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NEW NEVADA MODELING SHOWS ACHIEVING STATE CLIMATE GOALS AND 1.5°C ALIGNMENT COULD ADD $700 MILLION TO STATE ECONOMY BY 2030

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INTRODUCTION

In 2019, Nevada passed Senate Bill 254 (SB254) to address threats posed to the state by climate change. It set ambitious, economy-wide greenhouse gas (GHG) reduction targets for the state: 28 percent by 2025, 45 percent by 2030 below 2005 levels, and net-zero by 2050. The Nevada Division of Environmental Protection (NDEP) was instructed to develop an annual GHG emissions inventory for all major sectors of the state's economy, including electricity generation and transportation, and state agencies began developing Nevada's first climate strategy.

Nevada's *State Climate Strategy* was released under the Nevada Climate Initiative in late 2020 as a template for needed climate action,[1] calling on the state to "accelerate climate action necessary to achieve Nevada's climate goals and capture the health and economic benefits of the clean energy and technology revolution." It provides policy ideas for decarbonizing Nevada's economy, stopping short of offering specific policy proposals. As such, it is not modeled in this analysis, but many of the policies discussed below reflect thinking embedded in the State Climate Strategy.

The Nevada Energy Policy Simulator (EPS), developed by Energy Innovation (EI) and RMI, provides additional analysis to deeply reduce emissions in Nevada. The research outlines a policy package to decarbonize Nevada's economy, helping put it on the Intergovernmental Panel on Climate Change's recommended pathway to limit warming to 1.5 degrees Celsius.[iii] Implementing stronger electricity, transportation, buildings, industrial, land, and agricultural sector policies can transition the state to a low-carbon economy – generating 4,500 new jobs and adding $700 million to the economy per year by 2030, with 5,500 new jobs and more than $800 million to the economy per year by 2050. These policies would accelerate electricity sector emissions reductions, electrify all end uses where possible and switch to low-carbon fuels where

[i] RMI https://rmi.org/
[ii] Energy Innovation: Policy and Technology LLC https://energyinnovation.org
[iii] For more information see: https://www.unenvironment.org/resources/emissions-gap-report-2019.

not possible, expand emissions reductions from natural and working lands, and address non-carbon dioxide (CO_2) emissions.

They include:

- Switching to 100 percent clean electricity
- Rapidly adopting zero-emission cars and trucks, along with policies to facilitate reducing passenger vehicle miles traveled
- Shifting to efficient, all-electric buildings and appliances with low embodied carbon[iv]
- Moving away from fossil fuel use in manufacturing
- Reducing methane leakage from the waste management sector
- Improving land management to capture more carbon

The Nevada Energy Policy Simulator

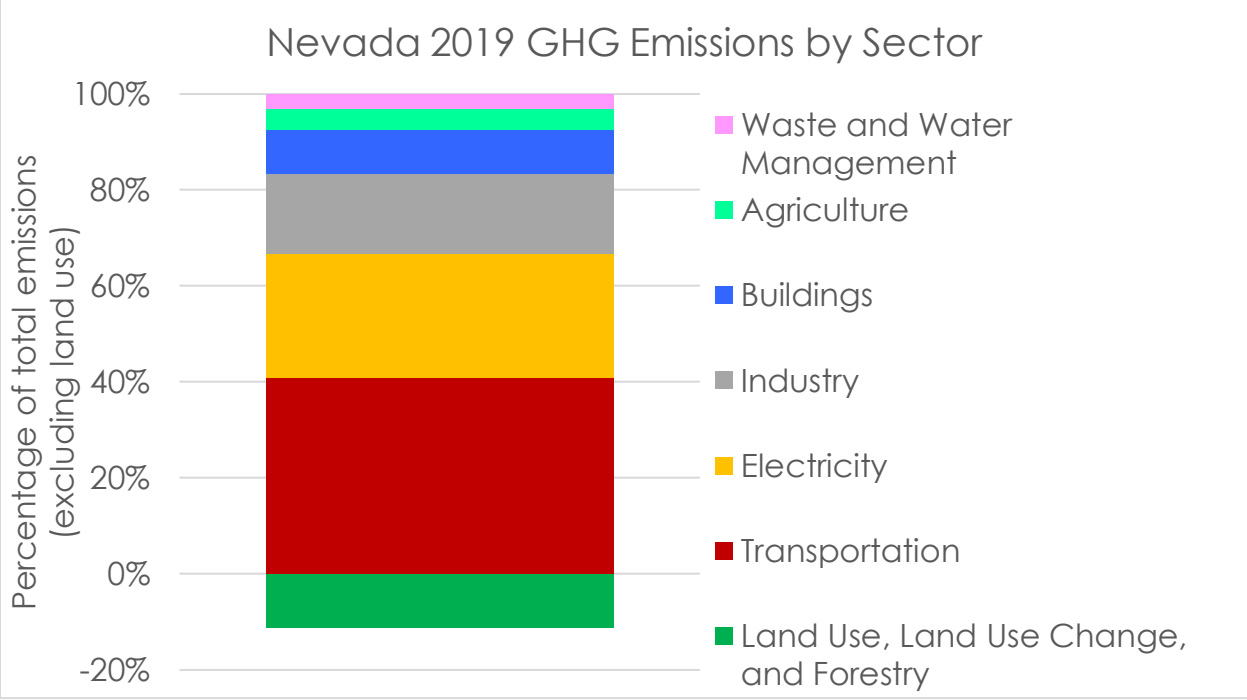
The Nevada EPS is a free, open-source, peer-reviewed model that allows users to estimate climate and energy policy impacts on emissions, the economy, and public health using publicly available data. The model estimates these impacts through 2050 and considers how policies interact with each other. EPS models have been developed for more than a dozen countries and several subnational regions, including California, Colorado, Minnesota, and Virginia. The Nevada EPS is one of 20 planned state-level EPS models being developed by EI and RMI. A companion document explains key data sources, assumptions, and calculation methodologies used in the EPS.

The Nevada EPS complements, but does not replace more granular analytical approaches such as energy demand infrastructure turnover and energy supply optimization,[v] electricity system reliability analysis,[vi] detailed assessments of electricity and natural gas utility and customer economics,[vii] analyses of local air quality,[viii] and mapping to ensure policies enhance equity.[ix] However, the Nevada EPS does calculate impacts in seconds in an accessible web-based interface, which can help policymakers and advocates rapidly screen policies and understand remaining emissions gaps.[x] A 2020 report released by environmental non-profits and energy modeling teams that proposes pathways for achieving the state's climate goals is one example of more granular modeling that complements the Nevada EPS.[2xi] This report is referenced throughout this document as the Pathways Report.

[iv] Embodied carbon is defined as the total amount of GHG emitted during the manufacturing and supply of construction materials and equipment, as well as the construction process itself.
[v] See, e.g., https://www.unsdsn.org/Zero-Carbon-Action-Plan.
[vi] See, e.g., https://www.2035report.com/wp-content/uploads/2020/06/2035-Report.pdf.
[vii] See, e.g., https://ww2.energy.ca.gov/2019publications/CEC-500-2019-055/CEC-500-2019-055-F.pdf.
[viii] See, e.g., https://ww2.energy.ca.gov/2019publications/CEC-500-2019-049/CEC-500-2019-049.pdf.
[ix] See, e.g., https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf.
[x] The Nevada State Climate Strategy names the EPS as one of several tools that can be used to conduct analysis.
[xi] A scenario representing the GridLab-led modeling in this report will be in a future release of the Nevada EPS.

NEVADA'S BUSINESS-AS-USUAL EMISSIONS OUTLOOK

The Business-As-Usual Scenario (BAU Scenario) includes existing policy, scheduled power plant retirements, some improvement in building and transportation efficiency, and economic adoption of electric vehicles (EVs). Transportation and electricity are Nevada's dominant sources of emissions, accounting for 41 percent and 27 percent of the state's GHG emissions in 2019, as modeled by the EPS.[xii] Nevada has already made significant progress decarbonizing electricity. However, transportation emissions have continued to increase.



Nevada's estimated 2019 greenhouse emissions in the Nevada EPS

Electricity emissions have declined 60 percent since 2005 (from 46 percent of gross emissions) with the retirement of the Mohave Power Station in 2012 and Reid Gardner Generating Station in 2017.[xiii] In addition to coal plant retirements, Nevada's renewable portfolio standard (RPS) requires 50 percent of utility-based electricity generation[xiv] to be carbon-free by 2030, with a goal of 100 percent carbon-free electricity by 2050. Approximately 27 percent of electricity generated in 2019 was renewable.[xv] The Nevada EPS projects that solar will constitute the majority of renewables growth to achieve the 2030 RPS target.

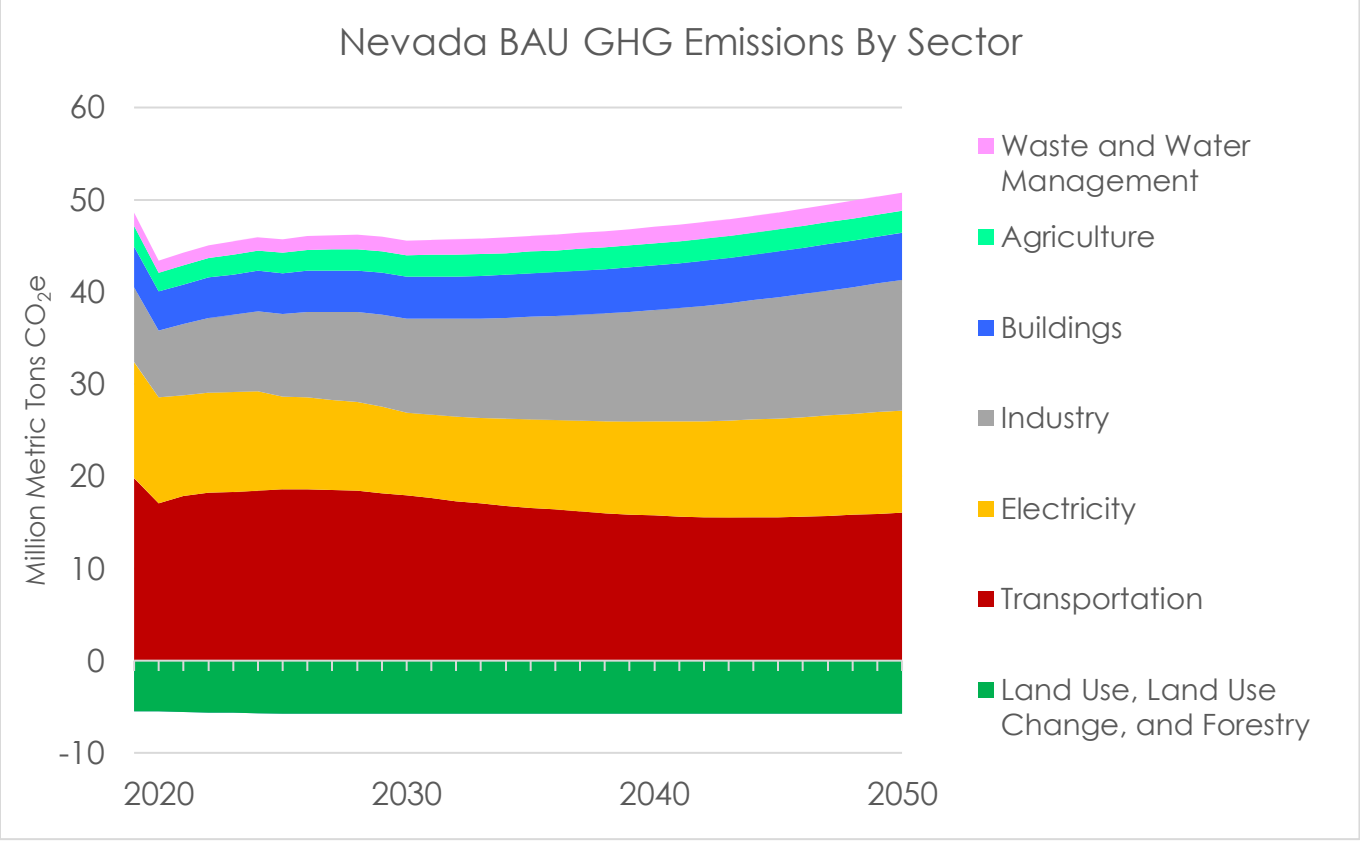
[xii] Year 2019 emissions are modeled as part of the BAU Scenario emissions trajectory in the EPS. These emissions are benchmarked to the Nevada GHG inventory year 2017 emissions (https://ndep.nv.gov/uploads/air-pollutants-docs/ghg_report_2020.pdf) along with other state and national data sources. The biggest difference from the Nevada inventory is accounting for aviation emissions from interstate travel: the EPS attributes emissions for all flights originating in Nevada, other sources of difference include continued trends, year-to-year weather variation, and differences in underlying data sources.

[xiii] Generator 1-3 in the Reid Gardner Coal Plant retired in 2014, Generator 4 retired in 2017. See: EIA-860M (https://www.eia.gov/electricity/data/eia860m/)

[xiv] The RPS covers investor-owned utilities which represent 82 percent of total generation serving in-state loads.

[xv] This includes large-scale hydro. See: https://programs.dsireusa.org/system/program/detail/373.

Nevada's economy-wide emissions in are expected to increase about 12 percent by 2050 from 2019 under the BAU Scenario. While projected EV uptake and new solar capacity reduce emissions, those reductions are outpaced by projected growth in air travel, natural gas demand growth in buildings, and increased industrial energy consumption.



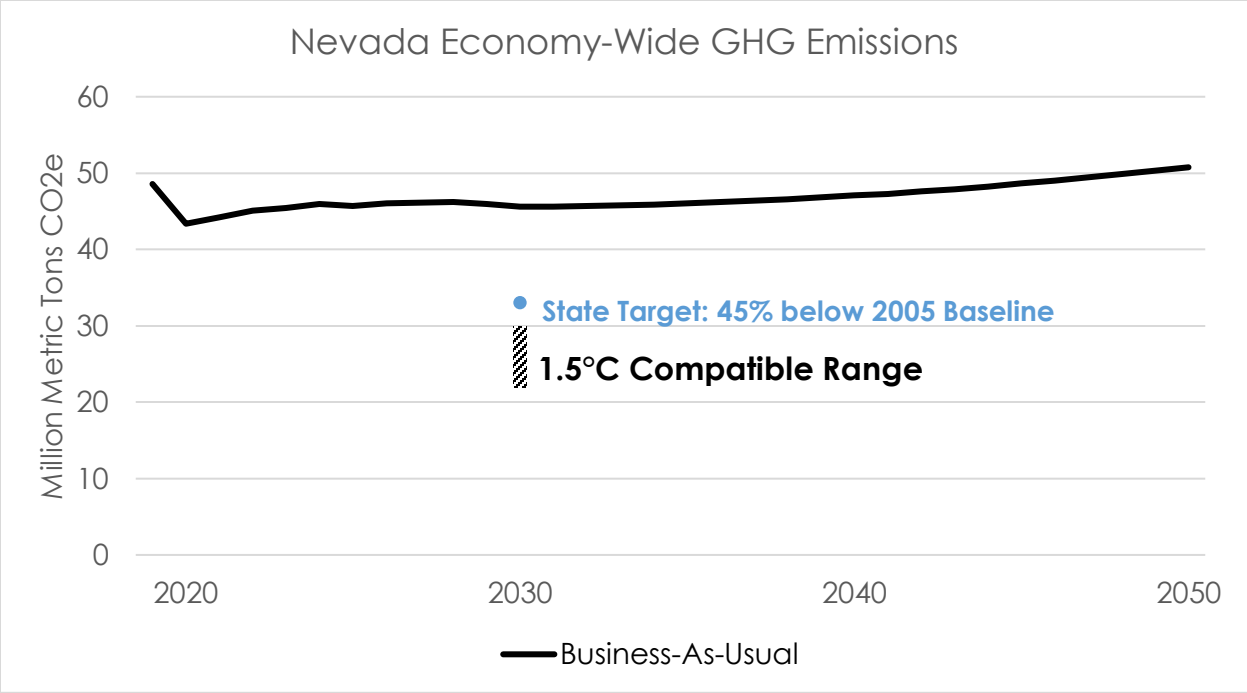
Projected GHG emissions by sector in the Nevada EPS

THE GAP TO 1.5 C

The Nevada EPS includes a 2030 emissions target range consistent with limiting global warming to 1.5°C. This range is estimated by downscaling from the national level using 2019 emissions, representing a 53-65 percent reduction below 2005 levels (excluding land sink) in Nevada.[xvi,xvii] Comparing Nevada's BAU Scenario to Nevada's 2030 state target (45 percent reduction) and the 2030 1.5°C-compatible target range shows a large gap. Below, we discuss the policy options available to close this gap.

[xvi] See the forthcoming Insight Brief from RMI on "Scaling United States Climate Ambitions to Meet the Science and Arithmetic of 1.5 C Warming."

[xvii] State level targets are approximate and should not be considered equivalent to an optimum state-by-state decarbonization assessment.



Projected GHG emissions, net of land carbon uptake, in Nevada EPS BAU scenario. The blue dot shows the state's 2030 target, and the gray hashed line shows an estimated 1.5°C-compatible target range.

Policy Options For Deep Decarbonization

The Nevada EPS includes a 1.5°C Scenario demonstrating a path to meet GHG emissions reduction goals aligned with global efforts to limit climate change. This illustrative policy scenario is adapted from a U.S.-wide scenario developed by EI[3] and shows one set of policies the state could use to achieve emissions reductions in line with limiting warming to 1.5°C, while meeting its interim and long-term climate goals.

The 1.5°C Scenario policies generally align with approaches outlined in the State Climate Strategy. In some cases, the 1.5°C Scenario underlines the need for rapid action to implement or expand upon the strategy, such as accelerating the dates for clean electricity policies and electrifying new construction to eliminate natural gas pollution. Policy documentation for the Nevada EPS describes the policies used in the 1.5°C Scenario and also compares them to those discussed in the State Climate Strategy.

Electricity

Rapidly replacing fossil fuel generation with clean electricity is key to deep decarbonization and provides the foundation for reducing emissions in other sectors. The 1.5°C Scenario implements a clean electricity standard of 80 percent carbon-free electricity generation in 2030 and 100 percent in 2035 and beyond.[xviii] Additional infrastructure investments including a several-fold increase in battery storage over the state target, doubling transmission capacity, and 500

[xviii] The Pathways Report targets 80 percent renewable generation by 2030 and exceeds 90 percent carbon-free by about 2040.

megawatts (MW) of additional demand response capacity increase grid flexibility and reliability as part of this scenario.[xix]

TRANSPORTATION

Decarbonizing on-road transportation is critical to meeting climate goals. The 1.5°C Scenario includes a strong EV sales standard requiring all new passenger cars and SUVs sold to be electric by 2035 and all new freight trucks to be electric by 2045, aligned with California's transportation sector policies[xx] and the multi-state Memorandum of Understanding[xxi] on moving to zero-emissions medium and heavy duty vehicles, respectively.[xxii] This measure adds 600,000 electric on-road passenger vehicles in 2030 and ensures nearly all on-road vehicles are electric by 2050 as old vehicles are gradually replaced.

The 1.5°C Scenario also invests in passenger car travel alternatives with supportive land use and transportation policies to enable people to use public transit and to walk and bike, reducing passenger car travel 20 percent by 2050. Such measures can be designed to provide broad economic and social benefits such as enhanced access to transportation and affordable housing[4] and would yield climate benefits beyond the direct emission reductions modeled in the Nevada EPS. For example, compact development and reduced car-dependence reduces embodied emissions for vehicles and buildings, building energy consumption, and conversion of natural lands.[xxiii]

BUILDINGS

Transitioning buildings away from fossil fuels and improving energy efficiency are critical to meeting the state's climate goals. The 1.5°C Scenario includes measures for building electrification and energy efficiency. A sales standard would require newly sold building equipment be fully electric by 2030 in both new and existing buildings.[xxiv] A sales standard would shift gas space and water heating systems to more efficient all-electric heat pumps, which are already commercially available and are common in many parts of the U.S.[5] Induction stoves provide a high-performing and clean alternative to gas stoves that also avoid indoor air pollution.[6]

[xix] Eliminating the last 10 percent of fossil generation and maintaining reliability in a zero-carbon grid is the subject of ongoing research. In the 1.5°C scenario, gas generators run at low and declining capacity factor to provide reliability, and in the 2040s these are modeled as being equipped with carbon capture and sequestration. Other decarbonized fuels could be possible, such as biogas or renewable hydrogen. Alternatively, Nevada's rich geothermal potential could be used to provide additional renewable electricity generation at baseload, reducing the need for backstop renewable integration and reliability solutions. This option was less cost-effective in the Nevada EPS, though more refined electricity capacity expansion modeling would be needed to confirm this.

[xx] https://ww2.arb.ca.gov/our-work/programs/zero-emission-vehicle-program

[xxi] https://www.energy.ca.gov/sites/default/files/2020-08/Multistate-Truck-ZEV-Governors-MOU-20200714_ADA.pdf

[xxii] The Pathways Report proposes reaching 100 percent zero emission vehicle sales by 2040. In the model, an EV standard is used, but these could be achieved by a technology-neutral zero-emissions vehicle sales standard.

[xxiii] See https://www.cogitatiopress.com/urbanplanning/article/view/1218 and https://www.nature.com/articles/s41558-020-00921-7

[xxiv] The Pathways Report proposes a date of 2035 (Graph 24A).

The 1.5°C Scenario also includes deep energy efficiency retrofits of 15 percent of buildings by 2050.[xxv] Enhanced efficiency standards for individual building appliances are also included, ranging from 11 to 40 percent by end use.

Industry, Agriculture, and Land

To reduce energy-related emissions in industry, the 1.5°C Scenario requires industrial facilities electrify all end-uses where possible and switch to a zero-carbon fuel (in this case, hydrogen) for all others by 2050.[xxvi] The scenario also requires hydrogen be produced through a zero-carbon process known as electrolysis. Policies promoting more efficient use of industrial materials and improved industrial energy efficiency achieve additional reductions in this sector.

The 1.5 C Scenario includes several policies to address non-energy combustion industrial emissions, including standards requiring methane leak mitigation in the waste management sector. Appliance manufacturers are required to switch to low global warming potential refrigerants consistent with the Kigali Amendment to the Montreal Protocol. The 1.5°C Scenario also requires carbon capture and sequestration to capture half of residual industrial sector CO_2 process emissions. Finally, implementing land use and agricultural policies, such as requiring the use of anaerobic digesters to capture manure emissions and afforestation of land, reduces emissions from land use and agriculture.

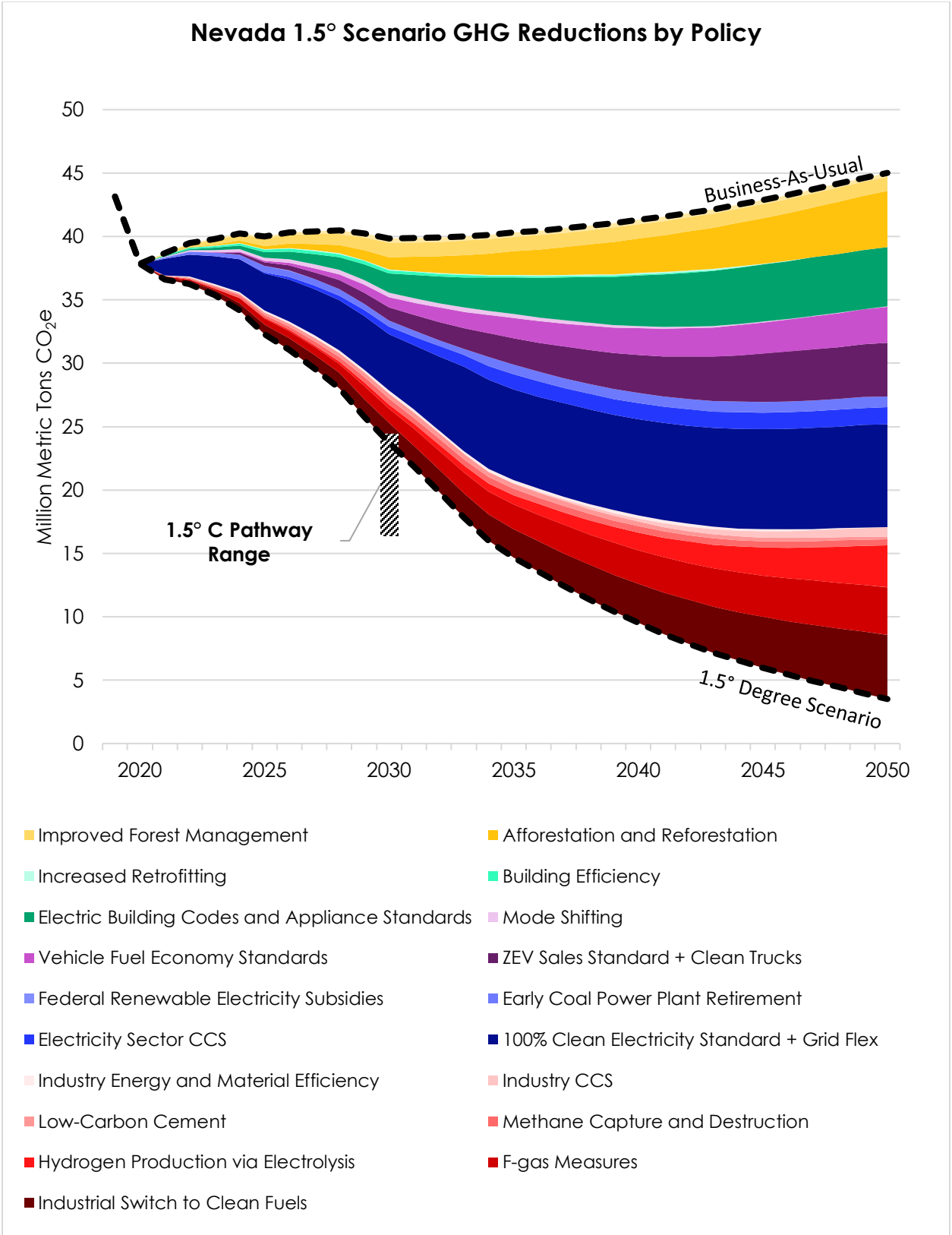
Aggregate Emissions Impacts

The Nevada EPS estimates economy-wide emissions reductions considering interactions between policies in each scenario. It also automatically and quickly estimates the contributions to emissions reductions from each individual measure. The table below summarizes GHG emissions avoided in the 1.5°C Scenario relative to BAU.

The 1.5 C Scenario reduces Nevada's projected net emissions (i.e., including land use) 40 percent below BAU in 2030 and 95 percent by 2050. This would avoid nearly 60 percent of the cumulative emissions currently projected by 2050 under the BAU Scenario. The most impactful measures are the clean electricity standard, building electrification, and EV sales measures, respectively.

[xxv] While not modeled explicitly in the Nevada EPS, new buildings should also strive for low embodied carbon to reduce lifecycle emissions from construction.

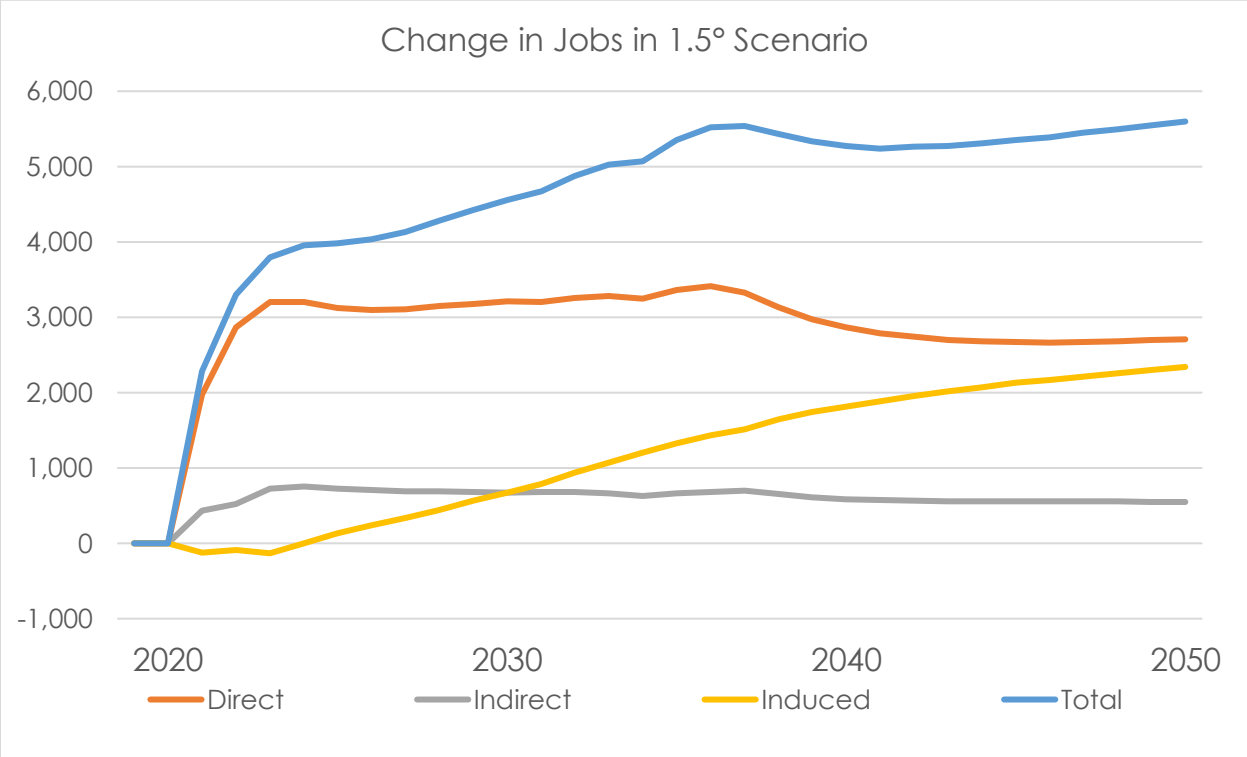
[xxvi] The Pathways Report also includes biofuels and synthetic carbon-neutral fuels in industry. Note that the optimal combination of industrial fuel decarbonization is the subject of ongoing research, which this simple treatment in the EPS does not replace.



Note: This wedge chart aggregates some policy levers to improve figure readability; a full interactive wedge graph is available on the Nevada EPS

JOBS AND HEALTH BENEFITS

Policies in the 1.5°C Scenario require installing new solar projects, retrofitting buildings, installing vehicle charging infrastructure, and more. The state-level input-output analysis embedded in the Nevada EPS[xxvii] estimates that roughly 4,500 jobs per year can be added under this scenario by 2030 (see figure below) and 5,500 new jobs per year in 2050. Additionally, new investments and recycled expenditures from fossil fuel savings help increase the gross state product by about $700 million per year in 2030 and by $800 million per year in 2050.



Projected changes in jobs relative to BAU in the 1.5°C scenario[xxviii]

Additional policies not modeled by the EPS will be necessary to ensure these newly created jobs benefit communities historically reliant upon, or harmed by the fossil fuel economy with high-quality jobs paying fair wages. Policy can support a sustainable, equitable, and just transition by considering impacted communities when choosing the location of new clean energy infrastructure projects. Policymakers can also create training programs to equip transitioning

[xxvii] Read more at https://energyinnovation.org/2020/10/19/united-states-eps-3-0-update-adds-gdp-and-jobs- impacts-improved-public-health-metrics-and-more/.

[xxviii] Direct jobs are created in industries responsible for building clean energy infrastructure. Indirect jobs are created when products or services are demanded by these industries (e.g. electronic components manufactured within the state). Induced jobs are the result of net savings from a policy that can be recycled into the local economy by households, firms, and the government (e.g. by reducing spending on imported petroleum and natural gas fuels, more money is available for local spending and investment).

workers with the required skills, among other efforts. Other social policies can provide for basic needs such as healthcare or other financial assistance to ease the transition.[xxix]

The 1.5°C Scenario also unlocks significant health benefits. Fossil fuel power plant retirements, emissions-free building appliances, zero emission on-road vehicles, and industrial fuel switching all reduce harmful particulate emissions and secondary atmospheric pollution created by burning fossil fuels. The Nevada EPS, which includes a simple assessment of these benefits based on regional emissions factors by fuel and end use,[xxx] estimates that the 1.5°C Scenario policies would prevent more than 120 deaths and 4,000 asthma attacks per year by 2030 and more than 500 deaths and 16,000 asthma attacks per year by 2050. Including a conservative estimate of the benefits of reduced climate pollution,[xxxi] the monetized health and other social benefits reach $8.7 billion annually by 2050.

Accelerating Renewables and Electrification

In addition to the comprehensive 1.5°C scenario, the Nevada EPS also includes an Accelerated Efficiency, Renewables, & Electrification Scenario (Accelerated Scenario) to illustrate the potential for rapid action in the next decade using a smaller set of policies. This simple scenario is based loosely on U.S. policy benchmarks provided by the United Nations and is consistent with closing the gap to 1.5°C by 2030.[7]

The Accelerated Scenario achieves similar outcomes to the 1.5°C Scenario using a smaller number of measures that are implemented more stringently. In transportation, it accelerates the 100 percent zero-emissions passenger vehicle sales standard from 2035 to 2030, matches targets set by the United Kingdom government[8] and a nascent U.S. industry coalition,[9] and targets zero-emissions freight vehicle sales by 2040 rather than 2045. It also accelerates the reduction in passenger vehicle miles traveled to be 13 percent below BAU by 2030 (instead of 7 percent). In buildings, the Accelerated Scenario targets building retrofits to cover 25 percent of buildings by 2030 (instead of 5 percent in the 1.5°C Scenario). In electricity, it accelerates the clean electricity standard to be 90 percent by 2030 instead of 80 percent. Finally, it includes a carbon tax to cover the industry and electricity sectors reaching $100 per ton by 2030.

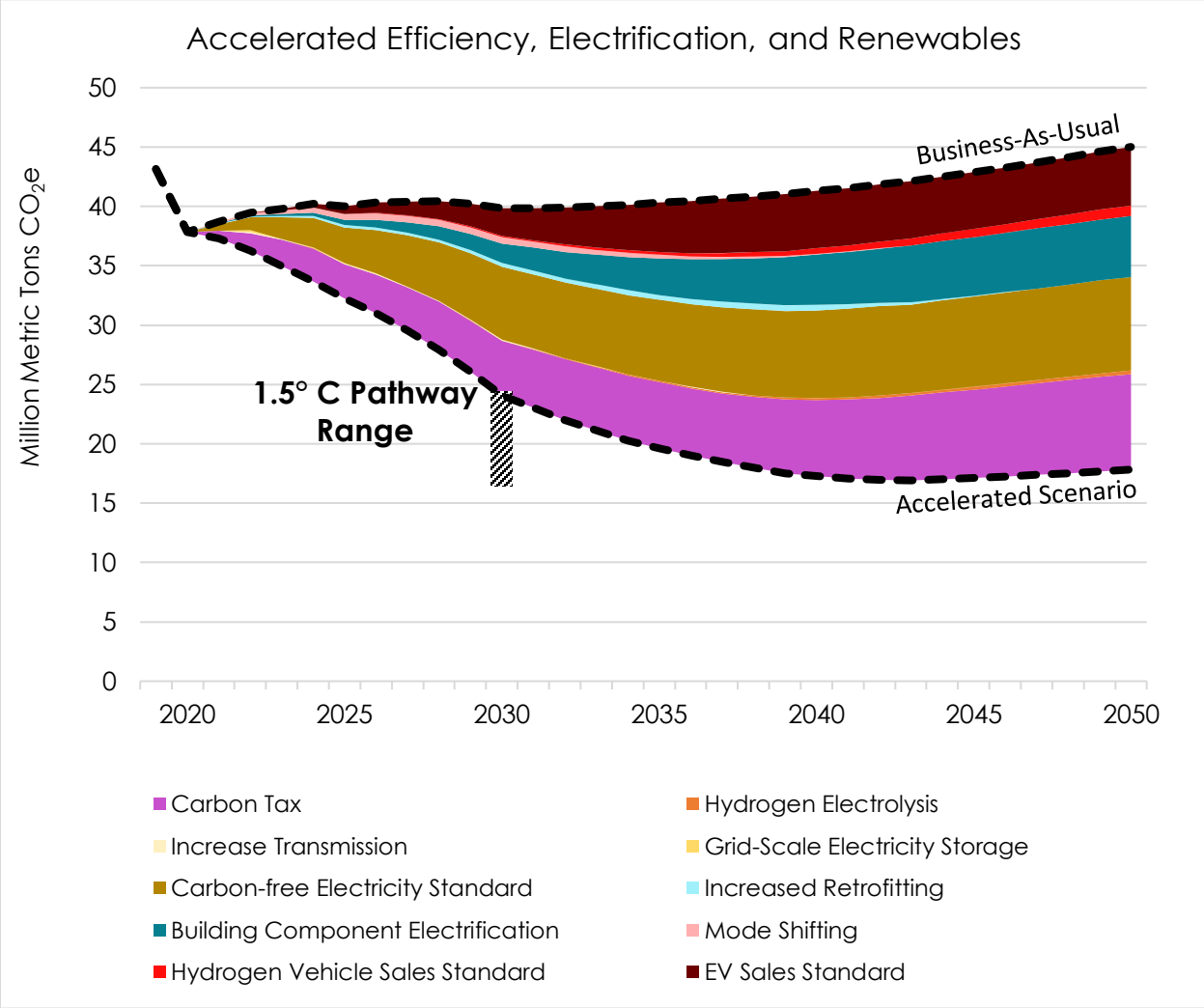
In the Accelerated Scenario, the carbon-free electricity standard provides early emissions reductions, along with the carbon tax, building efficiency, and transportation mode shifting to reduce car travel. The Nevada EPS finds the carbon tax effectively eliminates remaining coal generation and deploys cost-effective mitigation of non-combustion industrial emissions. Building and vehicle electrification measures ramp up to produce the largest effects by 2040, but

[xxix] See National Academy of Sciences. 2021. Accelerating Decarbonization in the United States: A Comprehensive Policy Approach to a Just Transition.

[xxx] See https://www.epa.gov/benmap/reduced-form-tools-calculating-pm25-benefits.

[xxxi] The Interagency Working Group estimate from 2016, from https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf. The central estimate of $42/ton in 2020 is used. Note that recent studies have suggested much higher possible ranges for social cost of carbon, such as $187-805/ton in https://www.nature.com/articles/s41558-018-0282-y.

rapid adoption of these measures is critical to achieve later savings due to the capital stock turnover time required to convert the appliance and vehicle fleet.



Estimated emissions savings by individual policy setting within the Nevada EPS Accelerated scenario

Conclusion

Nevada has outlined ambitious decarbonization goals, but careful planning and execution is critical for a rapid transition to help limit the worst effects of climate change. As the state begins considering how to meet the State Climate Strategy's goals, the Nevada EPS can quantify how proposed policies could reduce emissions and improve the state's economy and public health. The 1.5°C Scenario provides a strong example of a strategic set of decarbonization policies that can rapidly reduce harmful emissions, while creating thousands of new jobs and adding millions to the state's economy every year.

[1] https://climateaction.nv.gov/policies/introduction/

[2] Evolved Energy, GridLab, Natural Resources Defense Council, and Sierra Club. 2020. Pathways and Policies to Achieve Nevada's Climate Goals. https://gridlab.org/works/achieve-nevadas-climate-goals/.

[3] Energy Innovation. 2021. *A 1.5 Celsius Pathway to Climate Leadership for the United States.* https://energyinnovation.org/wp-content/uploads/2021/02/A-1.5-C-Pathway-to-Climate-Leadership-for-The-United-States.pdf

[4] https://t4america.org/wp-content/uploads/2020/10/Driving-Down-Emissions.pdf

[5] https://rmi.org/its-time-to-incentivize-residential-heat-pumps/

[6] https://rmi.org/insight/gas-stoves-pollution-health/

[7] https://www.unenvironment.org/resources/emissions-gap-report-2019

[8] https://www.theguardian.com/environment/2020/nov/14/uk-expected-to-ban-sale-of-new-petrol-and-diesel-cars-from-2030

[9] The Zero Emission Transportation Association: https://www.zeta2030.org/news/zeta-releases-2030-roadmap-for-transportation-electrification/