and grants for waste reduction and diversion through the Front Range Waste Diversion Enterprise and CDPHE. • Improve recycling end markets and recycling and reuse.	7.5 mmt
Industrial Process Emissions	• Federal HFC reduction provisions adding to AQCC rules (refrigerants, aerosols, etc.)	0.3 mmt

Other Actions	• **Advance the Governor's FY 2021-22 budget, which includes a number of innovative funding proposals that will help protect Coloradans from the existential threat of climate change, improve air quality, and position Colorado to seize the economic benefits of a renewable energy economy. More detail on the budget is included on page 92.** • **Convene a task force on Carbon Capture, Utilization and Storage (CCUS) starting in mid-2021, which will report to the Governor within a year on recommended framework, including policies and actions steps for advancing CCUS in Colorado.** • **Support local government and private sector climate action efforts.**	**0.3 tons**

The table above shows potential emissions reductions from the APCD's analysis by sector of the economy. In addition to creating a Target case for emissions reduction achievable from the near term actions, the APCD staff developed a Low and High case based on different assumptions about policy implementation. The chart below shows that in 2030 the Target case results in a 53% reduction compared to a goal of a 50% reduction (represented by the solid black line). Even the Low case achieves a roughly 66 MMT reduction, leaving a small emissions gap of less than 3% from the goal.

Figure 4: Comparison of State Pollution Reduction Cases



Near Term Action by Venue and Timeline

The chart below provides a list of near term actions over the next two years arranged by venue (e.g., regulatory agency or legislature) and by year the state anticipates the action being initiated (unless noted otherwise).

Table 2: Near Term Actions to Reduce GHG Pollution by Venue and Timeline

	Fall / Winter 2020	Spring 2021	Summer 2021	Fall 2021	Winter 2021	2022
Public Utilities Commission (PUC)	Tri-State Electric Resource Plan Xcel Transportation Electrification Plan	Xcel Clean Energy Plan Black Hills Transportation Electrification Plan	Xcel Renewable Energy Plan Black Hills Energy Efficiency Plan Black Hills Renewable Energy Plan			Black Hills Clean Energy Plan
Air Quality Control Commission (AQCC)	Regional Haze Rules Ozone Plan Oil and Gas Well Monitoring Rules Outreach on 2021 Oil and Gas Rules	Regional Haze Rules Phase 2 Stakeholder Processes for Transportation, Industrial, Oil and Gas Rules	Transportation Emission Rules (GHG standards for Transportation Plans and Trip Reduction Plans) Industrial Energy and Emissions Audits Rules	Greenhouse Gas emission reduction progress evaluation	Oil and Gas Emission Reduction Rules Structures/ Building Emission Reduction Rules	Transportation Emission Reduction Rules

Colorado Oil and Gas Conservation Commission (COGCC)	**Mission Change Rulemaking:** **200 Series - general and record keeping;** **300 Series - permitting process;** **400 Series - operational practices;** **500 Series - hearing process;** **600 Series - safety (and residential setbacks);** **800 Series - underground injection control wells;** **900 Series - environmental and Exploration & Production waste management; and** **1200 Series - wildlife (and riparian setback).**	**Rulemaking: 700 Series - financial assurance (bonding);** **Imposing permit fee; and requiring worker certification (These three topics complete mandatory SB 19-181 rulemakings.)**		**Greenhouse Gas emission reduction progress evaluation, in coordination with CDPHE**		
Other State Agency Actions	**Clean Trucking Strategy Initiated** **Just Transition Plan Completed**	**Convene taskforce on Carbon Capture, Utilization and Storage** **Study on how to incentivize progress on land use decisions** **Climate Equity Framework Completed**	**Clean Trucking Technical Analysis Completed**	**Natural and Working Lands Task Force Pathways Analysis Completed** **Electric Vehicle Equity Plan Completed**	**Draft Natural and Working Lands Strategic Plan Completed**	

Legislation		**Transportation** • New revenue to fund infrastructure and incentives to transition to low and zero emissions cars, trucks and buses. **Buildings and Gas Utilities** • Set carbon reduction targets for gas utilities. • Set biogas requirements for gas utilities. • Require existing large commercial buildings to track energy use and make progress toward energy and pollution performance standards. • Require regulated electric utilities to create programs that support beneficial electrification. • Expand energy efficiency investments from gas utilities. • **Governor's Proposed FY 21-22 Budget Proposal** • Clean Energy Finance ($40 M) • Wildfire relief, mitigation and prevention ($78 M) • Supporting local government investment in renewables and efficiency ($5 M) • Climate Resilience Office at the CO Department of Agriculture • Building the capacity of Colorado's Office of Just Transition			

Leadership and Innovation Required to Meet 2050 GHG Goal

The Roadmap not only models pathways to 2025 and 2030 GHG pollution reductions but examines how Colorado can make progress toward the longer term goal of meeting a 90% GHG pollution reduction by 2050. It is important to recognize that the modeling gets more uncertain over this longer time horizon and that the 1261 Targets Scenario for 2050 is best viewed as an illustrative scenario showing one reasonable pathway toward the state's 2050 emission goals. This is particularly true given the uncertainties in how technologies such as long duration energy storage, green hydrogen production, carbon capture utilization and storage, and advanced biofuels will develop over the coming decades.

KEY FINDINGS FOR 2050 GOALS

- All sectors have an important role to play in emissions reductions if the state is to reach 90% reductions by 2050. Every sector that is a significant energy producer or consumer— including electricity generation, oil and gas production, transportation, buildings and industry— would need to achieve reductions of 90% to 100%.
- In the illustrative scenario, our two largest utilities, Xcel Energy and Tri-State, meet energy needs with zero-carbon electricity by 2050 while smaller utilities reduce emissions 80% compared to 2005 levels. This is a conservative assumption.
- In transportation, we will need to transition to close to 100% electric cars on the road by 2050 and 100% market share for new vehicle sales of zero emissions trucks and buses by 2050. Achieving this will require close to 100% of new car sales to be electric by 2040. In addition, we need to continue pursuing strategies that reduce vehicle miles traveled.
- Unlike the 2030 goal, achieving the 2050 goal likely will require further technical innovation and economies of scale to bring costs down and allow deployment at scale in a number of sectors. Important technologies may include green hydrogen, long duration energy storage, carbon capture and storage, advanced biofuels, and synthetic fuels based on air capture of carbon.
- In the buildings sector, the 1261 Targets Scenario for full decarbonization by 2050 is based on a large-scale shift to the use of electric heat pumps, powered by zero carbon electricity, for space and water heating. There may be other pathways, depending on technological developments, which is why the near term actions support a wide variety of strategies for the buildings sector.
- Land conservation, restoration, and climate-adaptive ecosystem management will be critical for maintaining and enhancing resilient carbon sequestration on natural and working lands. Achieving these activities at sufficient pace and scale will require significantly scaled up technical assistance, research, and financial incentives.
- In agriculture, all sectors of the industry can adopt GHG reduction strategies in addition to sequestration targets. The development of markets that pay producers for ecosystem services may be an increasingly important tool to help producers remain viable while helping to reach our shared climate goals.

This Roadmap has been developed to meet the requirements of Colorado Revised Statute § 24-20-111, which calls for development of a state climate plan setting forth a strategy to address climate change and reduce greenhouse gas emissions, while taking into account previous state actions and efforts as well as voluntary actions taken by the private sector and local governments.

The GHG Roadmap represents a significant step forward for climate action and pollution reduction planning at the state level and advances Colorado's policy and programmatic vision for pursuing timely, enduring, and equitable strategies. Progressing toward our goals will continue to be iterative and multi-faceted. We look forward to continuing engagement from a diverse set of stakeholders from across the state.

ADDITIONAL MATERIALS

Several additional materials related to the Roadmap have not been included with the published version of the report but are available from the Roadmap website. These additional online materials include the following documents and technical appendices:

E3 Technical Appendix

The state hired Energy + Environmental Economics (E3) to model potential pathways, or scenarios, that would make progress toward meeting emissions reduction targets. E3 used its PATHWAYS model, which is built using bottom-up data for all emissions produced and energy consumed in Colorado, to model GHG emissions from all sectors of the economy and its RESOLVE model to develop least-cost electricity generation portfolios. The technical appendix provides greater detail about the modeling and the inputs used to build these modeled scenarios.

State of Colorado Technical Appendix

During the course of the development of the Roadmap, the Air Quality Control Commission and other stakeholders requested details on policies and near term actions the state might take to meet the GHG reduction goals. The state's Technical Appendix outlines how state staff aligned the sector emissions projections produced by E3 with the emissions reductions from near term strategies that Colorado expects to pursue.

Roadmap Outreach Plan and Feedback

This document includes the Stakeholder Outreach Plan, a description of the Technical Advisory Group, and the results of outreach activities.

Question and Answers on the Roadmap

This Q&A summary provides responses to the more frequently asked questions about the Roadmap.