

Big Sky Community Climate Action Plan

Collaborating on Our Future



Prepared for community
implementation by





“This is a comprehensive Big Sky community plan – no single non-profit organization, private entity, or district is solely responsible for the full execution of the CAP. Rather, implementation will be a collective and collaborative effort in which community members will elevate and support one another.”

Introduction

Big Sky

Where the skyline is defined by peaks, not buildings; the distance defined by markers along the river or trail, not city blocks; snow-capped peaks meet the forest; forest meets the waterway. Big Sky, Montana is defined by its sense of place: nestled among the Gallatin and Madison Ranges as part of the Greater Yellowstone Ecosystem, connected to the region by its waterways, valleys, and ridgelines. Residents are fortunate to call this place home, and visitors are welcomed to experience this unique mountain community. Preserving and protecting this community and its valued sense of place, now and for future generations, is the objective of the Big Sky Community Climate Action Plan (CAP). This plan is collaborative, strategic, and outlines a clear set of actions for implementation.

The goal of **Big Sky Sustainability Network Organization (SNO)** is to encourage the entire community to strive for responsible stewardship of this beautiful landscape. Prior to Chet Huntley realizing Big Sky in 1973, this land, now home to many, was historically preserved by Indigenous peoples. There is much to be learned from the long history of the Indigenous nations who honored and protected this land. To honor those who came before, actions today must be respectful of generations to come.

The ethos of a modern day mountain town is to embrace and partake in the outdoors. The allure of Big Sky is its pristine outdoors, access to serene and wild places, and abundance of flora and fauna. The recreation here captures attention, the scenic mountainscapes leave a lasting impression, and without care and planning, those virtues are at risk.

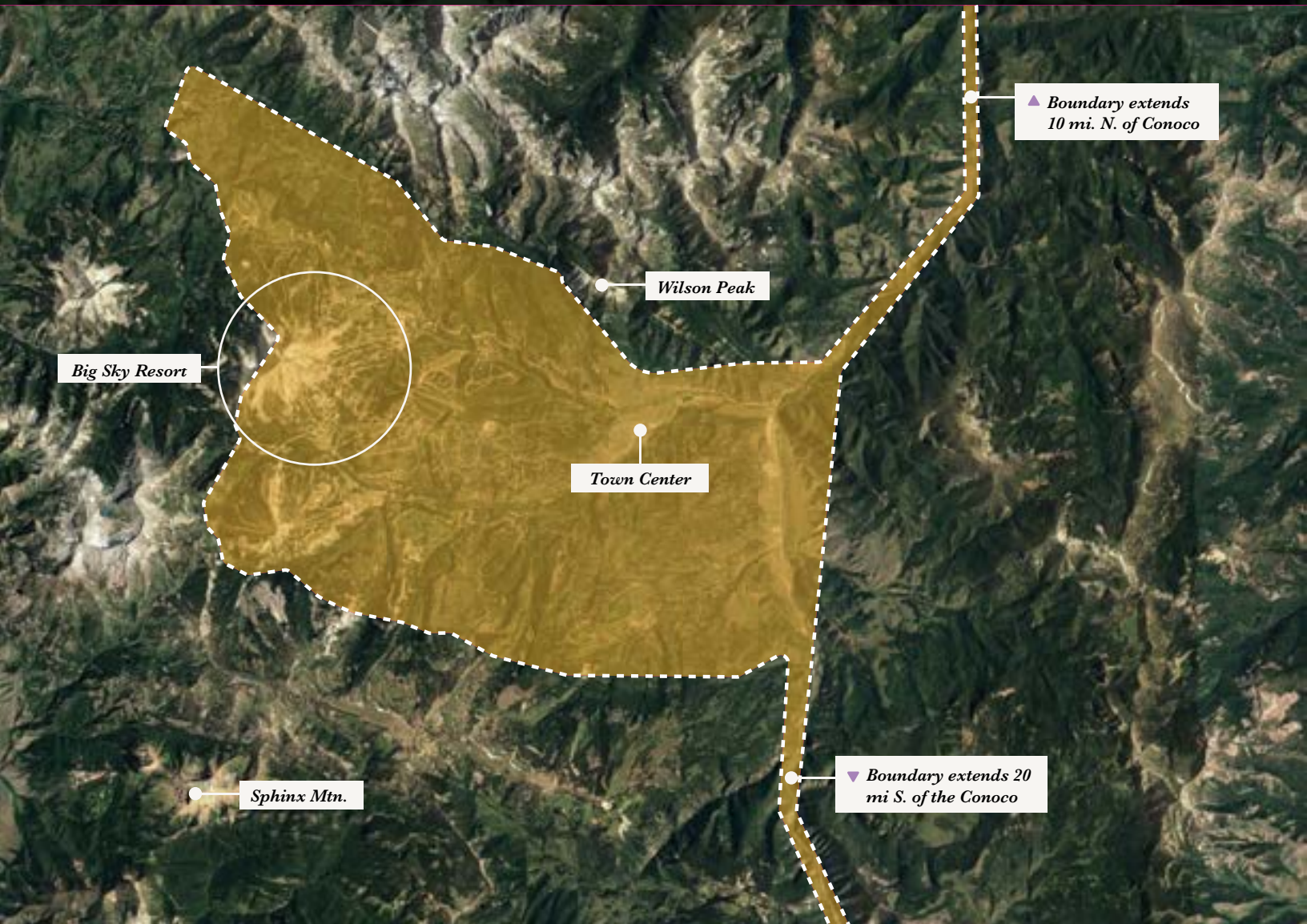
Whether skiing down the mountain, floating the river, or backpacking into the wilderness, maps are a key

navigational instrument. For this reason, the Big Sky Climate Action Plan (CAP) is presented as a trail map (Figure 1). As with many long-haul outdoor adventures, the final route taken is not always the initial route planned. Unexpected setbacks and successful nudges forward will undoubtedly be a part of the journey. Similar to many adventures, the immediate planning and short-term steps will all require patience; they may not be the most rewarding part of the journey, but the view at the end—net zero emissions in 2050—will be well worth the hard work it will take to get there.

The trail to net zero emissions by 2050 will happen efficiently if there is widespread community involvement. Realizing this goal will require the work of individuals and businesses, an abundance of funding, community investment, and advantageous climate legislation. With such a long-term goal, this document breaks down the path into Targeted Improvement Priorities with short-term tactics and strategies so the “peak” can be reached one step at a time. However, if community participation is not strong, the trail ahead is perilous and challenging. The CAP is an opportunity to provide resources to empower all of Big Sky to be a part of the solution and reach the apex with intention, as a team.

It is critical to mitigate and adapt to the impacts of climate change and provide guidelines for thoughtful development.

Big Sky, Montana is legally defined as an unincorporated, census-designated place (CDP) straddling two counties – Gallatin and Madison – with seven special districts, upwards of one hundred Homeowners Associations (HOAs), a myriad of nonprofits, businesses, and engaged residents all



contributing to its community governance, creating a complex local decision making network within a functional, operating framework of the Resort Area District.

As a gateway community to the Greater Yellowstone Ecosystem (GYE), Big Sky is a world-class outdoor recreation destination. The local economy relies heavily on the health of the environment including the naturally beautiful landscapes, a thriving wildlife population, and numerous recreational opportunities. To sustain the local economy and protect the community, so that future generations can experience and enjoy the area's abundant natural resources, it is critical to mitigate and adapt to the impacts of climate change and provide guidelines for thoughtful development.

Visitorship to the region increased rapidly in recent decades. Yellowstone National Park **visitation increased by 85% from 1970 to 2015**. The winter and summer outdoor recreation industry drove this increase: **skier days rose by 5%** per year in the three commercial ski areas of the region and angler days on the Madison River tripled from 1984-2016.

Prior to 2020, Big Sky grew at a rapid pace, and then during the early stages of the COVID-19 pandemic in 2020-2022, visitor numbers swelled at unprecedented rates. Yellowstone National Park received 4.86 million visitors in 2021, a record breaking high. This type of growth, coupled with ongoing development places a significant and noticeable burden on the Big Sky natural environment.

FIGURE 1

Climate Action Trail Map



Enhance Food Recovery Systems

Green Build Toolkit Platform

Electrify Buildings:
Reduce Propane Gas Use



Energy Efficiency Participation



Reduce Vehicle Miles Traveled

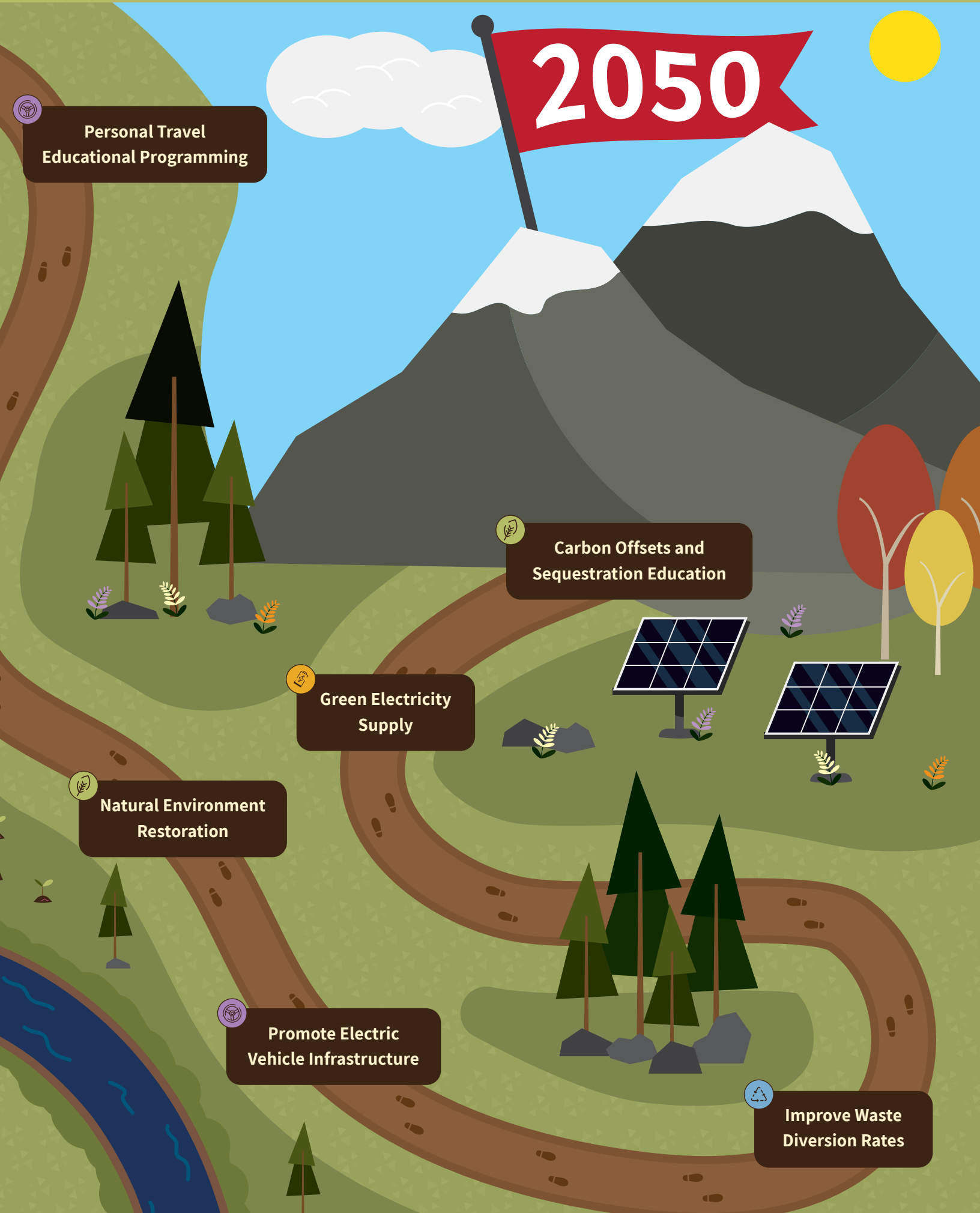



Increase Composting and Recycling




Water Use Reductions






 Personal Travel
Educational Programming

2050

 Carbon Offsets and
Sequestration Education

 Green Electricity
Supply

 Natural Environment
Restoration

 Promote Electric
Vehicle Infrastructure

 Improve Waste
Diversion Rates

With the increased demand on the environment, the need for community collaboration is urgent to mitigate possible negative impacts. This CAP begins to lay the groundwork for collaborative mitigation and adaptation, knowing that the community must adapt within future constraints and paradigm shifts. Help SNO meet the moment to ensure that future generations can explore and enjoy Big Sky for years to come, by using this CAP as a trail map.

SNO

Big Sky Sustainability Network Organization (SNO) formed in 2020 to address the environmental sustainability needs within the community. With a mission to preserve and protect Big Sky through advancing environmental and sustainability initiatives, SNO's efforts focus on projects and programs that shift collective habits to enrich environmental stewardship based on data-driven needs.

Sustainability is an all-encompassing concept *defined* as "the degree to which a process or enterprise is able to be maintained or continued while avoiding the long-



term depletion of natural resources." Recognizing that there was a gap in the network of community members and businesses

interested in sustainability, SNO established to both identify and solve current and future sustainability needs. As Big Sky's population and economy are principally dependent on a thriving symbiotic relationship with the natural environment, SNO's focus is primarily on the environmental and climate facets of sustainability.

SNO provides guidance and access to resources, helps secure funding, and facilitates community efforts: community recycling days, zero-waste events, carpooling incentive programs, reusable water bottle refill stations, clean-up/habitat restoration projects, and educational programming. The long-term vision for SNO is to expand the sustainability focus in Big Sky to encompass all 17 *Sustainable Development Goals (SDGs)* put forth by the United Nations to advance the wellbeing of all living organisms within the community and beyond.

Greenhouse Gas Emissions Inventory & Climate Action Plan (CAP)

After conducting and publishing a baseline *Community Greenhouse Gas (GHG) Inventory of 2018 and 2019*, SNO identified the need for a Climate Action Plan (CAP) to detail a strategic framework for measuring, planning, and reducing carbon emissions and increasing resilience to climate-related impacts. GHG inventories are a critical element of any Climate Action Plan and serve as a baseline to measure progress. Data from the baseline GHG inventory defined the four priority areas of the CAP: (1) improving building efficiency and clean energy supply, (2) reducing transportation emissions, (3) reducing consumption and waste, and (4) conserving and restoring the natural environment. Each of these actions has varying degrees of impact on emissions and the health of natural resources.



SNO engaged 30+ local stakeholders, including the public utility, environmental, social and civic non-profits, resorts, major landowners and developers, private contractors, renewable energy companies, and interested community members in working groups to produce the CAP. The strategies and initiatives laid out in this document are actionable and adaptable, paving a path toward medium-term goals for 2035 and net zero emissions by 2050. Mid-term and long-term goals are necessary to ensure that global warming does not “overshoot” the critical 1.5 degree celsius limit to climate change. Collaboration was integral in developing the CAP and will continue to be a priority for successful implementation.

This CAP, published by Big Sky SNO in February 2023, will serve as the long-term plan to reduce community GHG emissions and improve resilience to future climate change impacts. Community members can utilize the CAP to better understand which individual and collective actions can help Big Sky reach net zero by or before 2050.

*The need for
community
collaboration
is urgent, the
moment is now.
Let's act together.*





Table of Contents

| | |
|----|---|
| 2 | Introduction |
| 4 | Climate Action Trail Map |
| 10 | Humans and the Environment |
| 18 | The Route to a Sustainable Future |
| 24 | Establishing the Big Sky 2018 Emissions Baseline |
| 28 | 2018-2050 Business-As-Usual GHG Forecast |
| 34 | Advancing Big Sky's Climate Goals |
| 40 | Beyond Carbon Emissions: Ecological Resilience |
| 42 | Energy & Buildings Targeted Improvement Priority |
| 50 | Transportation Targeted Improvement Priority |
| 58 | Consumption & Waste Targeted Improvement Priority |
| 58 | Natural Environment Targeted Improvement Priority |
| 64 | The Trail Ahead |
| 72 | Implementation & Funding Partners |
| 74 | Key Terms and Abbreviations |
| 76 | Appendix |
| 80 | Figures |
| 88 | Tables |
| 90 | References |

Humans and the Environment



Jonathan Stone @jonathanstone_ for Big Sky Resort

Big Sky and communities everywhere must prepare for, address, and adapt to effects of climate change identified by the IPCC, a United Nations census-driven collaborative of scientists.

Air, water, and food are essential for humankind's survival and prosperity. These basic needs are the fundamental way of understanding humankind's dependence on the natural environment. *In 2009, scientists identified nine critical earth system processes* that contribute to the planet's stable environment and support the growing global population. Among these critical earth system processes are freshwater use, biodiversity, land-system change, and climate change. People depend on having clean, fresh water to drink, diverse animals and plants to eat, space to live, and a stable climate.

Each of the earth system processes that humans depend on possess a threshold, beyond which the system can no longer function in the same way. The space just before this threshold is considered the safe operating space for humanity, where people have enough clean water, air, and food to survive. Scientists defined nine planetary boundaries as the limits to this safe operating space. Surpassing planetary boundaries leaves the planet in a compromised zone of uncertainty, where systems may begin to change, negatively affect other earth systems, and pose great challenges and risks to human survival. For a greater understanding, see Appendix A.1.

The most well recognized of these planetary boundaries is the one established by the Intergovernmental Panel on Climate Change (IPCC). People commonly know of the 1.5°C limit to the warming climate, beyond which there is increased risk of flooding, drought, wildfire, and hotter average temperatures.

Sustainability not only requires efforts to prevent carbon emissions that lead to a worsening climate, but also entails efforts to prevent extinction of plant and animal species, improve soil health, manage freshwater resources, and prevent chemical pollutants. Conservation and preservation of the environment will allow future generations to enjoy Big Sky's beautiful mountains, forests, and rivers and will contribute to ongoing support of the recreational and economic activities that rely on the health of these natural wonders.

Global Climate Change Effects

Climate change is affecting every region of the globe, with human influence contributing to a multitude of *observed shifts in weather extremes*. Big Sky and communities everywhere must prepare for, address, and adapt to effects of climate change identified by the IPCC, a United Nations census-driven collaborative of scientists. IPCC modeling and data inform the timelines and targets established in this CAP. The IPCC is a central global organization for research and education on climate change, basing their information on foundational and widely accepted scientific data. Their *scientific community determined* that the "likely range of human-induced warming in global surface temperature in 2010-2019 relative to 1850-1900 is 1.07°C." Unabated global emissions and impacts will be congruent to impacts locally.

According to the IPCC *Physical Science Basis Report Summary for Policymakers* published in 2022, the 1.5°C temperature increase projected will inevitably impact all regions, including seasonal tourism and winter snow sports destinations like Big Sky. In recent years, the Rocky



Increased fire activity and accompanying smoke portend large ecological changes and threaten human health and the communities within the GYA.

Mountains and American West witnessed a diminishing snowpack, resulting in lower overall summer water flows and a coinciding increase in devastating wildfires. Warming decreases water availability, which in turn affects agricultural, municipal, and public land use in and around national forests and parks. The shift in the annual precipitation calendar coincides with a rising freezing altitude in the mountains, creating a significant change in the overall ecosystem. Not only will ski conditions shift, *an increasing intensity and likelihood of spring flooding*, shifts in freshwater species distribution, worsened water quality, and increased extinction risk for terrestrial species will drastically alter and impact the natural ecosystem.

Big Sky alone cannot reverse global climate change. However, acting in a collective manner with other communities provides the greatest opportunity for

long-term viability. While the IPCC Reports reflect global climate change impacts, regional outcomes are outlined in the Greater Yellowstone Climate Assessment.

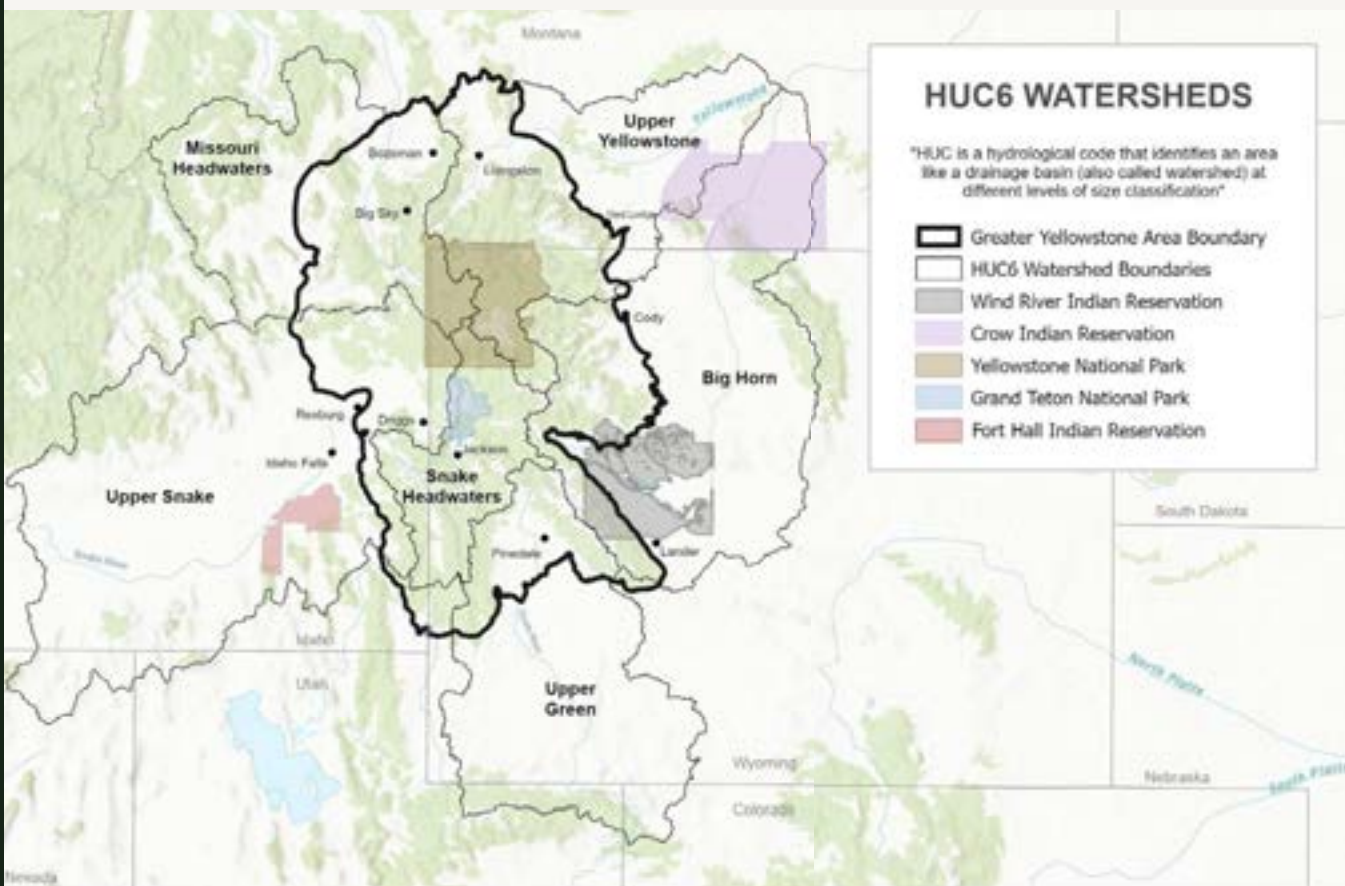
Regional Climate Change

Published in June 2021, the *Greater Yellowstone Climate Assessment (GYCA)* is the result of collaboration among The Greater Yellowstone Coalition, Montana State University, and various other organizations. The findings from the GYCA illuminate clear evidence that the impact of the changing climate on local snowpack and runoff will greatly affect Big Sky's ski and tourism industry.

The GYCA provides an in-depth summary of past, historical, and projected future changes to temperature, precipitation, and water in the Greater Yellowstone Ecosystem (GYE) and identifies important impacts and adaptation and mitigation opportunities related to climate change in the region. The study provides geographic detail to the analysis by focusing on the GYE and six major river basins within the Greater Yellowstone Area (GYA) as shown in Figure 2. Big Sky is located in the Missouri Headwaters River basin.

FIGURE 2

Greater Yellowstone Area (GYA) Boundary Map



Greater Yellowstone Area Boundary map depicting the area's watersheds

According to the GYCA, decreases in area snowpack are projected to continue in the future. Despite a projected increase in precipitation, as winters warm, a smaller portion of precipitation will fall as snow, and what was previously snow will be a mixture of rain and snow, particularly in March and April when the snow-rain transition now occurs. Elevational changes in snow will affect most aspects of winter recreation in the GYA. *The projected number* of ski days in 2050 will be reduced between 6 to 29 days at ski areas within the GYA.



Table 1 illustrates historic changes and projected trends for the GYA.

Based on IPCC scientific climate model RCP 4.5, a moderate scenario in which global emissions peak around 2040 then decline, the following climate impacts for the Missouri Headwaters projected for 2100 (as compared to 1986-2005 GYA baseline data) were identified in this study:

Increasing Temperatures

From 1950 through 2018, actual mean annual temperature increased 2.6°F. It's projected to increase 5.3°F.

Changes In Precipitation

From 1950 to 2018, actual annual average snowfall increased 4.1 inches (4%), but with less spring snow and with earlier spring peak stream flows (9 days earlier). Average annual precipitation is projected to increase 9% by 2100.

A greater portion of future precipitation will be in the form of rain, resulting in 43% less snowpack and a 36% reduction of June, July and August runoff by 2100.

Lackner et. al. anticipates that Big Sky's historic (1981-2011) number of ski days per year will decline from 192 to 169 days by 2050, considered as the number of ski days in a year starting on September 15.

Wildfire Impacts

Increased fire activity and accompanying smoke portend large ecological changes and threaten human health and the communities within the GYA.

Earlier snowmelt and loss of snowpack as a result of warming winters, followed by warmer summers, longer growing seasons, and reduced water availability will increase fire potential and severity at all elevations within the GYA.

This CAP leverages the findings from the GYCA to recommend opportunities and actions to improve Big Sky's ability to adapt to a changing climate and to increase resiliency to identified, regional climate impacts.

TABLE 1

Greater Yellowstone Ecosystem Precipitation and Temperature Trends

| | | GYA | Missouri Headwaters |
|--|-----------------------|----------------|------------------------|
| Change Between 1950 and 2018 | Temperature | 2.3°F Warmer | 2.6°F Warmer |
| | Snowfall | 23 Inches Less | 4.1 Inches More |
| | | 25% Loss | 4% Gain |
| | Peak Stream Flow | 8 Days Earlier | 9 Days Earlier |
| Trends to 2100 compared to 1986-2005 (based on a RCP4.5 assumption) | Temperature | 5.3°F Warmer | 5.3°F Warmer |
| | Precipitation | 9% Increase | 9% Increase |
| | Snowpack | 40% Loss | 43% Loss |
| | June-August Runoff | 35% Less | 36% Less |

The findings from the GYCA illuminate clear evidence that the impact of the changing climate on local snowpack and runoff will greatly affect Big Sky's ski and tourism industry.



The Route to a Sustainable Future



Climate Action Plans (CAPs) are increasingly developed for communities, cities, and regions in the Rocky Mountain West, the US and worldwide to create a path toward more sustainable and stronger communities.

CAPs outline customized paths for making informed, data-driven decisions, and understanding where and how to achieve the largest and most cost-effective emissions reductions which align with other community priorities. They encourage action and accountability. For Big Sky, the focus is on a healthy and thriving community and a robust year-round outdoor recreation and tourism industry.

Big Sky is one of many towns in North America seeking to address climate challenges through climate action and improved sustainability and resiliency. Peers in the outdoor tourism industry formed coalitions to support and elevate efforts in ski and outdoor tourism towns to reduce greenhouse gas (GHG) emissions and increase environmental resilience. SNO works with both *Mountain Towns 2030* and *Mountain Ideal*, collaborating with other ski towns that are pursuing net zero goals. SNO and the community of Big Sky can both learn from and contribute to these coalitions, as working in a silo cannot adequately address the global scale of the challenge.

Big Sky is a member of ICLEI - Local Governments for Sustainability (ICLEI), the first and largest global network of more than 2,500 city, town and county governments advancing sustainability and responding to the climate emergency and building communities that are equitable, nature-based, circular, and resilient.

The Big Sky CAP provides a community-based approach to promote sustainability and work towards net zero emissions by 2050. This plan lays out a trail map (Fig 1, pg 4) to reduce GHG emissions and envision a more environmentally, socially, and economically sustainable Big Sky. This path consists of strategies intended to engage residents and visitors alike, addressing and implementing targeted action items involving all sectors of the Big Sky community.

The CAP provides a trail map for developing achievable actions based on the strategies for each of the identified

targets. CAP stakeholders, composed of more than 30 regional and community area experts, developed the strategies highlighted along the trail map over the course of a six-month period beginning in October of 2021 and ending in April of 2022. The level of key participant engagement ensures that identified targets and strategies reflect widespread community needs. This inclusive approach pursues equity in addition to preservation of the Big Sky environment and Greater Yellowstone Ecosystem.

The intentional engagement process used to prioritize community buy-in and feasibility will also ensure future participation and viability. Additionally, the CAP complements existing plans and goals of other non-profit organizations and private entity partnerships. Implementation will require ongoing engagement with these partners and the community-at-large. Given the complexity of climate issues and solutions, the urgency, and varied action at the state and federal level, the trail map may change over time. The routes from here to the destination will vary as Big Sky seeks to optimize the path to net zero. Although the strategies below are thoroughly developed and laid out, the ever-changing environment will dictate shifts in approach and pace of success.



Max Lowe @max.lowe for Big Sky Resort

Community in Action

Energy & Buildings

- Calculate your household or business carbon footprint through a home energy audit (administered by NorthWestern Energy for free) and apply identified solutions to reduce energy use.
- Calculate your overall personal carbon footprint by quickly by using a carbon calculator (like *Climate Hero*) and apply identified solutions to reduce energy use.
- Take action to reduce energy (electricity and liquid propane) use and improve efficiency in your home or business through: heating and cooling system upgrades, appliance upgrades, adding insulation, and installing programmable thermostats. You can also make simple changes in behavior like turning off lights and appliances when they're not in use, or adjusting heating and cooling temperature settings.
- Utilize tax incentive programs that offer rebates for efficiency actions and implementations. When remodeling and updating, replace liquid propane appliances with electric considering EnergyStar Certified appliances.
- Calculate potential savings of upgrading to energy efficient systems at home. *Rewiring America* can estimate rebates & credits from the Inflation Reduction Act.
- Look for opportunities to invest in efficiency and renewable projects that have a positive return on investment.
- Businesses can reference SNO's *Greener Biz Quiz* for further and more specific actionable items.
- Switch to electric lawn and garden equipment.
- Sign on to climate legislation and write to government representatives. *Citizens Climate Lobby*, *Montana Environmental Information Center*, & *Sierra Club* are well known advocacy groups that notify individuals when they can sign on to support climate legislation.
- Register to vote and participate in elections by voting. Registration can be done at [vote.org](https://www.vote.org).



Although there are more systemic solutions listed in Big Sky Community Climate Action Plan Target Improvement Priorities, it takes all of us to reach our community climate goals. Here is a list of actions you can take to be more climate conscious.

Transportation

- Commit to reducing single occupancy passenger vehicle trips; log carpools and sustainable trips at *GoGallatin*. Combine errands into a single trip; walk, bike or use public transportation, such as the *Skyline Bus*; shop close to home when available.
- Purchase high mileage, high efficiency, hybrid or electric model when upgrading a personal vehicle.
- Purchase carbon offsets from a reputable source when traveling by air.
- Reduce vehicle idling as much as possible by turning off your vehicle when waiting in school pickup lines, drive thru lines, and avoid warming up your car for more than a minute or two in the winter.



Community in Action

Consumption & Waste

RETHINK purchasing and consumption norms to minimize waste

- Assess the upstream environmental impacts of all purchases in the supply chain for your business.
- Adopt community-wide incentives around more sustainable practices and the use of more environmentally conscious products.
- Donate unused or excess food to food recovery organizations or food banks, such as Big Sky Community Food Bank.
- Purchase regionally grown food and support local and regional agriculture, ideally at community-based food retailers when possible.

REDUCE consumption and waste

- Purchase higher quality, durable, repairable items that will last longer than less durable alternatives.
- Buy only what you need and will actually use; focus on quality over quantity.

REUSE as much as possible

- Look for opportunities to use existing products, rent (instead of buy) tools/equipment, borrow from your neighbors or start a neighborhood tool sharing library.
- Donate used items to charities and thrift stores.
- Replace commonly used disposable products (coffee mugs, zip-top bags, paper towels, takeout containers, batteries, etc.) with durable alternatives.

RECYCLE and COMPOST

- Purchase items made with less overall packaging and with recyclable or compostable packaging.
- Avoid materials that are not recyclable locally, including Styrofoam, most plastics and glass.
- Before purchasing a material object that will someday become part of the waste stream, stop to consider alternatives that use fewer natural resources (ex: electronic rather than paper subscriptions; durable rather than disposable products; minimal packaging waste).



Here is a list of actions you can take to be more climate conscious.

Natural Environment

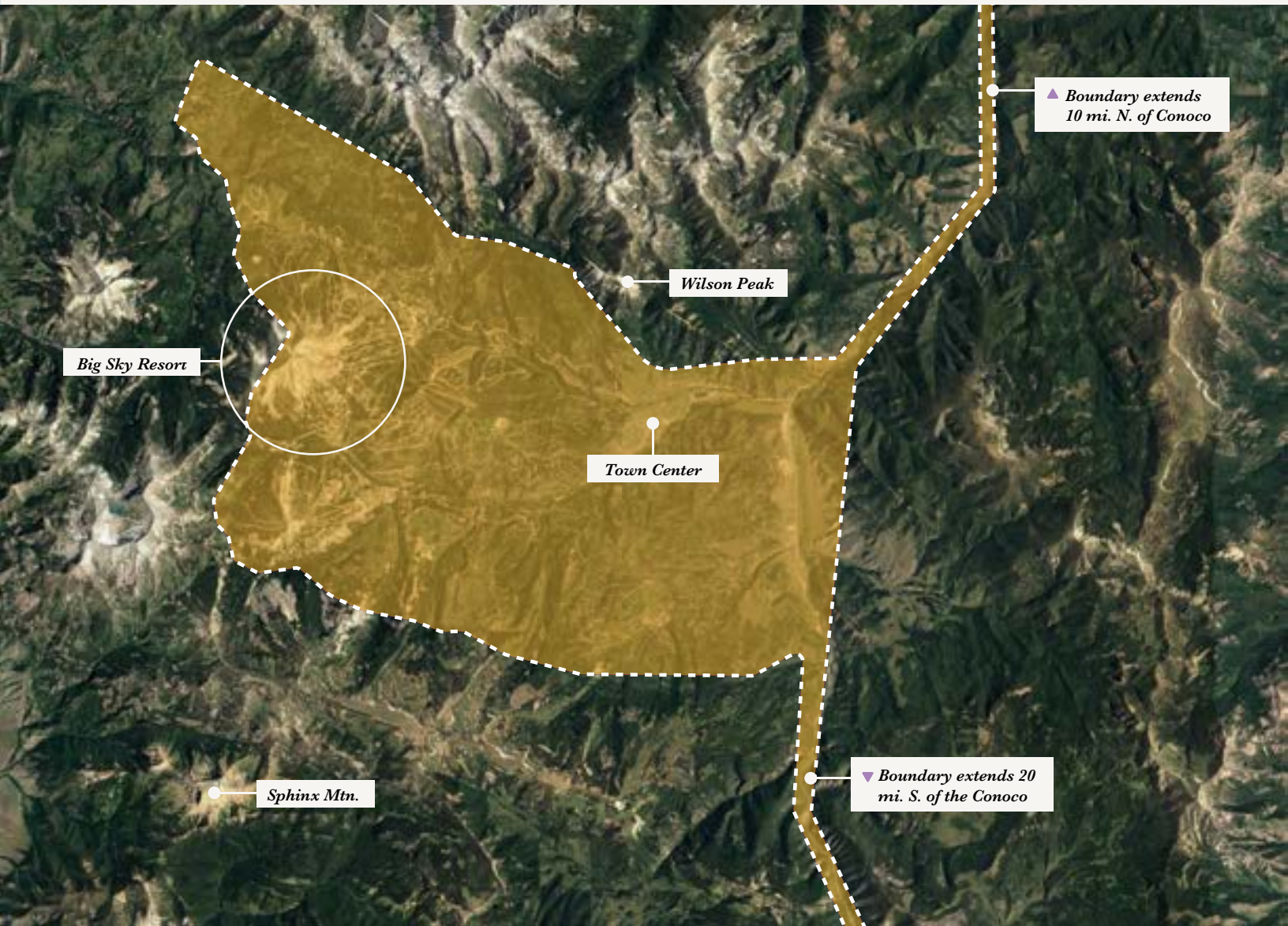
- Plant native, drought resistant trees and plants. Please reference the *Gallatin Invasive Species Alliance* website as a resource.
- Utilize *Gallatin River Task Force* as a resource for water information.
- Volunteer to protect/enhance natural areas in the community - invasive species removal events, planting events, river cleanups, *trail maintenance*, etc.
- Participate in the *Big Sky Water Conservation Program* by installing *WaterSense* fixtures and irrigation equipment then apply for a rebate to receive cash back
- Reduce water consumption in your home or business by adjusting faucets and fixtures.
- Employ *Water Wise (xeriscape) Landscaping*, instead of a traditional lawn, to reduce water consumption from irrigation.
- Contact Big Sky Fire Department for a defensible space landscape assessment to adjust your landscaping to be wildfire adapted.
- Support local farmers practicing regenerative agriculture by purchasing from them and educating yourself on the origin of your food.
- Reduce personal use of sod & Kentucky Bluegrass, and request your HOA alter their Covenants, Conditions & Restrictions (CCRs) to phase out highly consumptive non native grasses out overtime.
- Consider the impact of backcountry recreational activities on wildlife, and abide by burn regulations.
- Educate yourself on wildfire [preparedness and adaptation](#).
- Utilize recycling and composting programs. Diverting materials from the landfill directly reduces landfill greenhouse gas emissions:
 - Big Sky Recycling Center, 47280 Gallatin Road, Gallatin Gateway, MT 59730
 - Sign up for curbside Recycling from *Republic Services*.
 - Sign up for curbside compost with *YES Compost*.



Establishing the Big Sky 2018 Emissions Baseline

Naturally-occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation, a phenomenon known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases (GHGs) in the earth's atmosphere, and continuing with a "business-as-usual" (BAU) mentality will dramatically change the global climate. Collectively, these gases intensify the *natural greenhouse effect*, causing both global average surface and lower atmospheric temperatures to rise. The *EPA identifies* the most significant contributors of GHGs nationally are the burning of fossil fuels for electricity, heat, and transportation.

To understand Big Sky's specific emissions, SNO conducted a *Community Greenhouse Gas Inventory*. Establishing 2018 as the area's baseline year of study, this inventory used the approach and methods provided by the Global Protocol for Community-Scale Emissions (GPC). In addition, this inventory drew on methods from the U.S. Community Protocol, which provides more detailed methodology specific to U.S. communities. Inventory calculations were performed using the ClearPath tool, and training and assistance was provided by ICLEI- Local Governments for Sustainability USA (ICLEI USA).



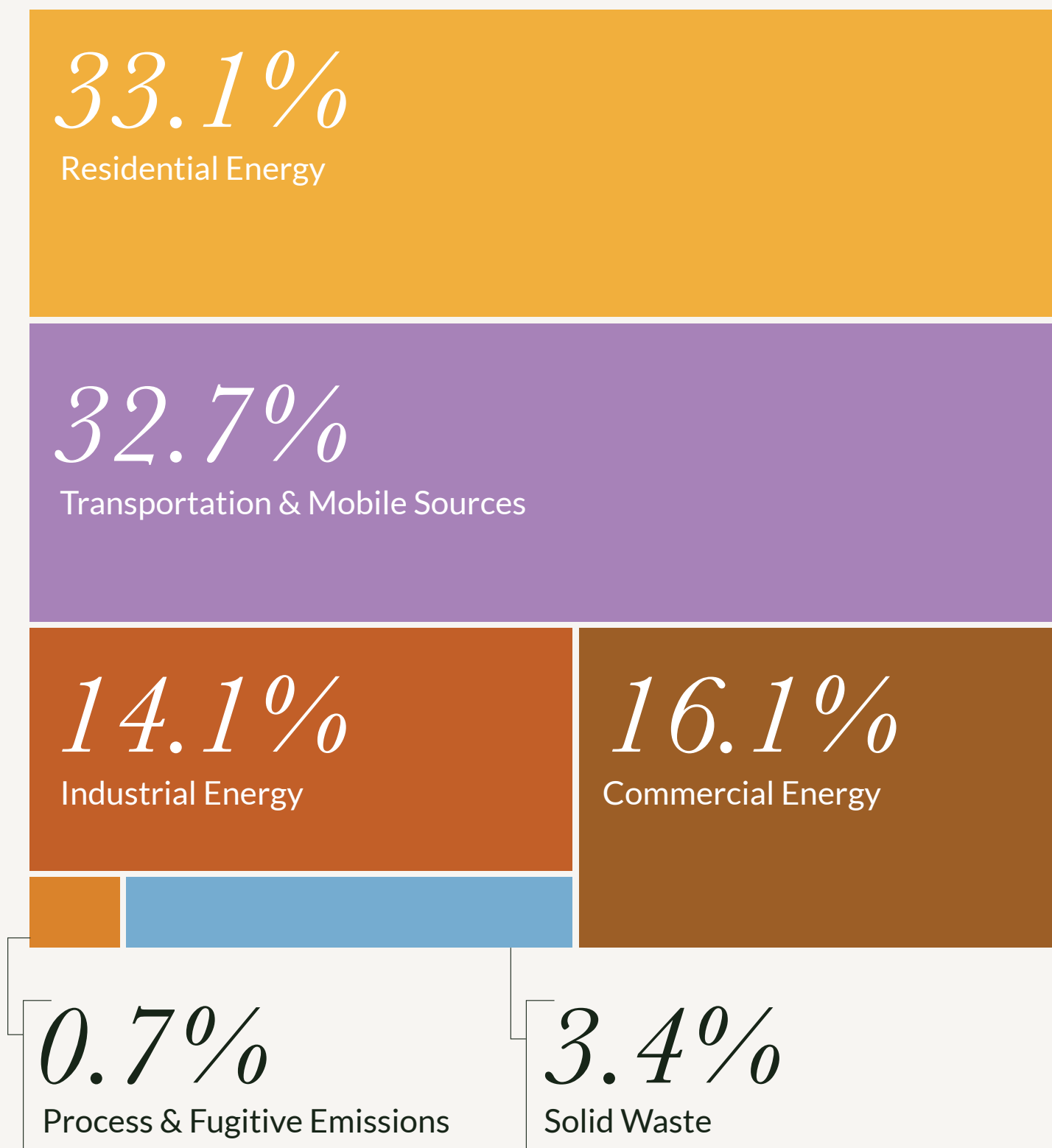
Defining the Big Sky Community Boundaries

Although Big Sky does not have official political boundaries, it is considered a *Census Designated Place* (CDP). CDPs are identified by the US Census Bureau to provide meaningful statistics for well-known, unincorporated communities. The area boundaries for the 2018 Community GHG Inventory and this CAP are defined by the electric service area of the three dedicated

substations serving Big Sky. This service area includes all NorthWestern Energy electric customers on the Mountain (Big Sky Resort, Moonlight and scattered homes), in the Meadow (Meadow Village, Town Center, Spanish Peaks, Yellowstone Club), and in the Canyon along US191 from 10 miles north of the Conoco to 20 miles south of the Conoco.

FIGURE 4

2018 Community-Wide Emissions by Sector MTCO₂e



In 2018, Big Sky's overall community emissions totaled 145,183 MTCO₂e

2018 Community Greenhouse Gas (GHG) Inventory Results

Figure 4 (here) displays the results by emissions sector from the 2018 Community Greenhouse Gas Inventory. Totals are shown in metric tons of carbon dioxide equivalent MTCO₂e. In 2018, Big Sky's overall community emissions totaled 145,183 MTCO₂e which are the result of emissions from the generation of the electricity that we use; burning propane gas for heating/cooling, cooking and water heating; utilizing gasoline and diesel fuels for transportation; hauling and landfilling solid waste and a small number of fugitive propane gas emissions. In Big Sky, "Industrial Emissions" are the result of ski and summer resort operations for Yellowstone Club (categorized as industrial by NorthWestern Energy), and Big Sky Resort (due to similar operational structure.)

More detailed information on Big Sky Area emissions can be found in the [*2018 & 2019 Community Greenhouse Gas Inventory*](#).

2018-2050 Business-As-Usual GHG Forecast

The process used in the creation of this CAP maps out a 2050 Big Sky community forecast of emissions that contemplates future changes in GHG emissions based on the 2018 and 2019 inventories and incorporating “known” or “likely” changes within the community.

This forecast is referred to as the business-as-usual (BAU) scenario and assumes that no new mitigation will be implemented over a 32-year period locally. Growth in part-time and permanent population, construction activity, and the number of visitors will significantly impact the forecast as more building occurs, more vehicles are driven, more people visit, and more waste is generated.

Under this local BAU scenario, GHG emissions are expected to increase by an estimated 92% by 2050, from 145,183 MTCO₂e in 2018 to 278,178 MTCO₂e in 2050 (Figure 5).

The BAU scenario assumes that emissions will increase by a compounded annual rate of 3.3% between 2018 and 2035 and 2.1% over the full 2018-2050 period. While this compound annual rate is calculated over the full 32-year period, growth rate assumptions for each of the 32 years vary significantly. More detail regarding Big Sky BAU growth assumptions by sector is included in Appendix A.3.

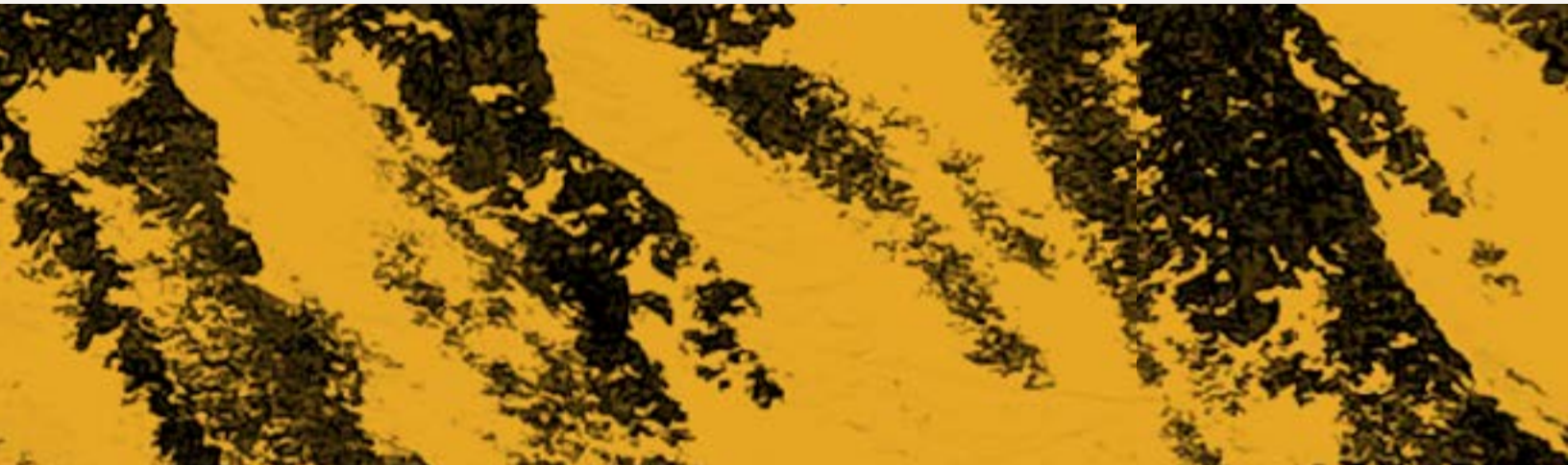
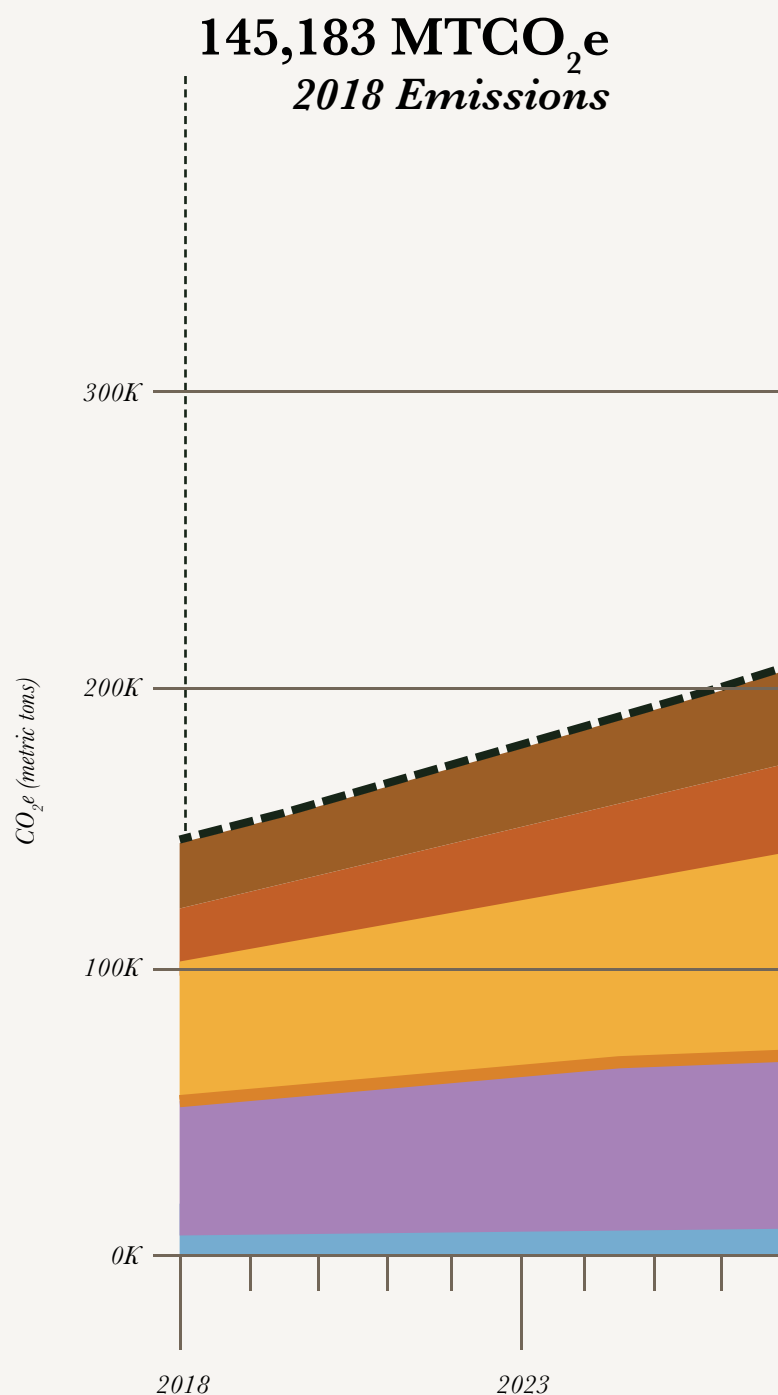


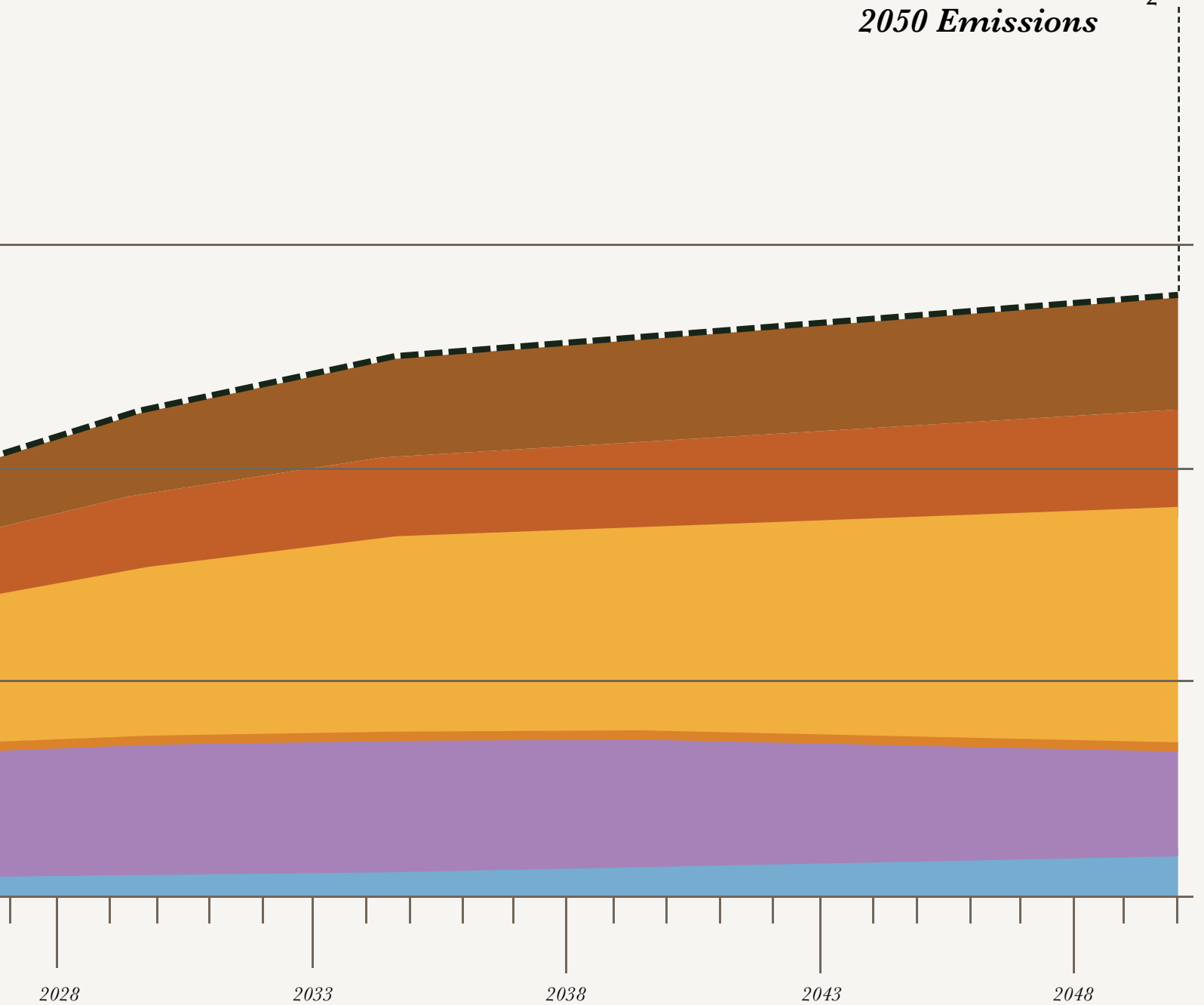
FIGURE 5

2018-2050 Forecast of Big Sky Community Emissions with No Mitigation Action (BAU)

This represents a result Big Sky cannot afford to see if it is to remain an outdoors town, sustaining its economic value and lifestyle quality.



278,178 MTCO₂e
2050 Emissions



Key

- Commercial energy
- Industrial Energy
- Residential Energy
- Process & Fugitive Emissions
- Transportation & Mobile Sources
- Solid Waste
- Business-As-Usual Forecast



Targeted Improvement Priorities

Each of the subsequent CAP sections outline the specific strategies necessary to achieve these targeted improvements.

Advancing Big Sky's Climate Goals

Big Sky SNO is taking ambitious climate action by committing to net zero carbon emissions by 2050.

There are several actions to reduce community greenhouse gas (GHG) emissions. Emissions reduction or “mitigation” focuses on actions which reduce or prevent GHG emissions and lessen human impacts on the environment. The Targeted Improvement Priorities (TIPs) are identified as sectors to improve emissions and resilience through mitigation. The targets in Figure 3 can be achieved through implementation of the strategies outlined.

The extent of the benefits expected from each TIP varies. For example, the Energy & Buildings and Transportation Priorities present significant GHG emissions reduction potential. In contrast, the Natural Environment Priority supports ecological resilience and Big Sky's ability to adapt to a changing climate. The Consumption & Waste Priority offers a balance to both emissions reduction and resilience benefits. These are shown as sliding scales in each section.

Tom Cohen @tomcophoto for Big Sky Resort



The CAP addresses emissions in four Targeted Improvement Priority (TIP) areas identified by the baseline Big Sky GHG Emissions Inventory:

- (1) Energy & Buildings**
- (2) Transportation**
- (3) Consumption & Waste**
- (4) Natural Environment**

Each Targeted Improvement Priority contains a set of targets that contain quantified outcomes (13 targets are listed in Figure 3,) in addition to short- and long-term strategies designed to achieve the desired results.

Each Targeted Improvement Priority is outlined in detail in its respective section of this plan.

FIGURE 3

Targeted Improvement Priorities

Energy & Buildings



- Green Electricity Supply
- Electrify Buildings; Reduce Propane Gas Use
- Energy Efficiency Participation
- Green Build Toolkit Platform

Transportation



- Reduce Vehicle Miles Traveled (VMT)
- Promote Electric Vehicle Infrastructure
- Personal Travel Educational Programming

Consumption & Waste



- Improved Waste Diversion Rates
- Increase Composting and Recycling
- Enhance Food Recovery Systems

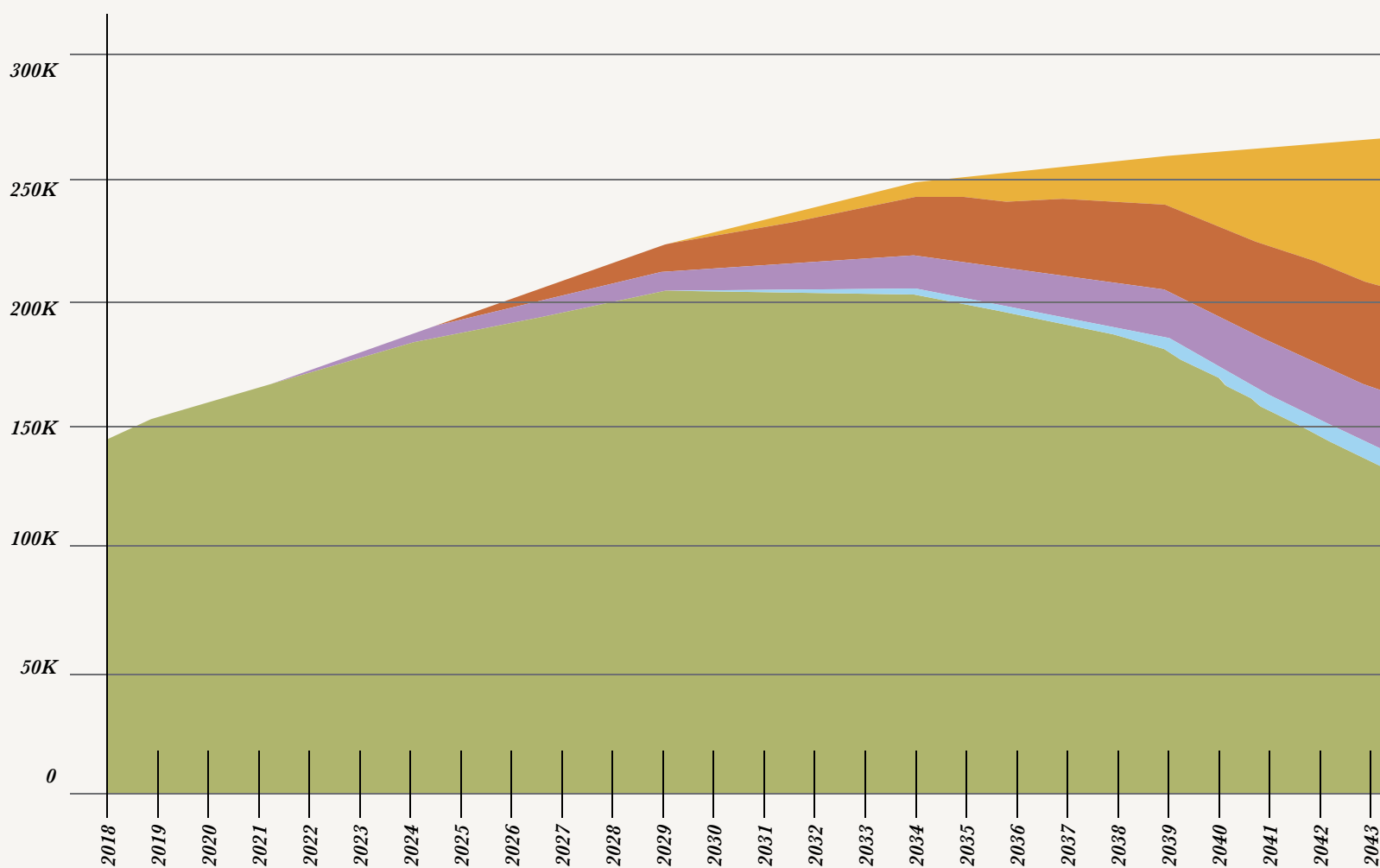
Natural Environment



- Carbon Offsets and Sequestration Education
- Water Use Reductions
- Natural Environment Restoration

FIGURE 6

Emission Reductions from BAU Forecast to Reach Net Zero by 2050



Key

- Green Electricity Supply
- Building Electrification & Efficiency
- Transportation VMT & Electric Vehicles
- Consumption & Waste
- Environmental Health and Advocacy, New Technology, Carbon Credits/Offsets & Sequestration

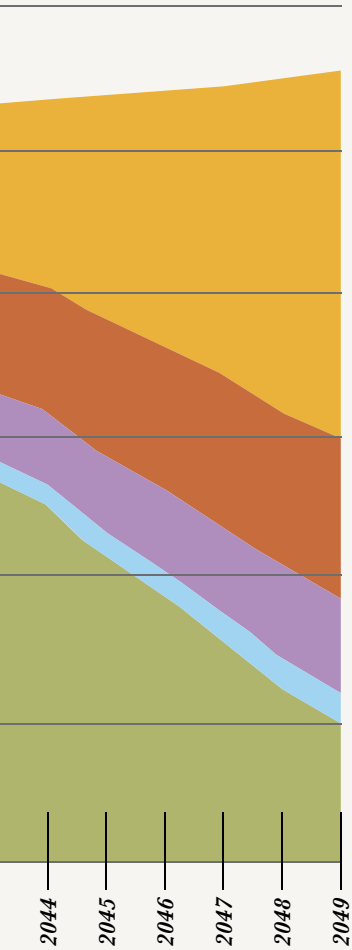


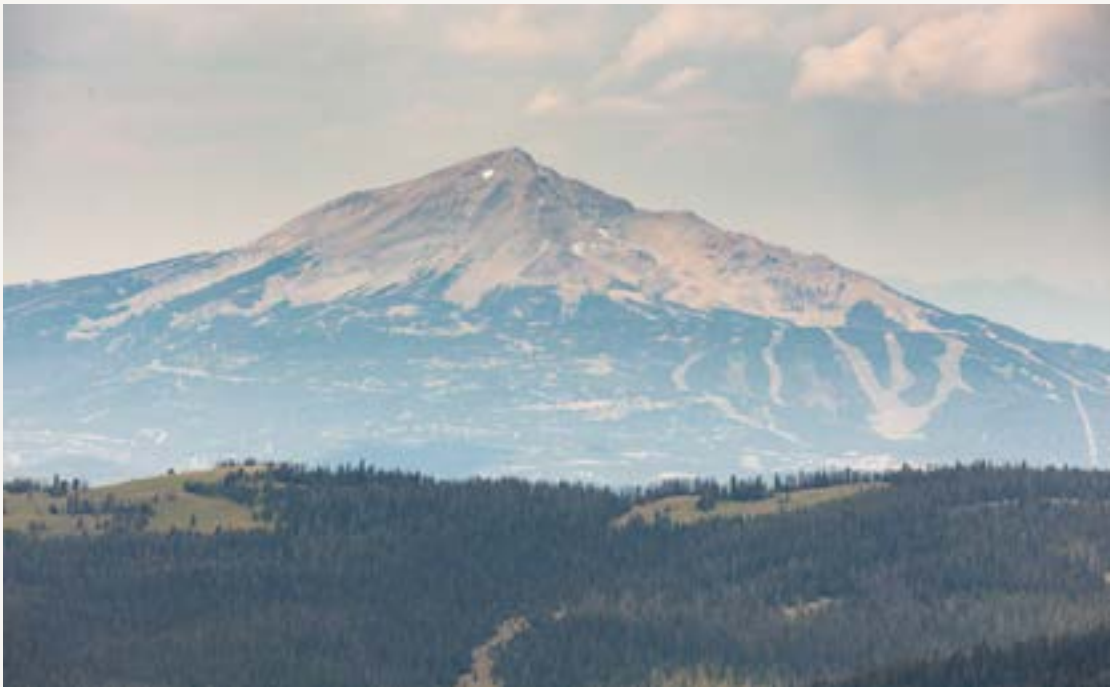
Figure 6 and Table 2 outline how each Targeted Improvement Priority can impact overall community GHG emissions over the 32 year period. Figure 6 is a graphical depiction of modeled results that shows the BAU scenario as the top line and then modeled reductions in emissions for each of the five categories listed on the chart. Table 2, below, presents the numerical values of 2050 total reductions for each Target Improvement Priority and a value for anticipated future developments in the areas of advocacy, new technologies, the use of carbon credits and offsets, and developments in carbon sequestration methods. This data provides the Big Sky community with a path to net zero by 2050.

TABLE 2

Summary of Forecasted GHG Emissions and Modeled Emissions Reduction by Targeted Improvement Priority

| Description | Amount (MTCO ₂ e) | % of BAU |
|---|------------------------------|----------|
| Total BAU Forecast Emissions in 2050 | 278,178 | - |
| 2050 Net Zero Reduction Goals | | |
| Reductions in Electricity Carbon Intensity; Net Zero 2050 | 108,567 | 39% |
| Buildings Electrification and Efficiency Measures | 75,665 | 27% |
| Transportation VMT and Electric Vehicles | 32,502 | 12% |
| Consumption and Waste | 12,388 | 4% |
| Environmental Health and Advocacy, New Technologies, Carbon Credits/Offsets & Sequestration | 49,056 | 18% |
| 2050 Net Zero Goal | 0 | 100% |

Beyond Carbon Emissions: Ecological Resilience



Although titled a “Climate Action” plan, this CAP incorporates strategies to enhance the management and increase the resilience of all earth system processes. Existing within a dynamic system, these processes are interrelated and interdependent. To mitigate the effects of a changing climate, managing the resilience of the whole system is critical.

Resilience is the capacity of a system to recover and return to its original state. Increasing resilience of environmental systems allows for adaptation and continuation of desired outcomes, ensuring stability of the environment. For example, a resilient wetland habitat supports biodiversity of flora and fauna, effectively sequesters carbon from the atmosphere, intercepts contaminated runoff and prevents pollutants from entering waterways, controls erosion, and enables flood abatement. Although restoring a wetland will not directly result in a decrease in calculated GHG emissions, a properly functioning wetland stores carbon and is inherently beneficial to the larger ecosystem.

Conservation, regenerative practices, and proper environmental management within the Greater Yellowstone Ecosystem will ensure that the region is more resilient to climate change, will retain lasting resources, and will support an economically and socially sustainable future.

Recognizing that all environmental processes are interconnected, the environmental and climate change solutions presented in the CAP may reduce carbon emissions, enhance ecological resilience, or simultaneously address both climate change and resilience. The sliding scales shown below, and located throughout the document, help identify where along the spectrums of carbon emissions reduction and ecological resilience enhancement, the area of environmental impact lies.

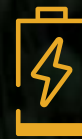
FIGURE 7

Example Priorities and their Relative Emissions Reduction and Resilience Benefits



These sliding scales help identify the impact of the priority along a spectrums of carbon emissions reduction and ecological resilience enhancement.

Energy & Buildings



Resiliency

Low

High

More than half of the Big Sky carbon footprint is the result of heating, cooling, and otherwise operating buildings using electricity provided by NorthWestern Energy, and propane gas provided by multiple, independent suppliers. This includes most residential and commercial emissions and more than half of the industrial emissions.

The average electric demand grew in Big Sky from 2017-2022 by 7.8% annually, nearly eight times the average growth of the Montana electric system (NorthWestern Energy Bozeman Division Update 4/2022). Big Sky is a large consumer of energy in Montana, as compared to other small, rural communities with similar populations. However, due to the nature of its unincorporated status, it has largely been unrepresented at the state legislature. With increasing growth and visitorship, Big Sky needs to meet the growing electricity demands in a sustainable manner.

In the Big Sky community, NorthWestern Energy is the only utility providing electricity to residential, commercial, and industrial customers. The NorthWestern Energy electricity portfolio consists of hydro, wind, solar, natural gas, and coal. The use of coal for Big Sky electricity generation from NorthWestern Energy declined with the closure of Colstrip Units 1 and 2 coal-fired electric generating plants, but units 3 and 4 continue to operate. Increasing the clean energy supply mix accessible to the Big Sky community requires advocacy at the local, state, and federal level, in addition to engagement with privately held stakeholders such as NorthWestern Energy.

1. Clean Electricity Supply

Big Sky aims for net zero electricity by 2050 or sooner. Along with the implementation of the strategies outlined below, there will likely be shifts and advancements in policies, technology, market forces and NorthWestern Energy's 2050 commitments that would allow us to reach this goal more quickly.

Clean electricity production is an overwhelmingly large proportion of the total reduction targets related to Energy & Buildings. Table 3 shows a 7% reduction of carbon emissions for electricity by 2035 due to greening of electricity, while Table 3 demonstrates the further reductions to net zero by 2050. This is the case even when considering the projected growth in Big Sky and the CAP strategies for electrification of buildings and transportation to eliminate emissions resulting from the combustion of propane gas, gasoline, and diesel fuels (electrification increases electricity use as it displaces combustible fuels). The breakdown between the contribution from obtaining clean electricity and successfully implementing other Energy & Buildings CAP strategies is as follows:

Emissions reduced by 2050 due to the greening of the power used = 108,567 MTCO₂e

Emissions reduced by other Energy and Buildings CAP strategies = 19,083 MTCO₂e

Carbon Emissions

Low

High

2. Electrify Buildings; Reduce Propane Gas Use

The elimination of liquid propane as a combustible source of heating, hot water, and cooking is a major source of CO₂ emissions from buildings. The process of electrifying existing and new buildings is an important CAP strategy.

For existing buildings, this is a long-term effort to promote the replacement of gas fired ranges, water heaters, and heating/cooling systems, as they reach the end of their useful life, with advanced technology electric options. When an old gas fired appliance or furnace is replaced with a new gas fired unit, carbon emissions are guaranteed to continue for 15 years or more.

For new buildings, energy models and the Green Build Toolkit, envisioned in these CAP strategies, will promote electric options that will be both economical and environmentally beneficial, with a collective shift toward cleaner electricity by 2035, and continued through to 2050. CAP strategies to promote energy efficiency programs and energy audits will also facilitate this process.

Table 3 shows that a significant reduction (36%) in carbon emissions from BAU is projected through the reduced use of propane gas by 2035. When accomplished, electrification and energy efficiency efforts will systematically reduce the combustion of approximately 4,000,000 gallons of liquid propane per year in homes and businesses by 2035. Under these same circumstances, a reduction of 9,000,000 gallons is projected by 2050, a 68% reduction, as seen in Table 4.

TABLE 3

Energy & Buildings 2035 MTCO₂e Reductions from BAU Scenario (2018-2035)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|-----------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| Sectors | 2018 | 2035 | Growth % | 2035 | 2035 | % Reduction |
| Electricity Use | 55,315 | 108,016 | 4.0% | 100,813 | 7,203 | 7% |
| LPG Use | 36,523 | 68,201 | 3.7% | 43,535 | 24,666 | 36% |

TABLE 4

Energy & Buildings 2050 MTCO₂e Reductions from BAU Scenario (2018-2050)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|-----------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| Sectors | 2018 | 2050 | Growth % | 2050 | 2050 | % Reduction |
| Electricity Use | 55,315 | 127,650 | 2.6% | 0 | 127,650 | 100% |
| LPG Use | 36,523 | 80,598 | 2.5% | 25,716 | 54,882 | 68% |

Climate Resilience

While the Targeted Improvement Priority of Energy & Buildings is primarily focused on emissions reduction, buildings also play a critical role in increasing community resilience to climate change impacts. Buildings provide shelter from increased climate change exposures such as high heat, intense storms, wildfires, and wildfire smoke. Electrified buildings have much improved indoor air quality (burning methane gas and propane are increasingly understood to have significant health impacts), and when gas fired heating systems are replaced with modern heat pump technology, air conditioning comes along with it. Finally, microgrids and distributed energy resources, such as solar, enhance the resilience of power systems during major events.

Co-benefits of reducing the use of fossil fuels and GHG emissions in this sector include rapid and widespread improvements to environmental health, ecosystem services, and increased resilience and independence from foreign energy sources.

Partners

Absaroka Energy, Big Sky Build, Big Sky Resort, Energy 1, Harvest Solar, Lone Mountain Land Company, NorthWestern Energy, Onsite Energy, Yellowstone Club

Strategies

The following targets and strategies focus on (1) green energy supply, (2) electrifying buildings and reducing propane gas use, (3) energy efficiency participation, and a (4) green build toolkit platform.





Energy Targets & Strategies

Green Electricity Supply

Reduce Carbon Emissions from Electricity Supply by 7% by 2035 and 100% by 2050 compared to the BAU Forecast.

Strategies

- Increase the clean energy supply by:
 - Promoting roof top solar and larger scale solar installations in Big Sky.
 - Advocating for green *net metering regulations* in Montana.
 - Researching and applying for grants that assist Big Sky in implementing energy projects.
 - Researching large scale solar installation opportunities and other localized clean energy resources for potential future implementation.
 - Assessing, tracking, and encouraging Big Sky to take advantage of provisions within the 2022 Federal Inflation Reduction Act.
- Collaborate with regional municipalities, local governments, and large consumers to support a regional clean energy transition, and strengthen relationships with neighboring communities of Helena, Bozeman, and Missoula as advocates for clean energy.
- Explore the use of new technologies and opportunities for application of alternative energy sources such as geothermal, hydrogen, plasma gasification, and biomass.
- Track and coordinate community letters of support for relevant local, state, and federal policies through legislative and regulatory engagement.
- Work with NorthWestern Energy on the following:
 - Participate in the design of a new green electric power generation product, monitor the development of a green tariff, and identify opportunities for Big Sky to participate as a recipient of the resulting new green electricity generated.
 - Encourage, support, and promote *NorthWestern's* commitment to net zero emissions by 2050.
 - Support the current installation of Smart Meter infrastructure, and educate homeowners and businesses on how to best utilize the new infrastructure.
 - Advocate for reductions in electric generation from Colstrip coal generation plants Units 3 and 4 in favor of new clean generation and peak demand generation alternatives.
 - Implement a coordinated process to identify and eliminate distribution grid reliability issues as electrification efforts succeed.
- Support distributed energy storage such as modular pump storage to address the intermittency of renewable energy sources such as solar and wind.

Electrify Buildings; Reduce Propane Gas Use

Reduce reliance on propane gas 36% from the Business-As-Usual (BAU) forecast by 2035 and by 68% from the BAU forecast by 2050.

Strategies

- Develop promotional and educational materials that present the environmental advantages of clean electricity use vs. liquid propane use.
- Publicize educational materials for electric powered options for home utility, cooking, water heating and home heating and air conditioning that includes environmental and economic considerations.
- Identify grants and financing options for the conversion of liquid propane equipment to electric equipment for difficult cases in existing buildings.
- Target local plumbing and heating, appliance sales and electrical/mechanical businesses as partners and advocates for converting liquid propane use to electricity use.
- Target architects, developers and HOA's as first contact promoters of new all electric buildings.
- Work with local and regional experts to research, understand and educate on the development of new technologies for heating and air conditioning commercial and large buildings using electricity.

Building Targets & Strategies

Energy Efficiency Participation

Increase participation in energy efficiency and energy audit programs by 10% annually.

Strategies

- Identify and publicize energy efficiency incentive programs (rebates, tax incentives, loans, etc.) offered by utilities, local and state governments and state agencies that make energy efficiency a more affordable option.
- Identify barriers to participation in energy efficiency programs and implement solutions as a rapid and cost-effective way to reduce GHGs and save money.
- Promote do-it-yourself and professional energy audits for residential and commercial buildings.
- Support a supplemental energy audit program for residential and commercial buildings that currently do not qualify for free energy audits.
- Identify and publicize qualified professional energy audit specialists serving the Big Sky community.
- Identify energy modeling services for proposed new buildings as a tool for architects and developers during the planning and design phases of new projects.
- Identify and promote actions that encourage full- and part-time residents, vacation rental properties, and hotels to reduce energy consumption.
- Promote energy benchmarking and reporting to enhance energy and resource efficiency in new and existing commercial buildings.
- Utilize the *HRDC Home Weatherization Program* to assess home energy usage and retrofit for those who qualify.

Green Build Toolkit Platform

Create a centralized platform for a Green Build Toolkit to reduce energy and water use in all buildings.

Strategies

- Work with local architects, engineers, contractors and HOA's to identify best green design and construction practices for the Big Sky community and create a "Green Build Toolkit" for use by these constituents. Sources for this tool to include:
 - Model codes for commercial buildings from the International Green Construction Code (IgCC 2012) and the ASHRAE 189.1 standard model code for high performance green commercial buildings.
 - A national rating and certification standard for green residential buildings (ICC700).
 - Rating and Certification systems for both commercial and residential buildings contained in the Leadership in Energy & Environment Design (LEED), as well as the Living Building Challenge certification system process.
 - The IECC – International Energy Conservation Code 2021 *as amended by the state of Montana*.
 - Incorporate *International Dark Sky Association Standards* into the Toolkit.
- As a part of or as a supplement to the Green Build Toolkit, implement:
 - A green build materials database that identifies materials with lower embodied energy, lower water consumption, lower carbon footprint, renewable, and locally sourced options.
 - Upgradable smart home technology in homes and businesses to optimize efficiency through real time monitoring and remote operation.
 - Electric vehicle (EV) ready and solar ready homes.
 - A simplified summary and check-list information taken from the full Green Build Toolkit to assure frequent use.
- Develop and implement tactics to help contractors and subcontractors spend less time onsite and less time commuting by establishing localized concrete batch plants, prefabrication, modular, and panelized construction methods.
- Publicize the Green Build Toolkit in a centralized location.
- Establish a Big Sky SNO "Green Leaf" tiered standard, awarded based on implementation of building practices established through the Green Build Toolkit.

Transportation



Resiliency

Low

High

In 2018, GHG emissions from on-road transportation within the Big Sky boundary were calculated to be 47,432 MTCO₂e, accounting for 32.7% of Big Sky's total carbon emissions. These emissions were the product of over 84,000,000 vehicle miles traveled (VMT) in 2018 alone. Between 2018 and 2019, VMT increased a dramatic 4.9% to over 88,000,000 miles and transportation emissions increased 3.5% (see Table 5).

The CAP forecast in a business-as-usual (BAU) scenario estimates that VMT in 2035 will increase to 152,786,000 miles which is a compound annual growth rate of 3.6% (see Table 6).

Table 6 shows that 36,412,805 miles and 15,064 MTCO₂e of emissions (24%) can be reduced from the BAU forecast through the implementation of CAP strategies by 2035. The forecast projects VMT will peak in the years 2029-2035, then begin to drop as a result of successfully executed CAP initiatives and a more gradual progression of build-out in Big Sky. Following this trajectory, VMT is projected to be 57,683,373 miles by 2050, lower than the 2018 traffic volumes.

To support these projections, the following additional information is considered:

- A 2017 traffic study, commissioned by the Big Sky Chamber of Commerce and conducted by Sanderson/Stewart in support of the Tiger Grant, reported that Big Sky traffic volume measurements, taken on Highway 64 near ACE Hardware Store, increased by 4.7% per year from 1992 through 2016. It was also reported that over the period of 2011 through 2016, the increase was 9.2% at this same location. The 2017 Sanderson/Stewart study used a 4.34% annual growth rate in its twenty-year projections (2017 through 2036).

- The CAP forecasted growth rate of 3.6% is based on calculated growth statistics for residential and commercial buildings in Big Sky, combined with forecasts of visitor statistics. While this growth rate is less than the Sanderson/Stewart assumption, it is believed to be an accurate update of those findings based on new information and actual data collected for 2018 and 2019. This data has been published in the GHG Inventory Report.

This CAP addresses the pressing realization that Big Sky is a young and growing community and that most of the miles traveled within the defined boundary are the result of construction and visitor activity that support the economy. Therefore, the CAP strategies are centered on:

- Promotion, incentives, and education regarding the use of ride sharing, public transportation, and reductions in single occupant vehicles;
- Recognition that government mandated Corporate Average Fuel Economy (CAFE) standards will continue to increase vehicle mileage and reduce emissions over time; and
- Preparation for the evolution of electric vehicles (EVs), realizing that Montana will lag in EV adoption in the years prior to 2035, but will grow exponentially by 2050.

The CAP challenges the BAU scenario by identifying strategies and actions that, as implemented, will reduce VMT emissions through 2035 at a lower rate, with a more significant reduction emerging between the years 2036-2050. As VMT decreases due to changes in transportation habits and local economic conditions, emissions will also be reduced. CAFE standards resulted in annual improvements in automobile and light truck efficiencies, and are incorporated into the BAU scenario.

Carbon Emissions



Climate Resilience

The Transportation Targeted Improvement Priority focuses primarily on reducing GHG emissions by reducing VMT, increasing gasoline and diesel vehicle efficiency, and moving to electric vehicles expediently. However, these strategies also work to improve public health and climate resilience, as they help catalyze reductions in ozone, particulate matter, and poor air quality days.

Data from Tables 5 and 6 show that the BAU forecast of VMT within the community boundary will increase by 88% from 2018 to 2050 if the existing transportation system is not improved. The BAU forecast of VMT in 2050 is not logistically sustainable. This is particularly problematic to Big Sky, as the community and the local economy relies heavily on transportation to move goods, services, and visitors in and around the region. Due to Big Sky's remote location, the community is highly susceptible to climate-induced natural hazards such as wildland fires and earthquakes, which have the potential to adversely impact the efficiency of transportation in and around the community, and neighboring destinations. The strategies listed in this Transportation Targeted Improvement Priority are critical to Big Sky climate resilience.

Partners

Big Sky Resort, Big Sky Transportation District, GoGallatin, Moonlight Basin, Spanish Peaks Mountain Club, Western Transportation Institute, Yellowstone Club.

Strategies

The following targets and strategies focus on: (1) changing land use and urban design; (2) moving to electric vehicles; (3) rethinking travel patterns, reason for travel, and higher occupancy versus singular occupancy travel; (4) incentivization of travel; and (5) transportation equity and equality.

TABLE 5
2018 & 2019 Actual VMT and Emissions

| Descriptions | 2018 | 2019 | % Increase |
|---|------------|------------|------------|
| Vehicle Miles Traveled (VMT/Year In-Boundary) | 84,191,996 | 88,280,726 | 4.9% |
| Total Transportation Emission (Metric Tons) | 47,432 | 49,069 | 3.5% |

TABLE 6
2035 & 2050 Forecast VMT and Emissions

| | 2035 | | 2050 | |
|------------------------|-------------------|-------------------|--------------------|-------------------|
| Scenario | VMT | CO ₂ e | VMT | CO ₂ e |
| Business-As-Usual -BAU | 152,786,146 | 63,210 | 158,989,876 | 51,008 |
| CAP Implementation | 116,373,341 | 48,146 | 57,683,373 | 18,506 |
| Reductions | 36,412,805 | 15,064 | 101,306,503 | 32,502 |
| % Change | 24% | 24% | 64% | 64% |

Transportation Targets & Strategies

Reduce Vehicle Miles Traveled (VMT)

Reduce VMT by 24% from the BAU forecast by 2035 and by 64% from the BAU forecast by 2050.

Strategies

- Collaborate with employers to subsidize transit and mobility options for employees.
 - Encourage ride sharing through incentivization and the use of existing commuter incentive programs.
 - Expand the use of airport shuttle services to include large neighborhoods and private clubs.
 - Educate residents and visitors about the cost of a commute and support an independent economic analysis.
 - Encourage use of for-profit ride sharing options like Uber, Lyft, and Zipcars.
 - Improve public transit by increasing bus service frequency and creating a real-time bus schedule app.
 - Support regional road pricing research.
 - Increase the cost of driving in certain places by using parking policies and prices to disincentivize single occupancy vehicle (SOV) travel.
-

Promote Electric Vehicle Infrastructure

Facilitate the transition to electric vehicle use by 2050.

Strategies

- Promote the use of electric vehicles by supporting local public electric vehicle charging infrastructure and leverage federal and regional charging network infrastructure development.
- Support the conversion to electric public transit by investing in hybrid electric buses and/or battery electric buses.
- Educate community members & large fleet owners about electric vehicle (EV) adoption.
- Convert private fleets to electric vehicles.
- Promote new home “electric vehicle (EV) ready” standards.

Personal Travel Educational Programming

Increase employment of personal non-motorized transportation.

Strategies

- Implement educational campaigns to support:
 - Urban design improvements, and incentives that encourage biking, walking, and other modes of self-propelled transportation.
 - Promotion of shared vehicles, carpooling with private vehicles, and for-profit ride sharing tools.
 - Publication and promotion of commuting costs.
 - Health impacts of non-motorized transportation.
- Create a more balanced use of land for recreation, commercial space, and neighborhood centers.
- Develop and incorporate “complete street” design to add bike lanes, sidewalks, and other trail networks between the residential and commercial centers of Big Sky: Big Sky Resort, Town Center, Meadow Village Center, the Gallatin Canyon, etc.
- Identify Big Sky Area’s walkability score.
- Increase the walkability score for the overall community.

Consumption & Waste

Resiliency

Low

High

Solid waste GHG emissions under this Targeted Improvement Priority come from waste generated within Big Sky, then transported to, and processed at the Logan Landfill, located 65 miles from the community. Organic components within the waste stream generate methane, a GHG, as they decompose. Methane is **28 times more powerful than carbon dioxide**. Additionally, heavy duty vehicles hauling waste to the landfill and processing it on site combust liquid fuels which release GHG emissions.

These GHG emissions, as a total of all Big Sky emissions, are small: 3.4% in 2018 and 3.2% in 2019. Solid waste emissions did not change significantly over this two-year period, increasing only 0.7%. While GHG emissions under this Targeted Improvement Priority are relatively small, waste is a highly visible component of local climate action and efficient waste management is important to most Big Sky residents and visitors. While this inventory accounts for the emissions as a direct result of the decomposition of that waste, there are far higher “upstream” emissions from the production and transportation of the goods that are landfilled. Food waste in particular has a high upstream emissions factor and **food waste diversion is an important environmental and equity strategy**.

As Big Sky’s waste is landfilled outside of the defined study boundaries, solid waste is considered a Greenhouse Gas Protocol Scope 3 emission and is included as such. These emissions are the result of collecting, transporting, and mostly landfilling 3,796 tons of waste in 2018 and 3,824 tons of waste in 2019. As the community grows, it is important to reduce both total community and per capita waste volumes. Similarly, increased diversion rates of construction and demolition waste are necessary to limit waste emissions. The emissions generated when purchased items are produced, packaged and shipped add to the emissions impact of waste management.

This Targeted Improvement Priority focuses on decreasing the amount of waste being sent to landfills through reducing (purchasing and consumer use), reusing (what is available), increasing composting availability and participation, and implementing more effective recycling opportunities.

Reduction in waste is far more environmentally friendly, efficient, and cost-effective than relying heavily on recycling, composting, and second-hand markets and services. Being mindful to reduce consumption and wastefulness should always be the first priority. Reusable goods that can be utilized multiple times without degradation is the second-best option. Small behavior changes such as remembering a reusable bag while shopping, or bringing a reusable mug when purchasing coffee can tremendously decrease the use of single-use disposable items and containers.

Composting is a process during which organic materials such as yard waste, food scraps, and a growing number of otherwise disposable products are decomposed to produce a nutrient-rich soil that helps restore overall soil health. When composting is available, and disposable containers are needed, compostable containers, made from corn and soy, are better alternatives to petroleum-based plastic products, as they are collected and processed with food scraps at industrial composting facilities. Not only does composting transform high-methane-emitting waste into soil, it can be processed locally and distributed to farms and gardens.

Recycling is the process of converting waste into reusable material. Recent shifts in the global recycling market and inefficient economies of scale, limit what can be collected and effectively recycled locally. Most of the recycled materials in Montana are sorted locally, but shipped long distances for processing. Some recycled

Carbon Emissions

Low

High

products such as aluminum, cardboard, and paper are easier to bale and convert to reusable material, making them more ideal to recycle than plastics and glass. Recycling effectively requires clear education and signage to limit contamination.

Climate Resilience

As the climate gradually changes, as predicted by the Greater Yellowstone Climate Assessment (GYCA), the seasonal characteristics of Big Sky are also expected to change. These changes include a shorter ski season, a longer summer season, a more year-round outdoor experience, more full-time versus part-time residents and continued growth in visitors and construction. Climate Resilience for the Priority of Consumption & Waste will require creative new ideas and implemented programs to avoid BAU forecasts that suggest roughly 12,700 tons

of solid waste will be collected and hauled to the landfill in 2050. For comparison, 3,824 tons of solid waste was collected and landfilled in 2019.

Partners

406 Recycling, Big Sky Community Food Bank, Big Sky Resort, Four Corners Recycling, Gallatin County Solid Waste, L&L Site Services, Montana Science Center, Republic Services, WeRecycle MT, Yellowstone Club, YES Compost.

Strategies

The following targets and strategies are established to reduce the environmental impact of collecting and landfilling solid waste by prioritizing materials reduction, with the ultimate goal of decreasing waste to manage.

TABLE 7

Consumption & Waste 2035 MTCO₂e Reductions from BAU Scenario (2018-2035)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|-------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| | 2018 | 2035 | Growth % | 2035 | 2035 | % Reduction |
| Solid Waste | 4,916 | 9,485 | 3.9% | 6,616 | 2,869 | 30% |

TABLE 8

Consumption & Waste 2050 MTCO₂e Reductions from BAU Scenario (2018-2050)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|----------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| | 2018 | 2050 | Growth % | 2050 | 2050 | % Reduction |
| Transportation | 4,916 | 16,425 | 4,037 | 6,616 | 12,388 | 75% |

Consumption & Waste Targets & Strategies

Enhance Food Recovery Systems

Expand the Big Sky food recovery system to include all food service & lodging industries.

Strategies

- Leverage community resources to increase knowledge, understanding, and use of food recovery systems and regenerative agriculture practices.
- Establish a community-wide program to monitor and report on food rescue and waste with composting hauler(s) and Big Sky Community Food Bank.
- Increase food storage space and number of access points to Big Sky Community Food Bank.
- Increase practice of portioning food as single or family-sized servings prior to donation.
- Incentivize food donation, recovery, and repurposing via competitions and other engaging programs.

Increase Composting and Recycling

Increase participation in composting and recycling programs by 5% annually.

Strategies

- Increase compostable item collection and recycling by creating more public drop-off stations.
- Incentivize residential options for composting and recycling via Homeowners' Associations (HOAs).
- Use bear-proof compost and garbage receptacles.
- Increase recycling rate through ongoing community engagement and events.
- Prioritize reusables over single-use items.
- Educate the community on the benefits of reusables over single-use items.
- Create best practices through uniform signage and more accessible drop-off receptacles to build familiarity and proper use.
- Implement best practices for waste disposal signage.
- Source uniform single-use items within the community and update clear signage to ensure consistent disposal.

Improved Waste Diversion Rates

Increase the overall waste diversion rate.

Strategies

- Complete a waste composition study by the end of 2025.
- Calculate the current waste diversion rate.
- Create a Solid Waste Strategic Plan and set a waste reduction goal.
- Establish waste prevention and recovery advocates in both the public and private sector.
- Identify and disseminate information on priority and hazardous waste items to ensure proper disposal.
- Donate and sell used items through second-hand markets and durable exchange programs.
- Use Waste Composition Assessment results to increase participation through educational outreach: refuse, reduce, reuse, repurpose, and recycle efforts.
- Create a zero-waste effort event toolkit that includes vendor agreements, mapping and marketing plans.
- Host zero-waste events by utilizing the zero-waste event toolkit.
- Increase use of reusable and durable items in order to reduce dependence on single use items.
- Improve landfill diversion rate through increased recycling and composting efforts.
- Update targets based on study results to align with the Solid Waste Strategic Plan.
- Improve waste hauling practices to reduce GHG emissions by maximizing transportation efficiency and advocating for electric hauling vehicles where appropriate.
- Maximize diversion of construction and demolition waste with the Green Building Toolkit and informal networks.
- Establish a Big Sky centralized processing and convenience site.
- Encourage more businesses and homeowners to use trash compactors to reduce waste-related transportation emissions.

Natural Environment

Resiliency

Low

High

This Targeted Improvement Priority leverages existing community efforts and resources to address GHG emissions through the natural environment. Up to 18% of Big Sky's GHG emissions are from sources that are difficult to quantify and reduce (refer to Table 1). Local conservation efforts, parks and open spaces, changes in land use and forestry, and regional regenerative agriculture practices present opportunities for carbon capture and storage. Additionally, there is an opportunity to look at the feasibility, timing, and role that carbon offsets might play in achieving net zero emissions by 2050.

Climate Resilience

The primary focus of this Targeted Improvement Priority focuses on strengthening ecological systems and processes to help Big Sky address climate change risks and impacts more effectively. The natural environment in Big Sky is being altered incrementally on a large scale. A pattern of landscape fragmentation occurred in the

area over the past fifty years, impacting both human and environmental health. Growth, climatic variability, drought, and cumulative impacts from land use and recreation challenge the future ability to preserve high quality river, riparian and wetland systems.

Public and private open spaces are home to diverse ecological resources including wetlands, sagebrush, grasslands, riparian areas, rivers and native species' habitat. These areas sequester and store carbon and support a wide variety of ecological services including fire prevention, pollinator diversity, clean drinking water, clean air, and habitat for big game and other native animal species. Robust planning and management, conservation, and successful restoration efforts are critical to building resiliency and increasing carbon sequestration.

Community growth and climate change will continue to present challenges for the availability and resiliency of Big Sky's water supply. Decreased snowfall, earlier mountain snowmelt, increased evaporative demand and extended



Carbon Emissions

Low

High

periods of warmer and drier conditions during the summer months are projected to result in further declines in groundwater supplies and low flows in the Gallatin River and surrounding tributaries. Climate change impacts also carry implications for future water quality. Higher temperatures and lower stream flow will likely contribute to ongoing consistent algal blooms throughout the watershed, creating challenges for fish and aquatic habitat along the Gallatin.

Water conservation, building resilient water supplies, and stormwater management are all important initiatives to pursue in the context of a changing climate. Improving water conservation and efficiency measures can reduce overall water demand. Water resiliency can be achieved by diversifying Big Sky's water sources, storage and conveyance options. Developing holistic wastewater and stormwater management and utilizing best available technologies and practices can help Big Sky meet long-term community water supply needs while protecting and improving the ecological health of the river systems.

Partners

Broken Ground Permaculture, Big Sky Landscaping, Big Sky Resort, Gallatin Invasive Species Alliance, Gallatin River Task Force, Montana Freshwater Partners, Trout Unlimited, Western Sustainability Exchange, WGM Group.

Strategies

The following targets and strategies are established to enrich the natural environment: (1) carbon offsets and sequestration education, (2) water use reductions, (3) natural environment restoration.



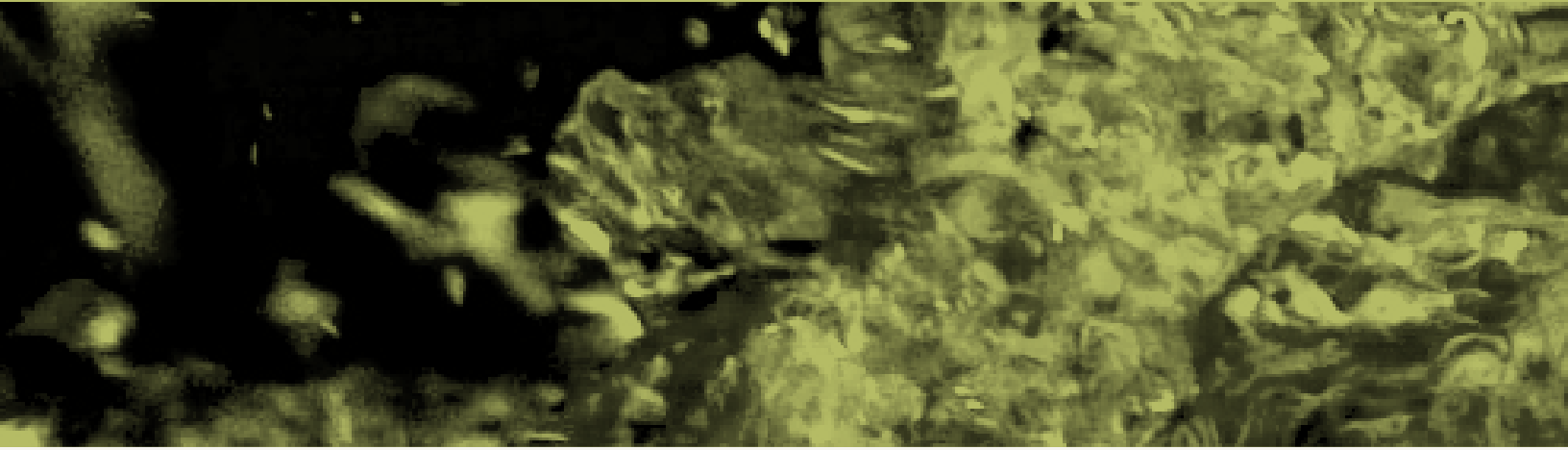
Natural Environment Targets & Strategies

Carbon Offsets and Sequestration Education

Increase knowledge, understanding, and use of regenerative ranching and farming practices and carbon credits and offsets to reduce carbon locally

Strategies

- Partner with regional regenerative ranching and farming practitioners to grow and diversify carbon credit opportunities.
- Research emerging carbon sequestration techniques and regional carbon offset programs.
- Conduct a cost analysis and budget for investing in and purchasing carbon offsets to meet near-term climate goals.
- Inform, educate, and empower individuals and organizations regarding sequestration and carbon offsets to meet GHG emissions goals.
- Calculate sequestration benefits associated with forestry, agriculture, wetland banking, and open and green spaces and how they impact and factor into the overall carbon budget.
- Develop recommendations for how to manage land and resources to maximize carbon capture and storage.



Water Use Reductions

Increase the resilience of water resources to thrive through climate stressors, such as drought, water shortages, and flooding

Strategies

- Conduct a robust water audit and water budget analysis.
- Explore the potential to restore natural water storage, particularly on neighboring ski areas.
- Expand opportunities for the carbon offset component of treatment wetlands, which have strong nutrient reduction abilities, that can be installed broadly across the landscape to tackle nutrient issues at the source.
- Utilize resources, data and information from community leaders in water conservation and use to educate the community on current water conditions and forecast implications.
- Educate the community on water conservation technologies, indoor and outdoor conservation programs, and direct and indirect potable reuse.
- Promote and support the Big Sky Water Conservation Program with homeowners and businesses.
- Establish a water reduction goal for the Big Sky area by 2025.
- Incorporate recommendations from Gallatin River Task Force's Water Conservation and Drought Management Plan in new developments.
- Identify and utilize recycled water to recharge the aquifer, such as purple pipe and rainwater harvesting.
- Explore efforts to reduce freshwater use for commercial irrigation.

Natural Environment Targets & Strategies

Natural Environment Restoration

Increase land conservation, forest management, and restoration efforts to protect riparian areas, native vegetation communities, and species habitat

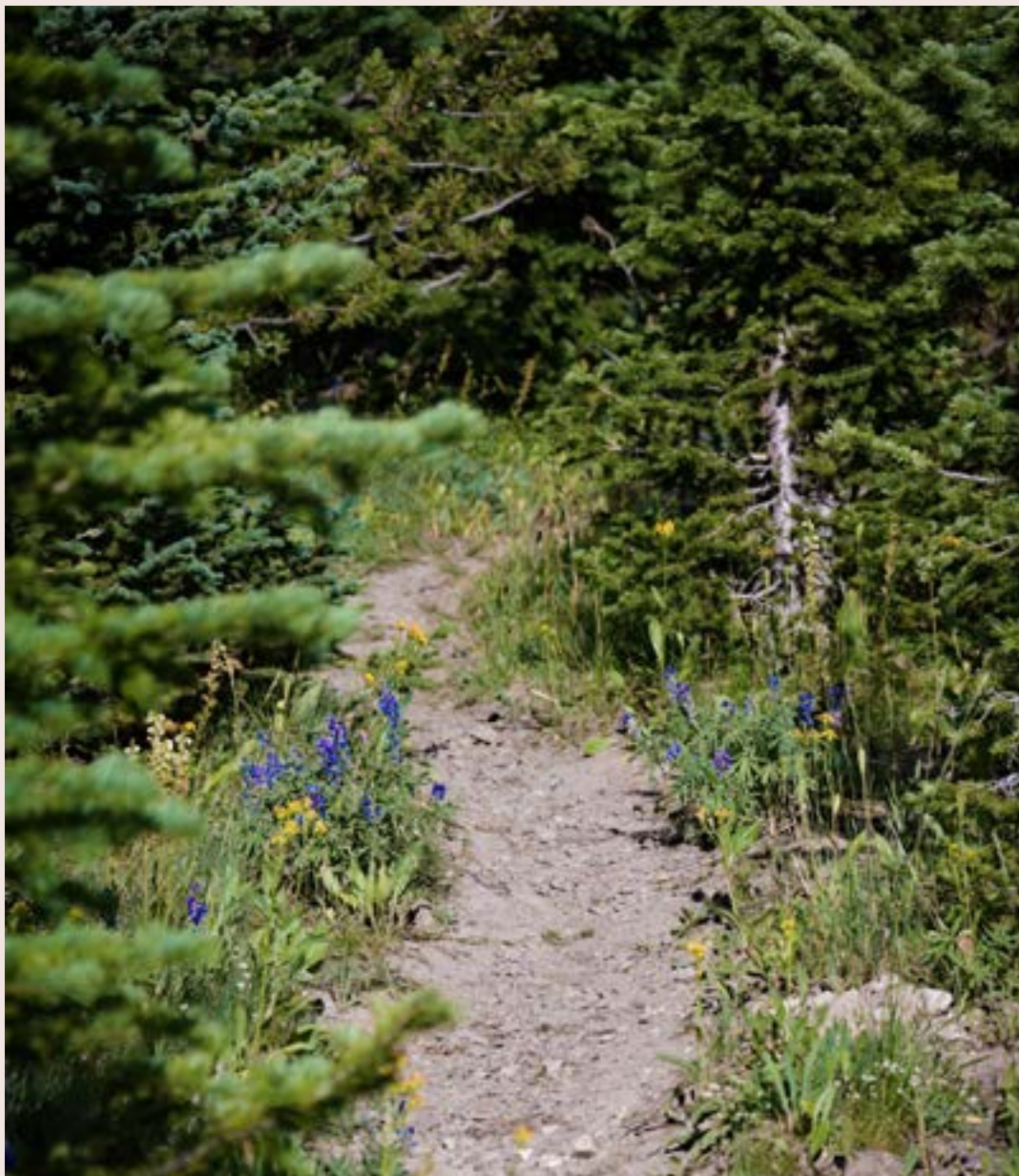
Strategies

- Adopt collaborative programs to revegetate landscapes, restore habitat, and improve hydrologic function.
- Include low impact development techniques in the Green Build Toolkit.
- Protect land permanently through conservation easements.
- Adopt “no sod” policies within local HOAs.
- Integrate forest management best practices and restoration efforts to maintain forest health and biodiversity.
- Develop a community wildfire adapted strategy through collaboration with Fire Adapted Big Sky, led by the Big Sky Fire Department to:
 - Support entities that mitigate wildfire risk.
 - Develop consistent and accessible pre-emergent wildfire education.
 - Enhance community safety response.
 - Create a holistic approach to becoming a wildfire adapted community.
- Communicate “Plan, Prevent, Prepare” wildfire messaging to community members and visitors.
- Participate in local forest and river restoration projects.
- Implement low-impact development techniques that enrich soils, enhance biodiversity, and restore watershed health.
- Develop and sustain an invasive species mitigation plan for every property.
- Research and identify viable opportunities for wetland banking.
- Avoid development within and adjacent to wetland ecosystems.



The Trail Ahead

Emissions Reduction via Implementation



The development and publication of this CAP is a launch point for implementation.

The partners who developed this CAP intend to begin projects in late 2022 and achieve significant progress by the end of 2035. The medium and long-term strategies in this CAP set the groundwork for the targets that will be necessary to achieve Big Sky's GHG emissions reduction goals. The following tables displaying 2035 and 2050 BAU trajectories provide motivation for immediate, intentional, and energized action.

Table 10 contains MTCO₂e data for the period of 2018-2035 for each sector (column 1), 2018 actual emissions calculated in the Community GHG Inventory (2), projected emissions in 2035 under a BAU scenario (3), the compound annual growth rate that relates to the 2018-2035 BAU projections (4), what the emissions are projected to be in 2035 if all of the CAP targets for 2035 are accomplished (5), the reduction in emissions from the BAU scenario if all of the CAP targets for 2035 are accomplished (6), and the percent change that the reduction represents (7). The 2035 data is presented as a means of setting and tracking medium term targets and emission reductions goals.

TABLE 10

Total 2035 MTCO₂e Reductions from BAU Scenario (2018-2035)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | % Reduction |
|---|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| Sectors | 2018 | 2035 | Growth % | 2035 | 2035 | |
| Electricity Use | 55,315 | 108,016 | 4.0% | 100,813 | 7,203 | 7% |
| LPG Use | 36,523 | 68,201 | 3.7% | 43,535 | 24,666 | 36% |
| Transportation | 47,432 | 63,210 | 1.7% | 48,146 | 15,054 | 24% |
| Solid Waste | 4,916 | 9,485 | 3.9% | 6,616 | 2,869 | 30% |
| Fugitive Emissions | 997 | 1,767 | 3.4% | 1,128 | 639 | 36% |
| Sub Total | 145,183 | 250,679 | 3.3% | 200,238 | 50,441 | 20% |
| New Technology, Sequestration, Advocacy & Carbon Offsets/ Credits | - | - | - | - | 9,800 | 4% |
| Total | 145,183 | 250,679 | - | 200,238 | 60,241 | 24% |

This same approach generated Table 11 to forecast 2018-2050 results. The 2050 data is presented to target and track longer term goals including the path to net zero by 2050.

These modeled findings confirm that implementing the strategies identified in each Targeted Improvement Priority and achieving targeted results is a path to net zero emissions by 2050. In the medium-term, this plan sets a target of 24% reduction in the BAU GHG emissions by 2035. While this is an improvement over the BAU model, emissions will still be 38% above the

2018 level. This 2035 forecast provides motivation to press on for net zero long-term results and mobilize around the key sectors identified herein: 1) the greening of the electricity used, 2) reducing the amount of liquid propane used in favor of clean electricity, 3) reducing transportation VMT and facilitating the transition to electric vehicles, 4) supporting a transition to reduced consumption and waste, and 5) promoting the implementation of new technologies, local Montana carbon sequestration opportunities and the use of carbon credits and offsets as needed to reach the emissions goals.

TABLE 11
Total 2050 MTCO₂e Reductions from BAU Scenario (2018-2050)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | % Reduction |
|---|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| Sectors | 2018 | 2050 | Growth % | 2050 | 2050 | |
| Electricity Use | 55,315 | 127,650 | 2.6% | 0 | 127,650 | 100% |
| LPG Use | 36,523 | 80,598 | 2.5% | 25,716 | 54,882 | 68% |
| Transportation | 47,432 | 51,008 | 0.2% | 18,506 | 32,502 | 64% |
| Solid Waste | 4,916 | 16,425 | 3.8% | 4,037 | 12,388 | 75% |
| Fugitive Emissions | 997 | 2,497 | 2.9% | 797 | 1,700 | 68% |
| Sub Total | 145,183 | 278,178 | 2.1% | 49,056 | 229,122 | 82% |
| New Technology, Sequestration, Advocacy & Carbon Offsets/ Credits | - | - | - | - | 49,056 | 18% |
| Total | 145,183 | 278,178 | - | 49,056 | 278,178 | 100% |



Collaboration and Expectations

CAP development cultivated a spirit of shared ownership around achieving community-wide sustainability goals. This was accomplished through the collaboration of diverse partners, representing all GHG emission sectors and Targeted Improvement Priorities. This is a comprehensive Big Sky community plan – no single non-profit organization, private entity, or district is solely responsible for the full execution of the CAP. Rather, implementation will be a collective and collaborative effort in which community members will elevate and support one another.

The Big Sky Community Climate Action Plan is one of many current planning efforts that positively influence GHG emissions in Big Sky and the surrounding area. Accordingly, an underlying priority for SNO is coordination with related efforts and plans. Other key implementation principles involve building on experience, evolving to match best practices, prioritizing actions, and performing routine evaluation and redesign. Cross-strategies and overlapping priority actions will enhance a comprehensive systems-approach. Collaborating with stakeholders, leveraging local expertise, building strong partnerships, employing capable staff, and actively engaging the community will ensure successful CAP implementation.

Big Sky SNO and contributing implementation partners developed this CAP with the understanding that social, economic, and political paradigms shift and cannot be easily predicted. Modifications in legislation, technology, social norms or the occurrence of natural disasters cannot be wholly accounted for in a singular document drafted on a unique date. Therefore, the targets set should be monitored and adjusted accordingly.

Now is the time for Big Sky to become a leader in climate action and commit to reducing GHG emissions, addressing environmental fragility, and increasing adaptability to the changing climate. Taking immediate action to implement the CAP grants the community of Big Sky, supporting non-profit organizations, and private entities a more credible voice for local, state, and federal policy changes. Sustainability is a community value in Big Sky that needs to be prioritized. It is imperative to look beyond the immediate local conditions to create a viable community for future generations. Residents and visitors alike have an opportunity to contribute toward a more sustainable and vibrant home in the American West.

Next Steps

Following CAP publication, each working group will reconvene to prioritize strategies in their respective Targeted Improvement Priority. If you are interested in joining one of the Target Improvement Priority working groups, reach out to bigskysno@gmail.com.

Take responsibility and take action for your individual or business climate impact by implementing changes highlighted in the “Community In Action” sections.

If you are interested in learning more about what SNO is working on in the Big Sky community, and the progress of Climate Action Plan implementation, become a SNO Steward by visiting www.bigskysno.org.



Now is the time for Big Sky to become a leader in climate action and commit to reducing Greenhouse Gas emissions, addressing environmental fragility, and increasing adaptability to the changing climate.



CAP Key Participants

Thank you to all of the partners who joined the CAP process. If you would like to join SNO's efforts, reach out to bigskysno@gmail.com.



Funding Partners



Key Terms & Abbreviations

Business-As-Usual Scenarios | BAU Scenarios Forecasts that incorporate known or likely structural changes within the community but do not incorporate any new mitigation actions.

Carbon Offset | An action intended to compensate for the emission of carbon dioxide (CO₂) into the atmosphere as a result of industrial or other human activity, especially when verified and purchased as part of a commercial program. Carbon offsets are different from Renewable Energy Credits (RECs).

Carbon Dioxide Equivalent | CO₂e The universal unit for comparing emissions of different Greenhouse gases (GHGs) expressed in terms of the global warming potential (GWP) of one unit of carbon dioxide.

Clean Energy | Energy derived from renewable or zero-emissions sources (“renewables”), as well as energy saved through energy efficiency (“EE”) measures including Renewable Energy that is naturally replenished over time, nuclear, and, hydrogen.

Climate Action Plan | CAP A detailed and strategic framework for measuring, planning, and reducing greenhouse gas (GHG) emissions and related climatic impacts.

Food Recovery | The act of collecting edible food that would otherwise go to waste and redistributing it to feed people in need. This is the highest and best use for food that would otherwise go to compost or the landfill.

Greater Yellowstone Ecosystem | GYE One of the largest nearly intact temperate-zone ecosystems on Earth located within the northern Rocky Mountains, in areas of northwestern Wyoming, southwestern Montana, and eastern Idaho, and is about 22 million acres (89,000 km²).

Greenhouse Gas | GHG Gases that trap heat in the atmosphere. Some greenhouse gases occur naturally and are emitted into the atmosphere through natural

processes. Others are created and emitted solely through human activities and intensify the greenhouse effect. The principal greenhouse gases that enter the atmosphere because of human activities are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and fluorinated gases (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride).

Greenhouse Gas Emissions | Gases released into the atmosphere that absorb infrared radiation (net heat energy) emitted from Earth’s surface and reradiate it back to Earth’s surface, thus contributing to the greenhouse effect.

Intergovernmental Panel on Climate Change | IPCC A central global organization for research and education on climate change, basing their information on foundational and widely accepted scientific data.

Metric Tons of Carbon Dioxide Equivalent | MTCO₂e The standardized unit used when measuring the amount of a greenhouse gas emitted.

Global warming potential | GWP The ratio of radiative forcing (degree of warming to the atmosphere) that would result from the emission of one mass-based unit of a given GHG compared to one equivalent unit of carbon dioxide (CO₂) over a given period of time.

Net Zero | A target of completely negating the amount of greenhouse gases produced by human activity, to be achieved by reducing emissions and implementing methods of absorbing carbon dioxide from the atmosphere. Most net zero targets include a large portion of emissions reduction with a very small percentage of sequestration or offsetting.

Renewable Energy | Energy derived from natural resources that are naturally replenished at a greater rate than they are consumed; this includes wind, solar, hydropower, biomass, and geothermal.

Renewable Energy Credit | REC (pronounced: rek)

A REC is a tradeable, market-based instrument or certificate that represents the legal property rights to the “renewable-ness” (or environmental attributes) of renewable electricity generation. One REC is created for every one megawatt hour (MWh) of electricity generated and delivered to the grid from a renewable energy resource.

Resilience | The ability of an ecosystem to maintain its normal patterns of nutrient cycling and biomass production after being subjected to damage caused by an ecological disturbance.

Scope 1 Greenhouse Gas Emissions | These emissions are direct greenhouse (GHG) emissions that are released on-site (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles). In Big Sky, these emissions are from the onsite combustion of liquid propane, wood and gasoline and diesel used in vehicles and other equipment inside the defined study boundary.

Scope 2 Greenhouse Gas Emissions | These emissions are indirect GHG emissions associated with the community’s consumption of electricity, steam, heat, or cooling generated off-site. Regardless of where they are generated, these emissions are accounted for in an organization’s GHG inventory and attributed based on the community’s energy use. In Big Sky, these emissions are from electricity supplied by NorthWestern Energy.

Scope 3 Greenhouse Gas Emissions | These emissions are the result of activities from the community, but are part of another community’s Scope 1 or 2 emissions. This CAP includes collection and landfill emissions for waste generated in Big Sky and landfilled sixty-five miles from the community as Scope 3.

Sustainability | The degree to which a process or enterprise is able to be maintained or continued while avoiding the long-term depletion of natural resources.

Sustainable Development Goals | SDGs A collection of 17 interlinked global goals designed to be a “shared blueprint for peace and prosperity for people and the planet, now and into the future”. The SDGs were set up in 2015 by the United Nations General Assembly (UNGA) and are intended to be achieved by 2030.

Target Improvement Priority | TIP The areas of impact identified by the GHG Study where Big Sky’s community can affect change.

TIGER Grant | An acronym for Transportation Investment Generating Economic Recovery Grant. A grant awarded to Gallatin County in 2017 for improvements on Montana Highway 64, including turn lanes, pedestrian infrastructure and a traffic signal as well as funding for Big Sky’s public transportation system.

Vehicle Miles Traveled | VMT The total miles traveled by a vehicle or vehicles, typically reported on an annual basis for emissions reporting.

Waste Diversion | Minimization of solid waste generation through source reduction, recycling, reuse or composting. Waste diversion also reduces disposal costs and the burden on landfills.

Appendix

A.1 Rockström’s Planetary Boundaries: A concept developed by Johan Rockström that defines thresholds within which humanity can survive, develop and thrive for generations to come. These nine boundaries create a safe operating limit for survival:

1. Stratospheric Ozone Depletion
2. Loss of Biosphere Integrity (biodiversity loss and extinctions)
3. Chemical Pollution and the Release of Novel Entities
4. Climate Change
5. Ocean Acidification
6. Freshwater Consumption and the Global Hydrological Cycle
7. Land System Change
8. Biogeochemical Flows (nitrogen phosphorus pollution)
9. Atmospheric Aerosol Loading

A.2 Greenhouse Gas Protocols

Greenhouse Gas Scope 1, 2, and 3 Emissions

The following defines Scope 1, 2, and 3 emissions from the Greenhouse Gas Protocol, and how they were applied to the Big Sky Community Greenhouse Gas Inventory:

Direct emissions (known as Scope 1): from onsite combustion and mobile sources. In Big Sky, these emissions are from the onsite combustion of liquid propane, wood and gasoline and diesel used in vehicles and other equipment inside the defined study boundary;

Indirect emissions (Scope 2): from purchased electricity and steam. In Big Sky, these emissions are from electricity supplied by NorthWestern Energy; and

All other indirect emissions (Scope 3): from emissions that occur outside of the defined study boundary but are of interest. This CAP only includes collection and landfill emissions for waste generated in Big Sky and landfilled sixty-five miles from the community as Scope 3.

Normally, only Scope 1 and Scope 2 emissions are collected because these are controlled by the owner and can be targeted with specific action plans. While Scope 3 emissions may be of interest in understanding carbon emissions related to community activity or in the surrounding area, the source of these emissions are part of another community’s Scope 1 or 2 emissions, and thus avoids double counting.

Calculation-based Methodology

Emissions sources in the GHG inventory used in this CAP are quantified using Calculation-Based methodologies using the following formula:

$$\text{Activity Data} \times \text{Emission Factor} = \text{Emissions}$$

Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions.

Preparing this BAU scenario required that assumptions be made about changes in both activity and carbon intensity factors over time. Activity examples are anticipated growth from new buildings, more permanent and temporary residents, more visitors and more on-road miles driven. Carbon intensity factors are inputs for calculating increases or decreases in the delivery of energy per unit of carbon emitted from burning propane gas, gasoline and diesel fuels (Scope 1 emissions), generating electricity used (Scope 2 emissions) and emissions from managing the waste generated, transport and landfill (Scope 3 emissions).

A.3 BAU Growth Assumptions

BAU compound annual growth rate assumptions for the periods of 2018-2035 & 2018-2050 in MTCO₂e are presented in the tables below.

BAU compound annual growth rate assumptions for the periods of 2018-2035 & 2018-2050 in MTCO₂e are presented in the tables here.

While these compound annual rates are calculated over the full 32-year period (2018-2050), growth rate assumptions for each of the 32 years vary significantly. A summary of Big Sky growth assumptions by sector follows below.

Electricity: BAU emissions that result from the generation of the electricity from NorthWestern Energy are calculated based on Big Sky's 2018 electricity use in kilowatt hours (kWh) and the carbon emission factor for the generation of that electricity in pounds per megawatt hour (lbs/MWh) for that calendar year. Subsequent yearly emissions are calculated using an estimate of growth each year for each of these calculation inputs.

Growth in kWh of electricity used in Big Sky has been estimated based on historical growth, updated build-out information and known plans for future projects. While the compound annual growth rate for the 32-year period is 2.6%, this rate is not evenly distributed over that period, and is higher in the early years and lower as 2050 approaches.

| YEAR | 2018 Actual | 2035 Projected | 2050 Projected |
|------|-------------|----------------|----------------|
| VMT | 84,000,000 | 153,000,000 | 159,000,000 |

Transportation 2035 MTCO₂e Reductions from BAU Scenario (2018-2035)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|----------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| | 2018 | 2035 | Growth % | 2035 | 2035 | % Reduction |
| Transportation | 47,432 | 63,210 | 1.7% | 48,146 | 15,064 | 24% |

Transportation 2050 MTCO₂e Reductions from BAU Scenario (2018-2050)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|----------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| | 2018 | 2050 | Growth % | 2050 | 2050 | % Reduction |
| Transportation | 47,432 | 51,008 | 0.2% | 18,506 | 32,502 | 64% |

For the first 15 years (2020-2034), the compound annual growth rate is 4%

For the last 15 years (2035-2050), the compound annual growth rate is 1.2%

For the BAU scenario, the electric generation carbon emission factor is assumed to remain the same at its actual 2018 value of 911 lbs/MWh

Propane Gas: BAU emissions resulting from the burning of propane gas are calculated based on 2018 use in gallons and using the standard carbon emission factor for propane gas.

Growth in the gallons of propane gas burned in Big Sky uses the same growth rates established for electricity use, except for 2019 where an actual value was known. This results in a similar pattern with a compound annual growth rate of 2.5% over the 32-year period and more growth in the first half of the period than in the second half.

Transportation: BAU emissions that result from on-road transportation are calculated based on 2018 vehicle miles traveled (VMT), within Big Sky Community boundaries, and average gasoline and diesel carbon emission factors that are based on the Montana mix of vehicle types and vintages in 2018. Subsequent yearly emissions are calculated using an estimate of growth per year for each of these calculation inputs. Transportation emissions growth over the 32-year period increased modestly by only 0.2% (Table 1). However, to understand the reasons for this small increase in a BAU scenario, the following additional information is helpful.

VMT Growth Assumptions

The BAU scenario projected VMT over the 32-year period are:

- This scenario forecasts a large increase in the early years and a much smaller increase in the later years.
- For the first 17 years (2018-2034), the compound annual growth rate is 3.6%
- For the next 5 years (2035-2039), the compound annual growth rate is 1.0%
- For the next 10 years (2040-2050), the compound annual growth rate is zero (0.0%)

While it is astounding to think that VMT in Big Sky

could increase by 82% by 2035, this forecast is supported by a 2017 traffic study commissioned by the Big Sky Chamber of Commerce and conducted by Sanderson/Stewart in support of the TIGER Grant. The TIGER Grant was awarded to Gallatin County for improvements on Montana Highway 64, including turn lanes, pedestrian infrastructure and a traffic signal as well as funding for Big Sky's public transportation system. This study reported that Big Sky traffic volume measurements, taken on Highway 64 near the ACE Hardware Store, increased by 4.7% per year from 1992 through 2016. It was also reported that over the period of 2011 through 2016, the increase was 9.2% at this same location. The 2017 Sanderson/Stewart study used a 4.34% annual growth rate in its twenty-year projections (2017 through 2036).

The CAP VMT forecasted growth rate of 3.6% (2018-2034) and 2.0% (2018-2050) is based on known Big Sky growth statistics for residential and commercial buildings, build-out projections for Big Sky and forecasts of visitor statistics.

Carbon Emissions Factors

If the BAU transportation forecast assumed that automobile and small trucks manufactured after 2018 would not have improved mileage and emissions characteristics, then total transportation emissions would be 89,573 MTCO₂e in the year 2050. However, this CAP has reasonably assumed that significant progress in this regard has already been made and will continue to occur, in part due to CAFE (Corporate Average Fuel Economy) standards. Transportation emissions are governed by federal law codified as CAFE standards. These standards have motivated auto makers to significantly improve auto and light truck mileage and emissions efficiency in the past and will likely become more aggressive in the future. Because these standards have been codified into U.S. law, their impact on reducing transportation emissions have been included in the BAU scenario. Here, the BAU forecast is 51,008 MTCO₂e, 38,565 MTCO₂e (43%) less in 2050 when applying the existing CAFE standards.

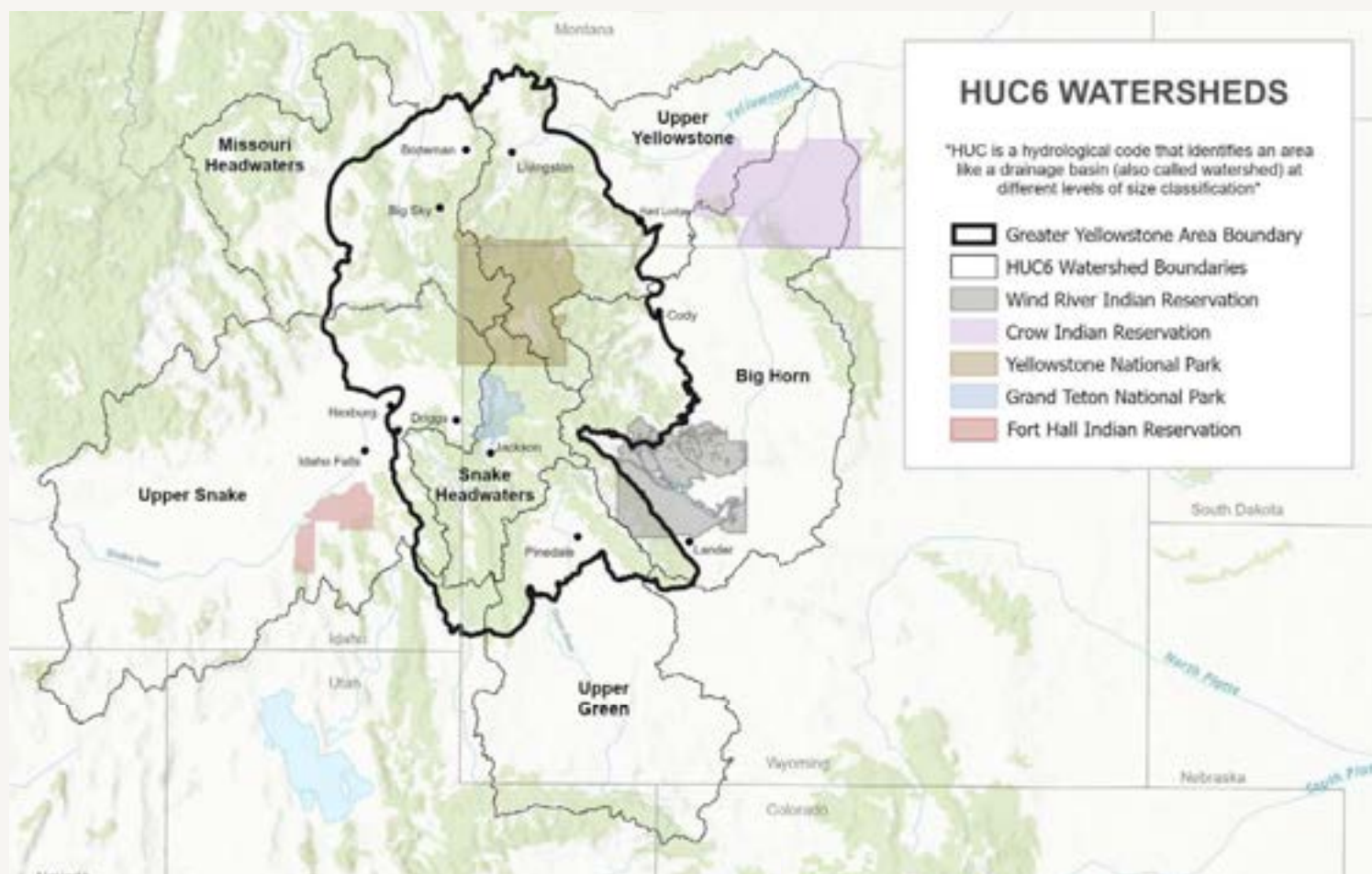
Transportation Summary

Taken together, the projected rapid rise in VMT until 2035 is offset by the steady increase in vehicle efficiencies resulting in the 0.2% increase in transportation emissions in the BAU scenario.

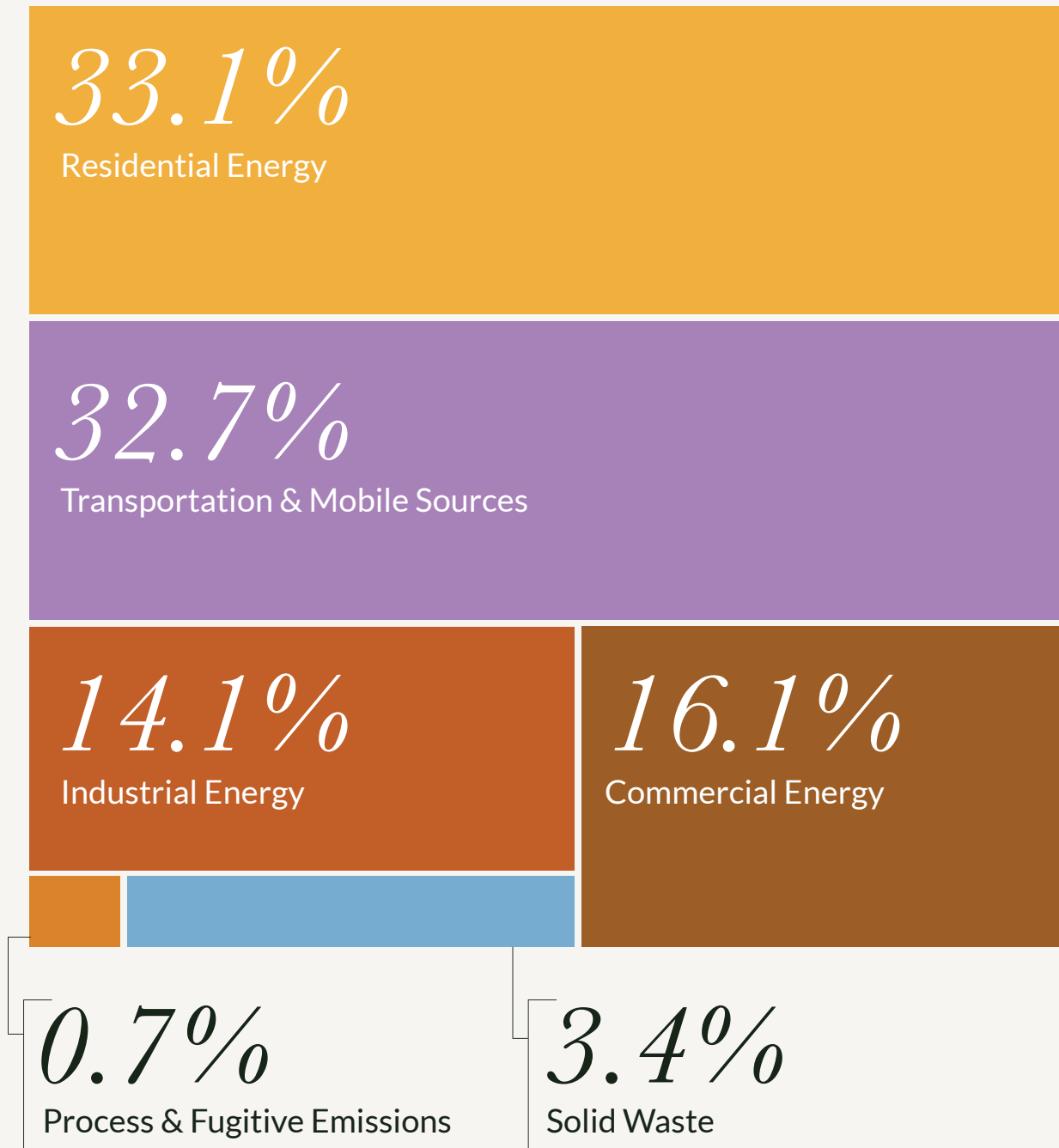


Figures

Greater Yellowstone Area (GYA) Boundary Map

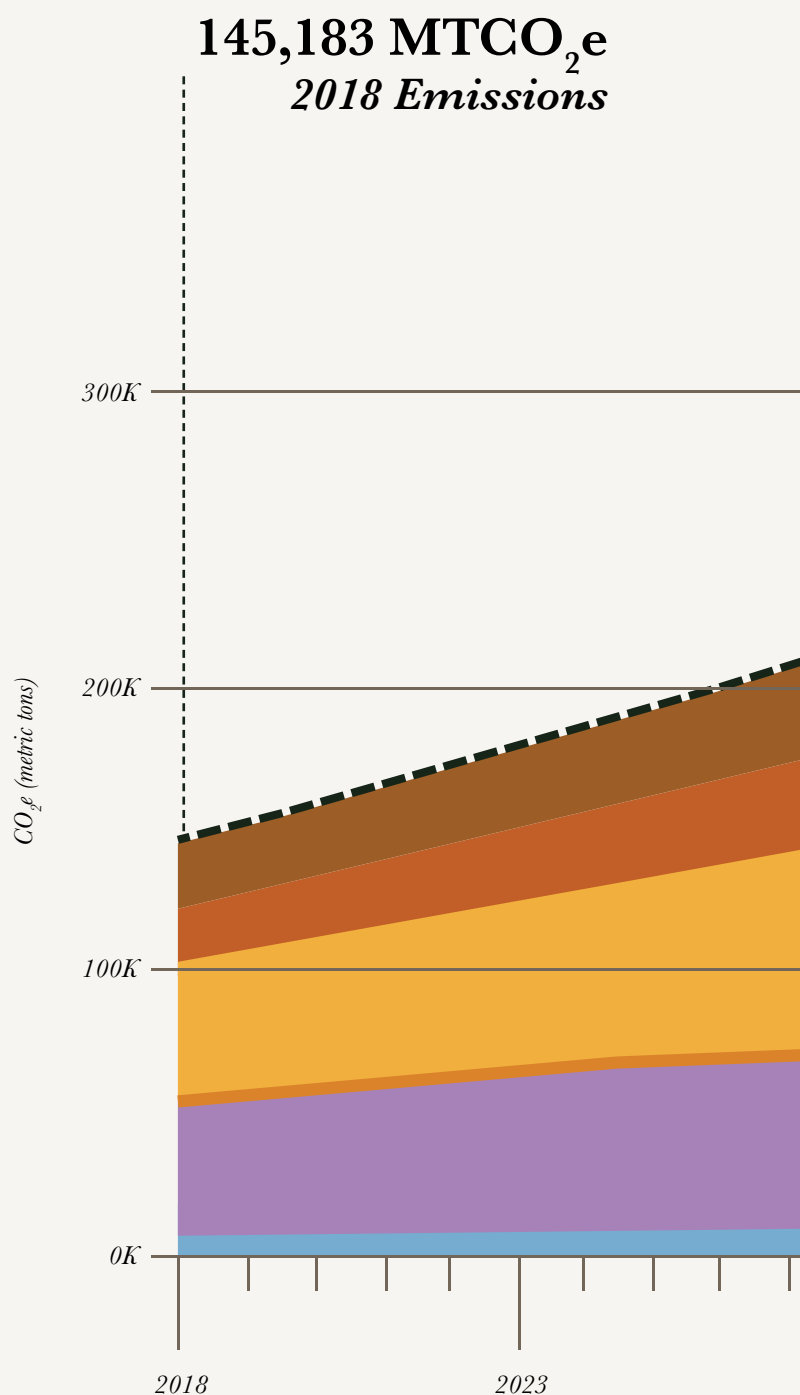
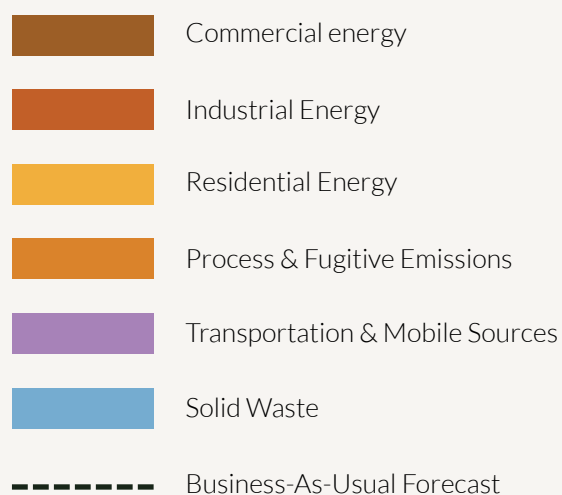


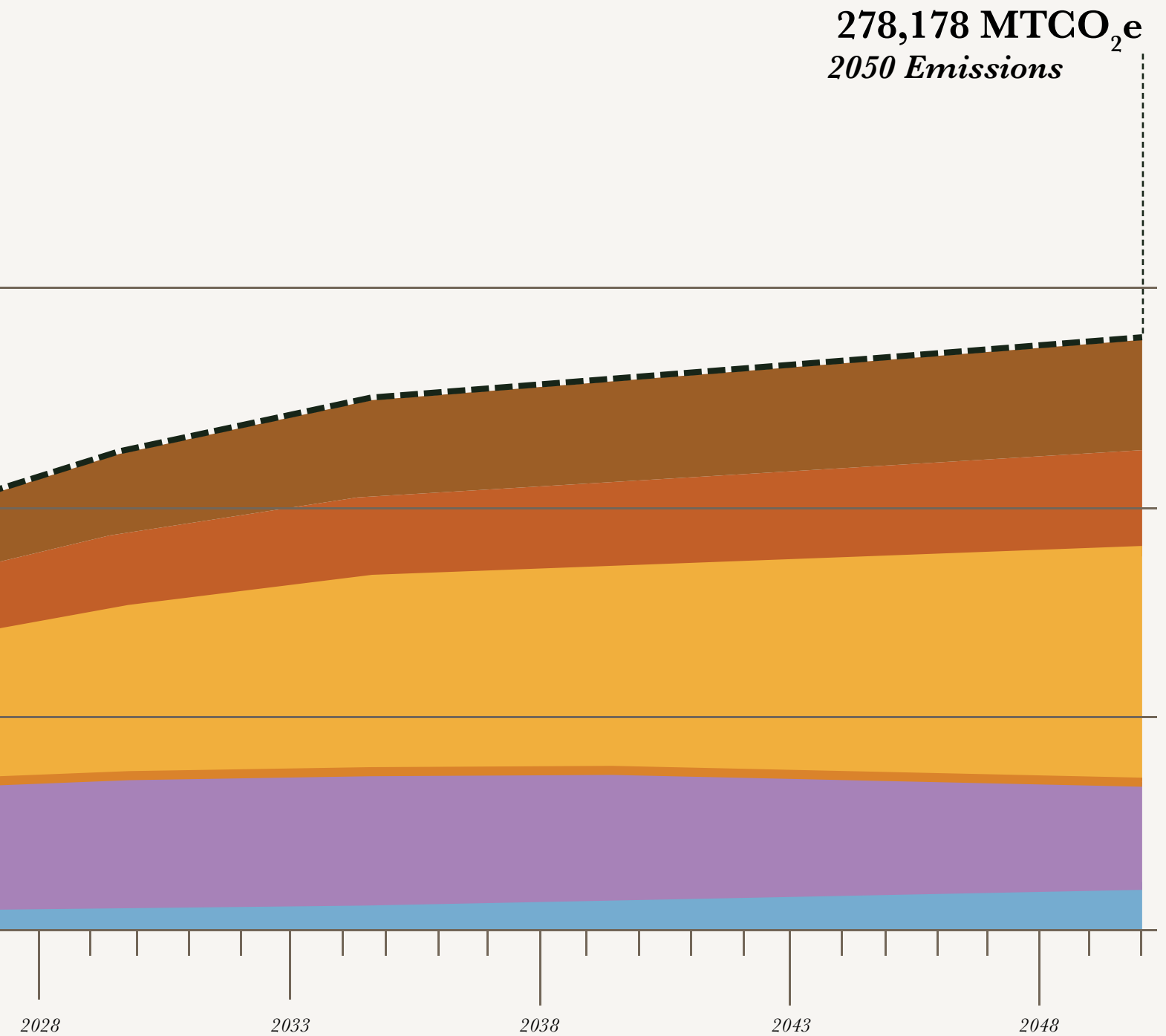
2018 Community-Wide Emissions By Sector



2018-2050 Forecast Of Big Sky Community Emissions With No Mitigation Action (BAU)

Key





Targeted Improvement Priorities

Energy & Buildings



- Green Electricity Supply
- Electrify Buildings; Reduce Propane Gas Use
- Energy Efficiency Participation
- Green Build Toolkit Platform

Transportation



- Reduce Vehicle Miles Traveled (VMT)
- Promote Electric Vehicle Infrastructure
- Personal Travel Educational Programming

Consumption & Waste



- Improved Waste Diversion Rates
- Increase Composting and Recycling
- Enhance Food Recovery Systems

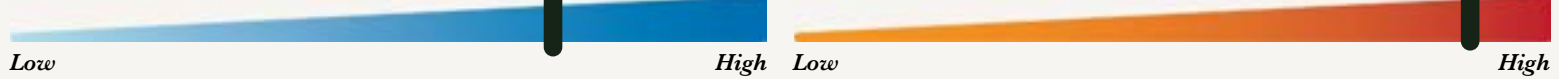
Natural Environment



- Carbon Offsets and Sequestration Education
- Water Use Reductions
- Natural Environment Restoration

Priorities and Their Relative Emissions Reduction and Resilience Benefits

Energy & Buildings



Transportation



Consumption & Waste

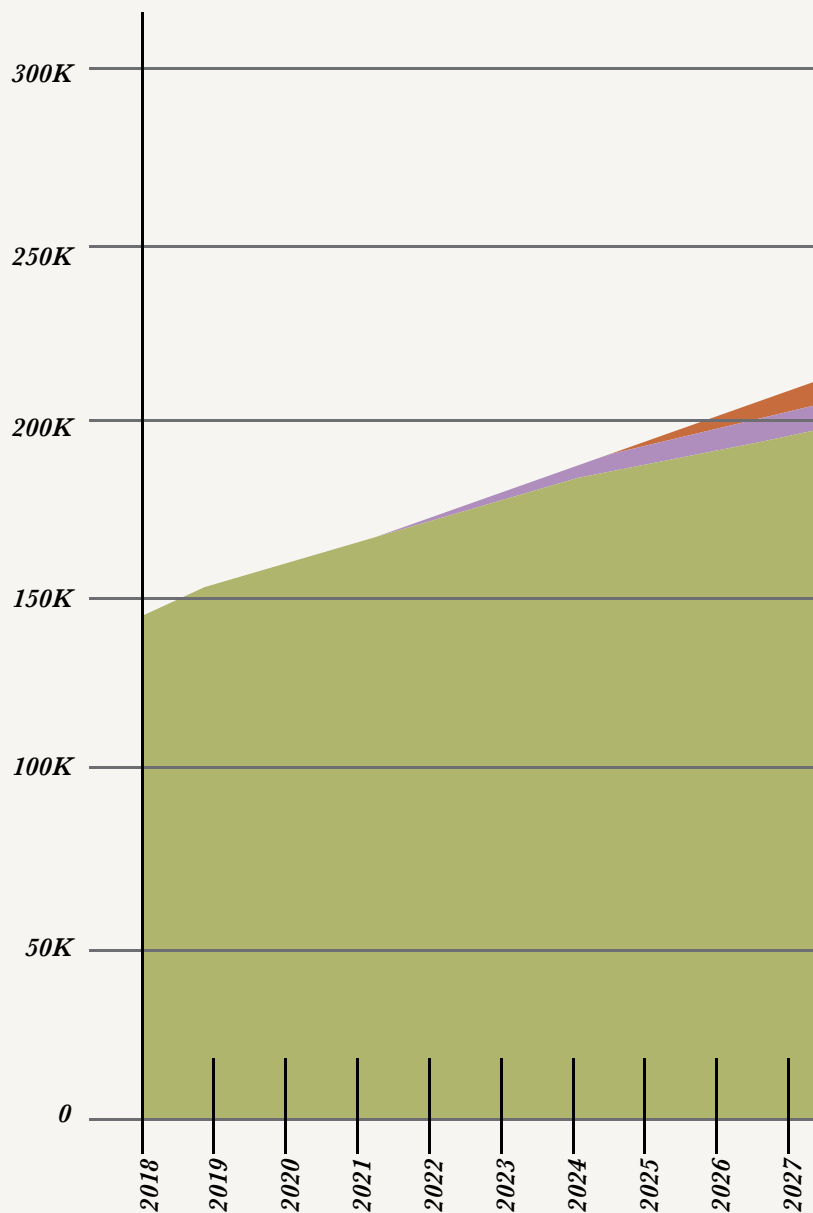


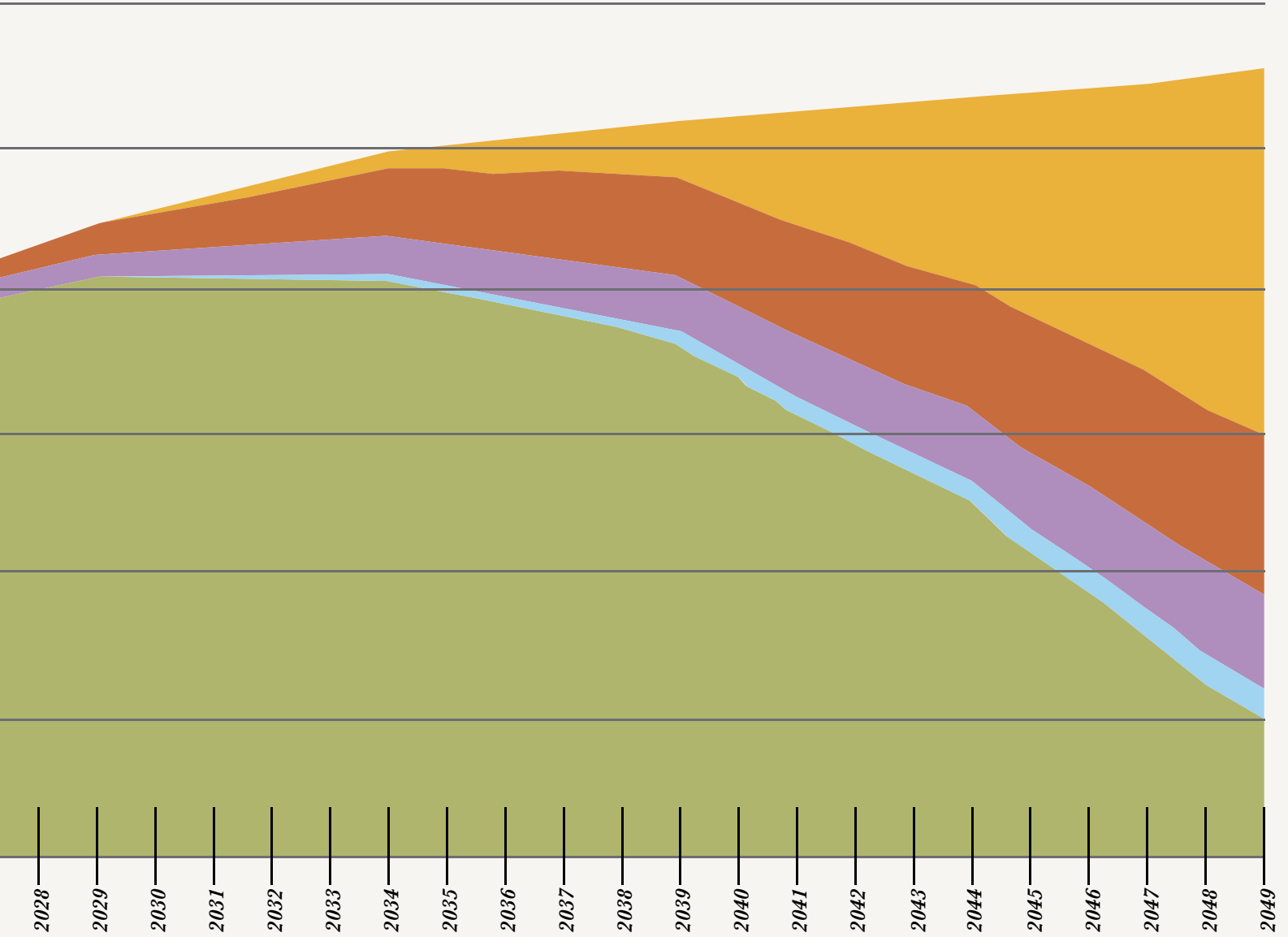
Natural Environment



Emission Reductions From BAU Forecast to Reach Net Zero By 2050

Key





Tables

Summary of Forecasted GHG Emissions and Modeled Emissions Reduction by Targeted Improvement Priority

| Description | Amount (MTCO ₂ e) | % of BAU |
|---|---------------------------------|-------------|
| Total BAU Forecast Emissions in 2050 | 278,178 | - |
| 2050 Net Zero Reduction Goals | | |
| Reductions in Electricity Carbon Intensity; Net Zero 2050 | 108,567 | 39% |
| Buildings Electrification and Efficiency Measures | 75,665 | 27% |
| Transportation VMT and Electric Vehicles | 32,502 | 12% |
| Consumption and Waste | 12,388 | 4% |
| Environmental Health and Advocacy, New Technologies, Carbon Credits/Offsets & Sequestration | 49,056 | 18% |
| 2050 Net Zero Goal | 0 | 100% |

Energy & Buildings 2035 MTCO₂e Reductions from BAU Scenario (2018-2035)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|-----------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| Sectors | 2018 | 2035 | Growth % | 2035 | 2035 | % Reduction |
| Electricity Use | 55,315 | 108,016 | 4.0% | 100,813 | 7,203 | 7% |
| LPG Use | 36,523 | 68,201 | 3.7% | 43,535 | 24,666 | 36% |

Energy & Buildings 2050 MTCO₂e Reductions from BAU Scenario (2018-2050)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|-----------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| Sectors | 2018 | 2050 | Growth % | 2050 | 2050 | % Reduction |
| Electricity Use | 55,315 | 127,650 | 2.6% | 0 | 127,650 | 100% |
| LPG Use | 36,523 | 80,598 | 2.5% | 25,716 | 54,882 | 68% |

2018 & 2019 Actual VMT and Emissions

| Descriptions | 2018 | 2019 | % Increase |
|--|------------|------------|------------|
| Vehicle Miles Traveled (VMT/Year In-Boundary | 84,191,996 | 88,280,726 | 4.9% |
| Total Transportation Emission (Metric Tons) | 47,432 | 49,069 | 3.5% |

2035 & 2050 Forecast VMT and Emissions

| | 2035 | | 2050 | |
|------------------------|-------------------|-------------------|--------------------|-------------------|
| Scenario | VMT | CO ₂ e | VMT | CO ₂ e |
| Business-As-Usual -BAU | 152,786,146 | 63,210 | 158,989,876 | 51,008 |
| CAP Implementation | 116,373,341 | 48,146 | 57,683,373 | 18,506 |
| Reductions | 36,412,805 | 15,064 | 101,306,503 | 32,502 |
| % Change | 24% | 24% | 64% | 64% |

Consumption & Waste 2035 MTCO₂e Reductions from BAU Scenario (2018-2035)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|-------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| | 2018 | 2035 | Growth % | 2035 | 2035 | % Reduction |
| Solid Waste | 4,916 | 9,485 | 3.9% | 6,616 | 2,869 | 30% |

Consumption & Waste 2050 MTCO₂e Reductions from BAU Scenario (2018-2050)

| | Actual Emissions | BAU Projected Emissions | Compound Annual Growth | Projected with Targets | Reduction | |
|----------------|------------------|-------------------------|------------------------|------------------------|-----------|-------------|
| | 2018 | 2050 | Growth % | 2050 | 2050 | % Reduction |
| Transportation | 4,916 | 16,425 | 4,037 | 6,616 | 12,388 | 75% |

References

"Big Sky Sno." Big Sky SNO, <https://www.bigskysno.org/>.

"Stats Report Viewer." National Parks Service, U.S. Department of the Interior, [https://irma.nps.gov/STATS/SSRSReports/Park%20Specific%20Reports/Annual%20Park%20Recreation%20Visitation%20\(1904%20-%20Last%20Calendar%20Year\)?Park=YELL](https://irma.nps.gov/STATS/SSRSReports/Park%20Specific%20Reports/Annual%20Park%20Recreation%20Visitation%20(1904%20-%20Last%20Calendar%20Year)?Park=YELL).

Hansen, Andrew J., and Linda Phillips. "Trends in Vital Signs for Greater Yellowstone: Application of a Wildland Health Index." *Ecosphere*, vol. 9, no. 8, 2018, <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.2380>.

"Discover the Story of English: More than 600,000 Words, over a Thousand Years." Home : Oxford English Dictionary, <https://www.oed.com/>.

"The 17 Goals | Sustainable Development." United Nations, United Nations, <https://sdgs.un.org/goals>.

"Big Sky SNO Community Greenhouse Gas Inventory: September, 2021 Final Report." Big Sky SNO, <https://static1.squarespace.com/static/5fab042f4d06190a0128e012/t/6165e4f00593933ab48f51bc/1634067697296/2019+Big+Sky+GHG+Report.pdf>.

Planetary Boundaries: Exploring the Safe Operating Space for Humanity. https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1063&context=iss_pub.

"Climate Change 2021: The Physical Science Basis: Summary for Policymakers." IPCC Intergovernmental Panel on Climate Change, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf.

"Climate Change 2021: The Physical Science Basis: Technical Summary." IPCC Intergovernmental Panel on Climate Change, https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_TS.pdf.

Hostetler S, Whitlock C, Shuman B, Liefert D, Drimal C, Bischke S. 2021. "Greater Yellowstone climate assessment: past, present, and future climate change in greater Yellowstone watersheds." Bozeman MT: Montana State University, Institute on Ecosystems. 260 p. <https://doi.org/10.15788/GYCA2021>.

Lackner, Christian Philipp, et al. "Impact of Global Warming on Snow in Ski Areas: A Case Study Using a Regional Climate Simulation over the Interior Western United States." *Journal of Applied Meteorology and Climatology*, 2021, <https://doi.org/10.1175/jamc-d-20-0155.1>.

MT2030, <https://www.mt2030.org/>.

"Mountain Ideal Sustainable Destinations." Walking Mountains Science Center, 6 Apr. 2021, <https://www.walkingmountains.org/sustainability-hub/mountain-ideal-sustainable-destination/>.

July 16, 2019 Melissa Denchak. "Greenhouse Effect 101." NRDC, 27 Apr. 2022, <https://www.nrdc.org/stories/greenhouse-effect-101>.

"Sources of Greenhouse Gas Emissions." EPA, Environmental Protection Agency, <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#:~:text=The%20largest%20source%20of%20greenhouse,Greenhouse%20Gas%20Emissions%20and%20Sinks>.

Bureau, US Census. "Census Designated Places." Census.gov, 28 Mar. 2022, <https://www.census.gov/programs-surveys/bas/information/cdp.html>.

"Northwestern Energy: Together, We're Working to Deliver a Bright Future." Northwestern Energy, <https://www.northwesternenergy.com/>.

“Calculate Your Carbon Emissions with Climatehero’s Carbon Footprint Calculator.” ClimateHero, <https://carbon-calculator.climatehero.me/>.

“Energy Star.” ENERGY STAR | The Simple Choice for Energy Efficiency., <https://www.energystar.gov/>.

“Household Electrification Savings Calculator.” Rewiring America, <https://www.rewiringamerica.org/app/ira-calculator>.

“Citizen’s Climate Lobby.” Citizens’ Climate Lobby, 5 Oct. 2022, <https://citizensclimatelobby.org/>.

“Sierra Club.” Home | Sierra Club, <https://www.sierraclub.org/>.

“Net Zero by 2050.” Northwestern Energy, <https://www.northwesternenergy.com/clean-energy/net-zero-by-2050>.

GoGallatin, <https://gogallatin.org/#/>.

“Get Some Altitude.” Skyline Bus - Link to the Peak, <http://skylinebus.com/>.

Borunda, Alejandra. “Methane Facts and Information.” Environment, National Geographic, 3 May 2021, <https://www.nationalgeographic.com/environment/article/methane#:~:text=Each%20of%20those%20puffs%20coming,more%20powerful%20over%2020%20years>.

“Sustainable Management of Food.” EPA, Environmental Protection Agency, <https://www.epa.gov/sustainable-management-food>.

Republic Services, <https://www.republicservices.com/shop>.

“Compost Collection Company in MT.” YES Compost, <https://www.yescompost.com/>.

“The 17 Goals | Sustainable Development.” United Nations, United Nations, <https://sdgs.un.org/goals>.

“Gallatin Invasive Species Alliance.” GISA, <https://www.gallatinisa.org/>.

Gallatin River Task Force, 8 Sept. 2022, <https://gallatinrivertaskforce.org/>.

Big Sky Community Organization, 11 Oct. 2022, <https://bsco.org/>.

“Water Conservation: Gallatin River Task Force.” Gallatin River Task Force, 20 June 2022, <https://gallatinrivertaskforce.org/water-conservation/>.

“WaterSense.” EPA, Environmental Protection Agency, <https://www.epa.gov/watersense>.

“Native Planting Guide.” Gallatin River Task Force, 20 June 2022, https://gallatinrivertaskforce.org/wp-content/uploads/2022/09/2209_GRTF_NativePlantingGuide_5x8_WEB.pdf.

Montana Department of Labor & Industry Building Codes, <https://bsd.dli.mt.gov/building-codes-permits/current-codes>







www.bigskysno.org | bigskysno@gmail.com