

Colorado Plateau Greenhouse Gas Emissions Inventory and Forecast Overview Report

June 2020



Acronym List

AFOLU	Agriculture, Forestry and Other Land Use
CO ₂	Carbon Dioxide
CO ₂ E	Carbon Dioxide Equivalent
CH ₄	Methane
GHGRP	Greenhouse Gas Reporting Program
GIS	Geographic Information System
GPC	Global Protocol for Community-Scale Greenhouse Gas Emission Inventories
GWP	Global Warming Potential
HFC	Hydrofluorocarbon
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
Mt	Metric Ton
N ₂ O	Nitrous Oxide
NF ₃	Nitrogen trifluoride
PFC	Perfluorocarbon
SF ₆	Sulfur hexafluoride
the Trust	Grand Canyon Trust
USCP	United States Community Protocol

Introduction

The Intergovernmental Panel on Climate Change’s (IPCC) report, *Global Warming of 1.5°C: Summary for Policymakers*, details the potential impacts to our planet should average global temperatures continue to climb.¹ Impacts include, but aren’t limited to, increased loss of biodiversity, including species extinction, water and food supply stress, impacts to indigenous populations, and increased wildfires. These changes and their impacts on our communities and livelihoods could be lessened if humans significantly reduce the amount of carbon being released into the atmosphere.

To prevent global temperatures from rising beyond 1.5 degrees Celsius above preindustrial levels—the threshold at which consequences of climate change are significantly worse—the IPCC warns that global emissions must be reduced 45 percent from 2010 levels by 2030 and reach net zero by 2050. Net zero is also known as carbon neutrality and refers to a net balance of zero emissions. It is accomplished by cutting emissions as much as possible and compensating for what cannot be eliminated through means such as carbon offsets or renewable energy certificates.

The Grand Canyon Trust (the Trust), a non-profit organization whose mission is to “safeguard the wonders of the Grand Canyon and Colorado Plateau while supporting the rights of its Native peoples”, has recognized this challenge and has committed to reducing greenhouse gas emissions on the Colorado Plateau. The region has already felt the impacts of a changing climate, including increased wildfire activity and water scarcity from prolonged droughts. Action is needed immediately to prevent the worst impacts of the climate crisis on the Colorado Plateau.

As an advocate for the Grand Canyon region and the Colorado Plateau, the Trust understands that policy changes must be supported by sound science to gain widespread acceptance. The first step of this process was to establish a baseline of GHG emissions through an emissions inventory.

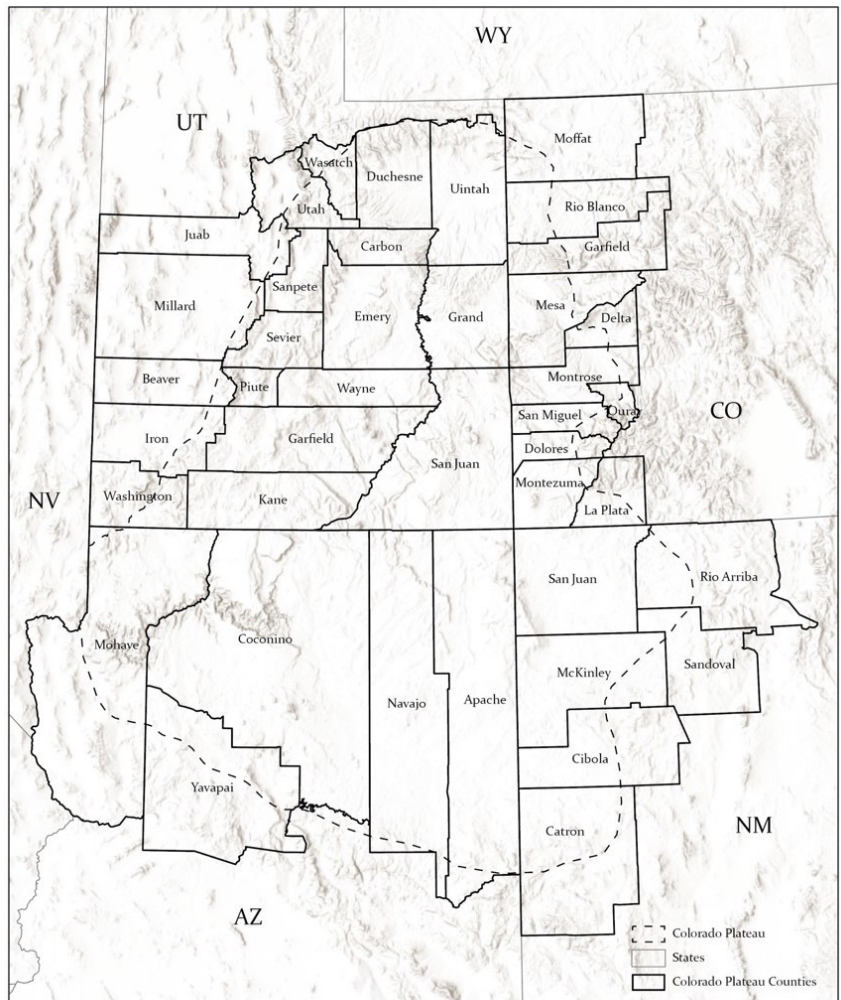


Figure 1. Map of the Colorado Plateau counties.

¹ For more information see: https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf.



The Colorado Plateau includes land in four states—Arizona, Colorado, New Mexico, and Utah² and portions of 41 counties. The inventory provides details on total emissions for each of the 41 counties that intersect the Colorado Plateau boundary. Because of its size and diverse character, a one-size-fits-all approach to accounting for emissions was not appropriate. An approach to greenhouse gas accounting specific to the Colorado Plateau was developed based on available emissions accounting protocols. Two separate, reputable greenhouse gas accounting protocols were used to complete the emissions inventory: the IPCC Protocol and the U.S. Community Protocol. These protocols were selected based on the ability of the emissions inventory to inform future policymaking, the ease of both data collection and the calculation approach to improve replicability and transparency, and the alignment with available data and regional data variations. The resulting greenhouse gas emissions inventory identifies significant emission sources on the Colorado Plateau for 2018 and serves as a foundation in prioritizing the Trust’s response to the urgent need for emissions reductions throughout the Colorado Plateau area.

Supplemental to the calculated greenhouse gas emissions, the Trust sought to understand the current carbon stock held across the Colorado Plateau. Carbon stock refers to the capacity of existing land cover and land use, such as forests and grasslands, to absorb carbon from the atmosphere. Increases in carbon stock mean a greater capacity for removal and storage of carbon from the atmosphere. Conversely decreases in carbon stock (for instance, as a result of a catastrophic forest fire) not only decrease the capacity for carbon removal and storage but also adds carbon to the atmosphere as previously captured carbon is released. Current carbon stocks in five broad land cover types were assessed across the Colorado Plateau and serve as a baseline from which future changes in land cover and use can be compared.

Using 2018 as the baseline year, emissions were forecasted to 2050 in a business-as-usual scenario to help the Trust understand the trajectory of emissions on the Colorado Plateau without intervention. This report details the findings from the 2018 Colorado Plateau greenhouse gas emissions inventory, the carbon stocks analysis, and the emissions forecast. Emissions are counted in carbon dioxide equivalent (CO₂e). Since different greenhouse gases have varying strengths with regard to their impact on climate change, CO₂e allows for apples to apples comparison to pull out the emitters with the most impact on climate change. For instance, for the first two decades after its release to the atmosphere, methane is up to 84 times stronger than carbon dioxide at trapping heat in the atmosphere.

Emissions Overview

In 2018, the 41 counties on the Colorado Plateau produced more than 124 million metric tons of carbon dioxide equivalent (mt CO₂e) emissions.³ That amounts to approximately 2.1 percent of the total 2018 greenhouse gas emissions for the United States.⁴ Sixty-four percent of that total, 79,258,435 mt CO₂e, or about 1.3 percent of the total 2018 greenhouse gas emissions for the United States, are estimated to have occurred on the Colorado Plateau, as opposed to within a county that is partially on the plateau, but the

² Gila County, Arizona and Daggett and Summit County, Utah were excluded from the inventory since they have less than ten percent of their area on the Colorado Plateau and the land that is within the Colorado Plateau falls 90-100 percent within national forest land. Therefore, it is very unlikely that there were any notable emissions coming from those areas.



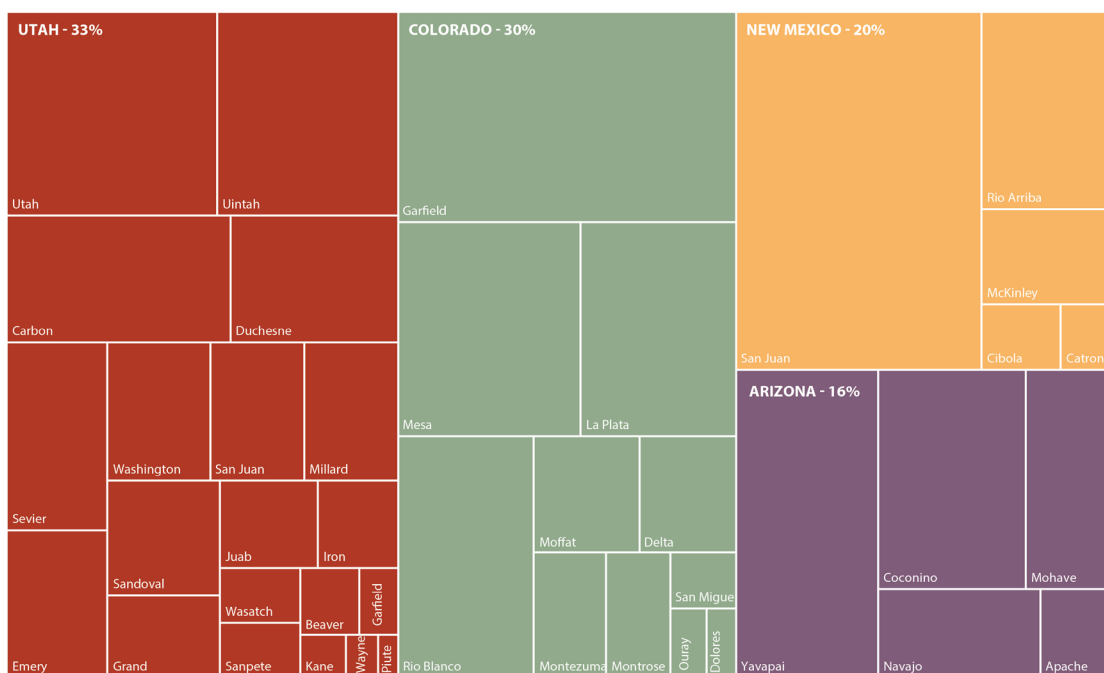


Figure 2. Colorado Plateau 2018 emissions by state (mt CO₂e).

source of emissions is not. Counties in Utah contributed the largest proportion of emissions while Arizona counties contributed the least (Figure 2).

Emissions were broken down by sectors, subsectors, and sources (Figure 3). Emission sectors refer to the general activity type (e.g., energy emissions) from which emissions are generated. Subsectors are the specific type of activity (e.g., residential electricity). The source of emissions refers to the actual “source” of generated greenhouse gas such as the fuel burned or emitted from a material’s decomposition (e.g., oil and gas wells or wastewater treatment).

It is important to understand that the emissions estimates for the electricity sector were made using a consumption-based approach to emissions accounting, and thus reflect the GHG emissions created in each county based on the amount of electricity consumed primarily by residential, commercial, and industrial users within each county. This means that direct emissions from the Colorado Plateau’s large power plants were not included in the inventory except to the extent that the power they generated was used on the Colorado Plateau. The consumption-based approach allows the impacts of local policies, programs, and energy efficiency measures to be reflected in future inventories. Generation-based emissions accounting shows greenhouse gas emissions produced by electricity generation facilities on the Colorado Plateau, such as coal-fired power plants. Generation-based emissions are discussed at length in *Appendix A* of the Colorado Plateau Greenhouse Gas Emissions Inventory and Forecast Report. To protect the integrity of the analysis, the generation-based emissions total cannot be simply added to the main overall inventory. It must be considered separately.

³ Emissions are measured in metric tons of carbon dioxide equivalent (mt CO₂e). Greenhouse gases considered in the inventory include carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), sulfur hexafluoride (SF₆), perfluorocarbons (PFCs), nitrogen trifluoride (NF₃), and hydrofluorocarbons (HFCs).

⁴ According to the EPA, after accounting for sequestration from the land sector, 2018 U.S. greenhouse gas emissions totaled 5,903 million mt CO₂e.



SECTORS EXPLAINED

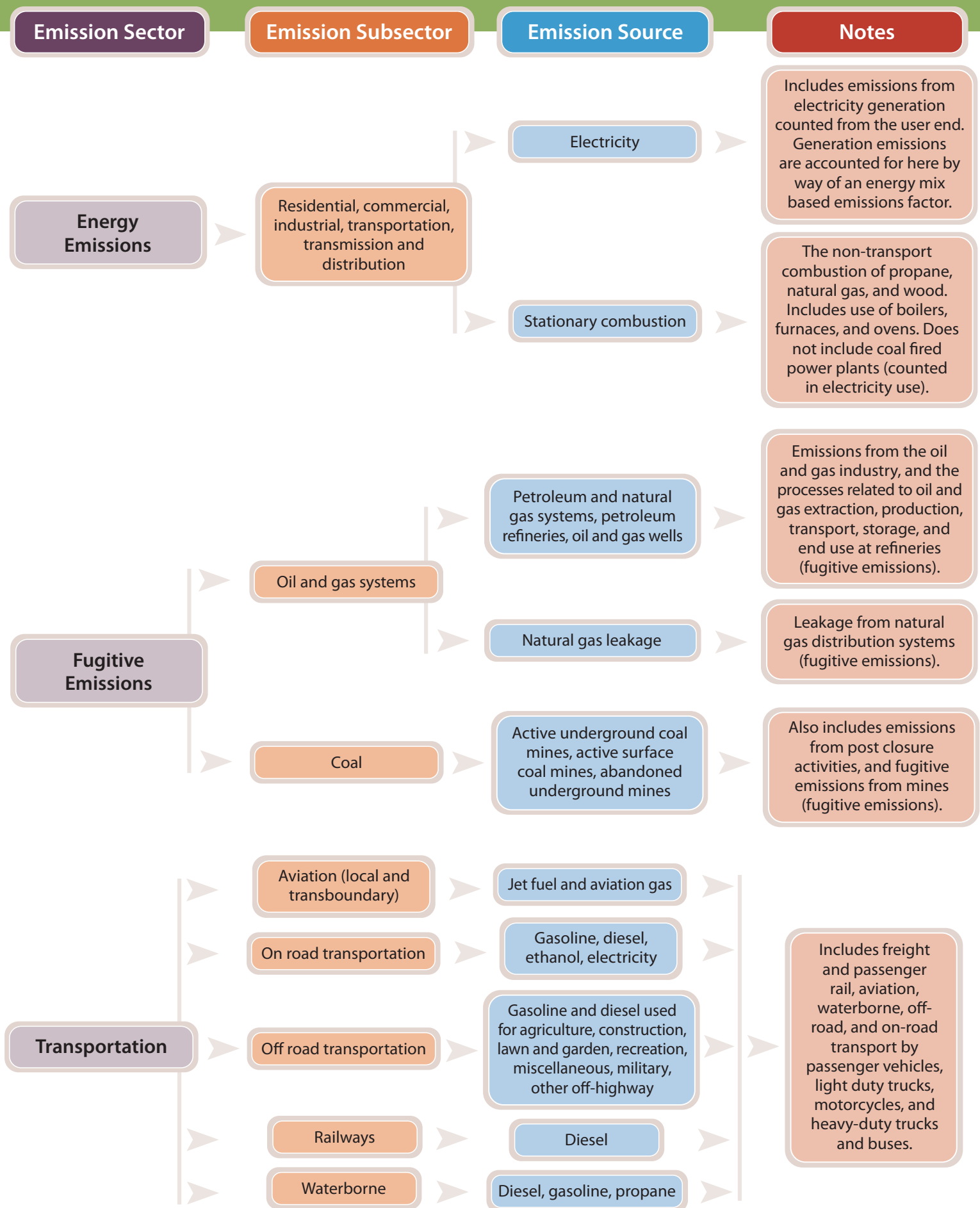


Figure 3. Emissions sector and sources detail.

SECTORS EXPLAINED continued

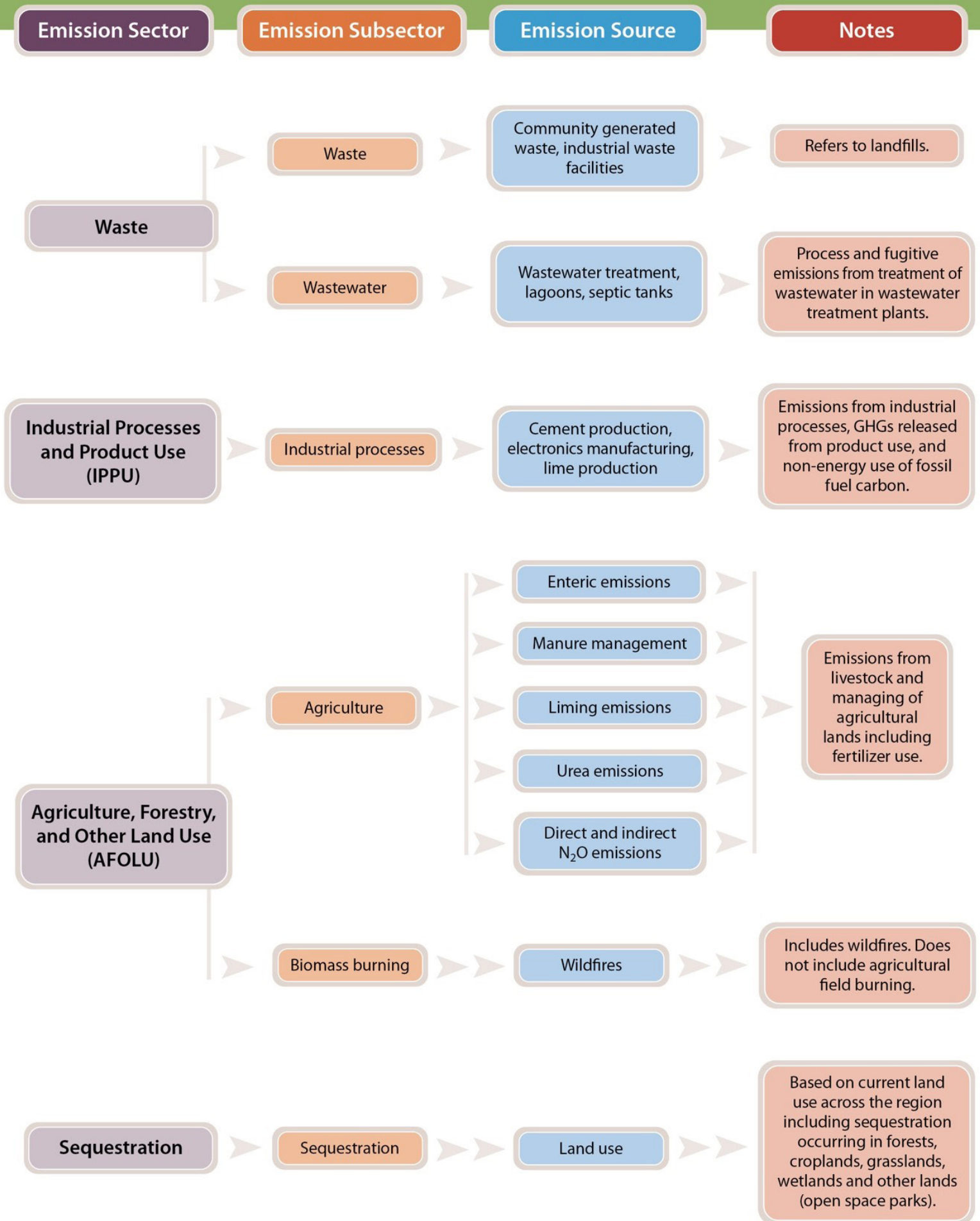


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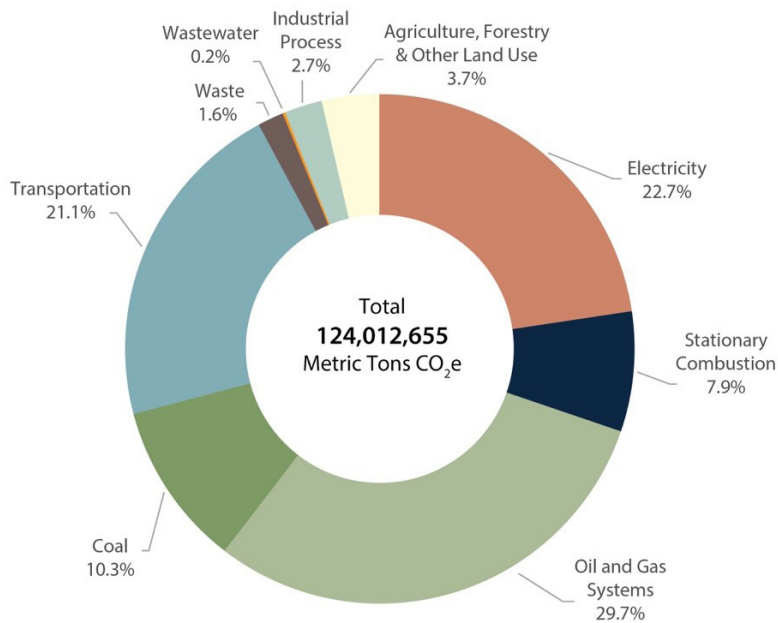


Figure 4. Colorado Plateau summary emissions (mt CO₂e).

The fugitive emissions sector, which includes the subsectors of oil and gas systems and coal mining, produced the most emissions on the Colorado Plateau. This was followed by the electricity and transportation sectors (Figure 4). The waste sector had the least emissions on the Colorado Plateau. Figure 5 shows the breakout of greenhouse gases by subsectors and sources.

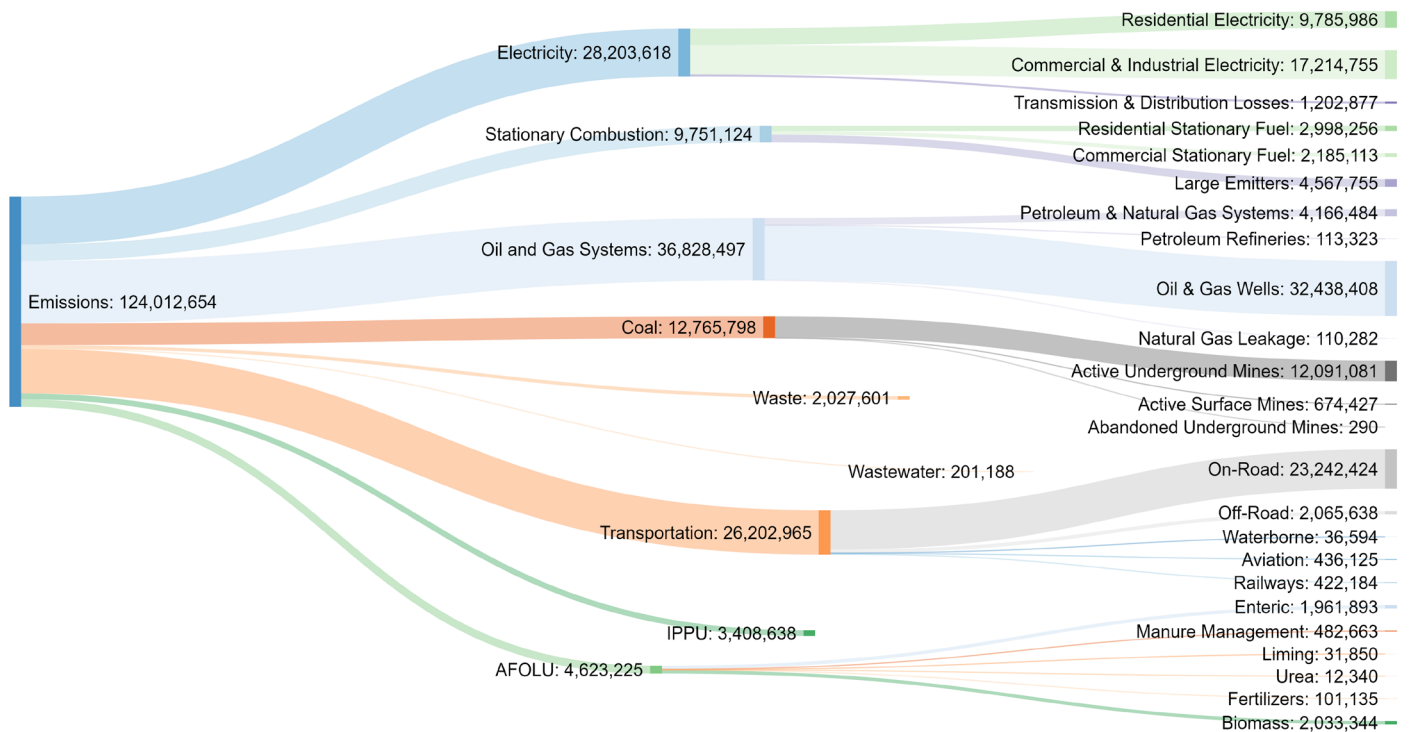


Figure 5. Colorado Plateau emissions by subsector and source (mt CO₂e).



Across the various sectors, oil and gas systems were the largest source of emissions for Utah, Colorado, and New Mexico counties. For Arizona counties, electricity and transportation accounted for the majority of emissions and 76 percent of Arizona counties' total. Collectively, transportation and electricity also account for 51 percent of Colorado counties' other high-emission activities. Transportation and electricity emissions are primarily associated with higher population areas. In New Mexico counties, fugitive emissions from coal mining accounted for 18 percent of the state counties' total—the highest for coal emissions across the region. Utah counties had the second highest coal emissions across the region, but they comprised 23 percent of the state counties' total.

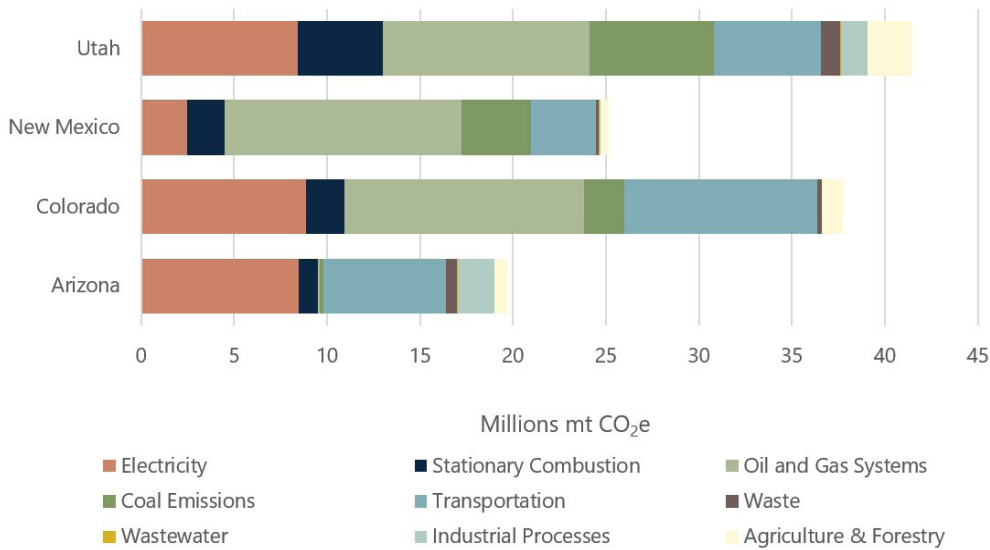


Figure 6. Colorado Plateau county emissions by state.

Carbon stock occurring from land cover and land uses was calculated at the county level. Five land cover and use types were analyzed: forests, croplands, grasslands/shrublands, wetlands, and other lands. The total carbon stock is estimated to be just under 2.5 billion mt C (Figure 7). This is carbon that is already stored and does not represent available storage capacity. It does represent potential added emissions if the land cover providing the storage is destroyed. The forest land cover type is the largest carbon stock of the land cover types, followed by grasslands and shrublands.

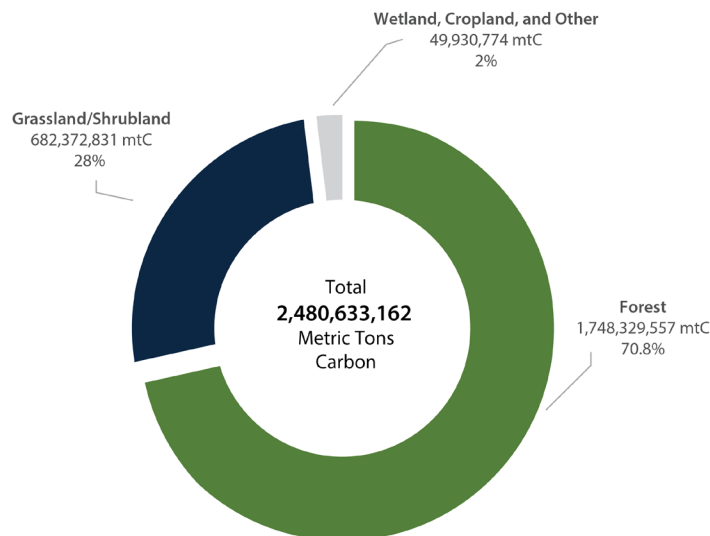


Figure 7. Carbon stocks across the Colorado Plateau.



Forecasted Emissions

Greenhouse gas emissions were forecasted out to 2050 in a business-as-usual scenario using 2018 as the baseline year. Emissions are expected to decrease across the counties that fall partially or totally within the Colorado Plateau boundary, except for the counties in Utah, which are anticipated to see an increase in emissions. Arizona counties are expected to see the largest decrease in emissions of 52 percent by 2050. Colorado counties are expected to have the next largest reduction in emissions of 31 percent by 2050. New Mexico counties are expected to see a 14 percent reduction in emissions by 2050.

Arizona, Colorado, and New Mexico saw their largest emissions reductions in the electricity and stationary combustion. This is primarily due to closures of major energy facilities (like coal fired power plants), and due to state and utility carbon reduction policies and goals for electricity generation. Utah counties are anticipated to increase their emissions by 20 percent, largely due to population increases which contribute to increases in activity in the electricity and stationary combustion, transportation, and waste/wastewater sectors. In addition, Utah does not currently have any statewide carbon reduction policies for electricity generation. The cumulative reduction is responsible for overall emission reductions of nearly 14 percent across Colorado Plateau counties (Figure 8).

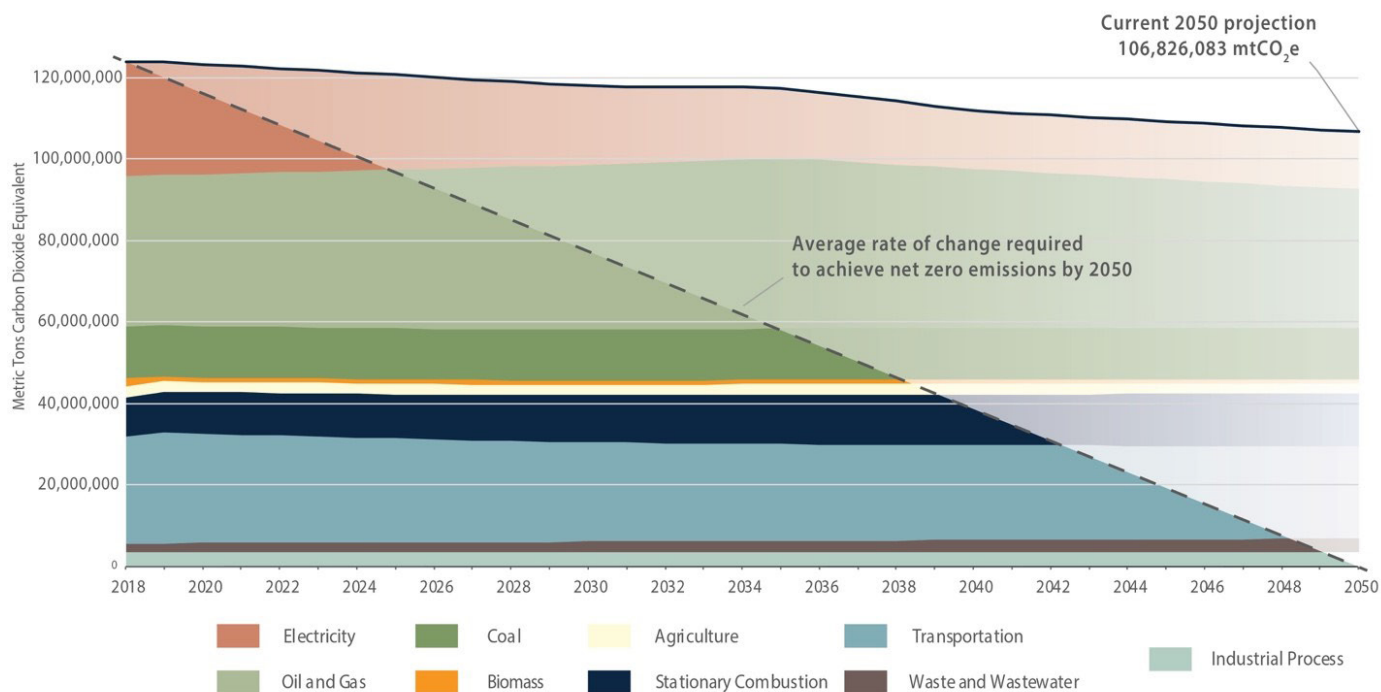


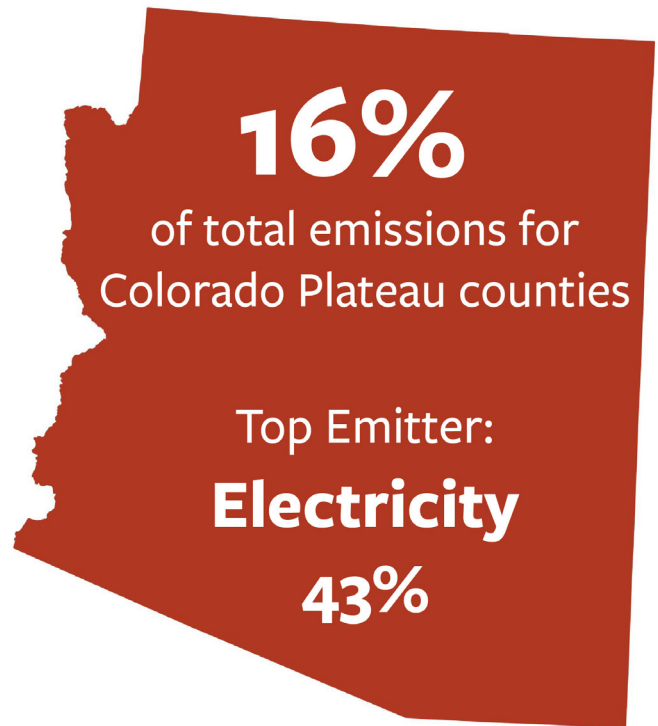
Figure 8. Forecasted emissions for Plateau counties through 2050 (mt CO₂e).



Arizona Counties

Five counties in Arizona fall partially or totally within the Colorado Plateau boundary, totaling 39 percent of the entire land area of the Colorado Plateau. These counties contributed 17 percent, nearly 20 million mt CO₂e, of total plateau county emissions in 2018. Yavapai County had the highest emissions with just over 7 million mt CO₂e.

The electricity sector was the largest contributor among the five counties and accounted for 43 percent of their total emissions (Table 1). Arizona counties' total carbon stock was estimated to be over 708 million mt of carbon. The majority of the carbon stock, 61 percent, was stored in the forest land cover type.



Emissions for the five Arizona counties are forecasted to reduce emissions by 25 percent by 2050 in a business-as-usual scenario, or slightly more than 10 million mt CO₂e. This is largely attributed to projected reductions in the electricity and stationary combustion and transportation sectors.

Table 1. Colorado Plateau emissions by sector, subsector, or source for 2018 in Arizona.

Sector/Subsector/Source	Total Emissions (mt CO ₂ e)	Percentage
Electricity	8,481,942	43.08%
Stationary Combustion	1,049,276	5.33%
Oil & Gas Systems	78,704	0.40%
Coal	196,341	1.00%
Transportation	6,570,391	33.37%
Waste	600,098	3.05%
Wastewater	66,433	0.34%
Industrial Process	1,964,302	9.98%
Agriculture and Forestry	680,845	3.46%
Sequestration	(708,024,245 mt C)	-
Total	19,688,332	100%



Colorado Counties

Eleven counties in Colorado fall partially or totally within the Colorado Plateau boundary, totaling 10 percent of the entire land area of the Colorado Plateau. These 11 counties contributed 37.7 million mt CO₂e of total plateau county emissions in 2018. Garfield County had the highest emissions, nearly 12 million mt CO₂e emissions.

Oil and gas systems was the largest emitter for the 11 Colorado counties, and accounted for 35 percent of their total emissions (Table 2). Colorado counties' total carbon stock was estimated to be over 465 million mt of carbon. The majority of the carbon stock, 83 percent, was found in the forest land cover type.

Emissions for the 11 Colorado counties are forecasted to reduce by 31 percent in a business-as-usual scenario by 2050. This is largely attributed to projected reductions in electricity and stationary combustion.

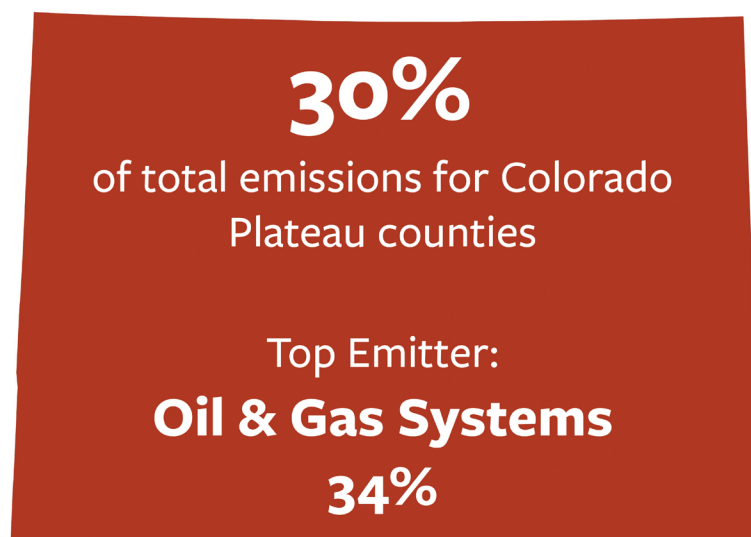


Table 2. Colorado Plateau emissions by sector, subsector, or source for 2018 in Colorado.

Sector/Subsector/Source	Total Emissions (mt CO ₂ e)	Percentage
Electricity	8,857,560	23.46%
Stationary Combustion	2,095,014	5.55%
Oil & Gas Systems	12,854,771	34.05%
Coal	2,166,895	5.74%
Transportation	10,375,153	27.48%
Waste	255,206	0.68%
Wastewater	25,476	0.07%
Industrial Process	0	0.00%
Agriculture and Forestry	1,119,503	2.97%
Sequestration	(465,281,683 mt C)	-
Total	37,749,578	100%



New Mexico Counties

Six counties in New Mexico fall partially or totally within the Colorado Plateau boundary, totaling 14 percent of the entire land area of the Colorado Plateau. These six counties contributed over 25 million mt CO₂e of total plateau county emissions in 2018. San Juan County produced the most emissions, nearly 15 million mt CO₂e emissions.

Oil and gas systems was the largest emitter for the six counties, and accounted for 51 percent of their total emissions (Table 3). New Mexico counties' total carbon stock was estimated to be over 470 million mt carbon. The majority of the carbon stock was found in the forest land cover type.

Emissions for the six New Mexico counties are forecasted to decrease by 14 percent by 2050 in a business-as-usual scenario with reductions largely coming from electricity and stationary combustion.

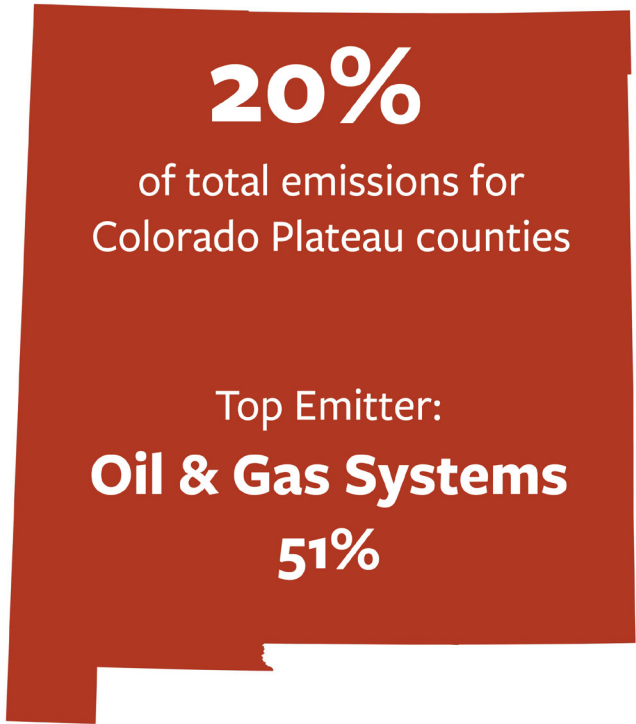


Table 3. Colorado Plateau emissions by sector, subsector, or source for 2018 in New Mexico.

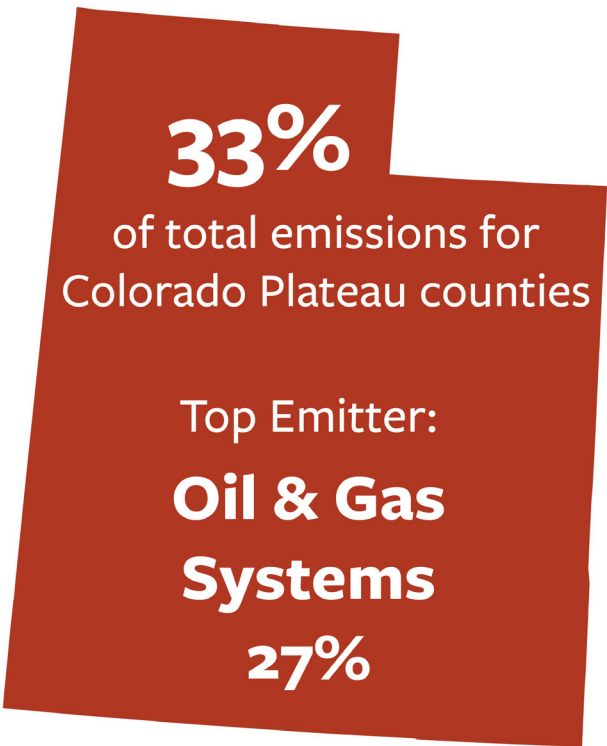
Sector/Subsector/Source	Total Emissions (mt CO ₂ e)	Percentage
Electricity	2,457,087	9.78%
Stationary Combustion	2,023,247	8.05%
Oil & Gas Systems	12,764,930	50.80%
Coal	3,705,194	14.74%
Transportation	3,499,282	13.92%
Waste	171,761	0.68%
Wastewater	27,822	0.11%
Industrial Process	40,184	0.16%
Agriculture and Forestry	440,644	1.75%
Sequestration	(472,755,625 mt C)	-
Total	25,130,151	100%



Utah Counties

Nineteen counties in Utah fall partially or totally within the Colorado Plateau boundary, totaling 37 percent of the entire land area of the Colorado Plateau. These counties contributed the most emissions to the Colorado Plateau region with over 41 million mt CO₂e emissions in 2018, and accounted for 33 percent of total plateau county emissions. Uintah County produced the most emissions, over six million mt CO₂e emissions.

Oil and gas systems was the largest emitter for the nineteen counties, and accounted for 27 percent of their total emissions (Table 4). Utah counties' total carbon stock was estimated to be over 834 million mt carbon. The majority of the carbon stock was found in the forest land cover type.



Emissions for the nineteen counties in Utah are forecasted to increase by 20 percent by 2050 in a business-as-usual scenario. This is mostly attributed to an increase in electricity and stationary combustion.

Table 4. Colorado Plateau emissions by sector, subsector, or source for 2018 in Utah.

Sector/Subsector/Source	Total Emissions (mt CO ₂ e)	Percentage
Electricity	8,407,029	20.29%
Stationary Combustion	4,583,587	11.06%
Oil & Gas Systems	11,130,092	26.86%
Coal	6,697,369	16.16%
Transportation	5,757,892	13.89%
Waste	1,000,536	2.41%
Wastewater	81,457	0.2%
Industrial Process	1,404,152	3.39%
Agriculture and Forestry	2,382,233	5.75%
Sequestration	(834,571,610 mt C)	-
Total	41,444,347	100%



Conclusion

The science is clear: the climate is changing, and the world is just beginning to feel the impacts. On the Colorado Plateau, this could mean increased and more intense wildfires, water shortages, extreme heat, and more infrequent and intense precipitation. According to the Fourth National Climate Assessment, heat associated deaths and illnesses across the southwest are expected to rise, and the cultural resources and spiritual wellbeing of Indigenous communities will be increasingly affected by drought and wildfire. In order to lessen the impacts of climate change, it is imperative to take actions to significantly reduce greenhouse gas emissions in every way possible.

In 2018, the counties across the plateau emitted an estimated 124,012,655 mt CO₂e emissions. When forecasted in a business-as-usual scenario, emissions from plateau counties are projected to decrease by nearly 14 percent, or 17,186,577 mt CO₂e. In light of warnings from the IPCC that the global community must reduce emissions by 45 percent from 2010 levels by 2030 and reach net zero by 2050, the business-as-usual scenario for the Colorado Plateau is not aggressive enough. Actions must be taken to more significantly reduce emissions going forward if the American southwest is to do its part to avoid the catastrophic effects within the region from further global climate change.

The Grand Canyon Trust will continue to fight to protect the unique and stunning resources on the Colorado Plateau to ensure that all residents of the region can continue to live safe, healthy, and prosperous lives. This greenhouse gas emissions inventory can help inform the process of identifying the next steps the Trust and communities throughout the plateau can take in the fight against climate change.





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