Public health

CLIMATE ACTION FRAMEWORK 2026

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Introduction

Climate change threatens the health and well-being of everyone in Minnesota. It increases the risk of illness and injury, worsens existing health conditions, and deepens inequities shaped by age, race, income, geography, and other social and economic factors. Without swift action, these health risks will continue to intensify, placing increasing strain on communities, health care systems, and the economy.

Minnesota's 2026 Climate Action Framework is the state's roadmap to reduce climate pollution, also known as greenhouse gas (GHG) emissions, and prepares communities for climate change in ways that benefit all Minnesotans. Actions that reduce climate pollution or increase the removal of GHG emissions from the atmosphere (e.g., by expanding forests) are referred to as *mitigation*, while *adaptation* refers to actions that help reduce vulnerability to the current or anticipated impacts of climate change. Many climate actions advance both goals. The framework includes mitigation and adaptation strategies, as well as public health strategies to reduce climate-related health risks.

This public health supplement to the framework is organized in two sections:

1. **Health harms of climate change** — a summary of some of the current and expected health impacts from climate change.
2. **Health benefits of climate change mitigation** — an overview of current conditions, health pathways, and potential health benefits associated with eight categories of mitigation strategies included in the framework.

This document focuses on mitigation strategies because they can deliver immediate and long-term health benefits that are often overlooked. Understanding the health benefits of climate action can help decision-makers identify opportunities to maximize benefits and advance health equity. Framing climate action through a public health lens can also strengthen support for climate solutions and encourage broader engagement.

Both sections are informed by a large body of scientific literature, as well as input and feedback from state agency staff and members of the public who participated in the framework's engagement process, described in the engagement supplementary document. This resource also incorporates *social determinants of health* concepts. According to the U.S. Centers for Disease Control and Prevention:

> Social determinants of health are the nonmedical factors that influence health outcomes. They are the conditions in which people are born, grow, work, live, worship, and age. These conditions include a wide set of forces and systems that shape daily life such as economic policies and systems, development agendas, social norms, social policies, and political systems.[1]

In addition to posing direct health risks, climate change indirectly poses health risks by impacting the social determinants of health. Conversely, climate change mitigation actions can influence the social determinants of health in ways that provide broad public health benefits. For example, increasing multimodal transportation options can reduce climate pollution while improving air quality and promoting increased physical activity.

The pathways between climate action and health outcomes are complex and multi-layered, but evidence suggests that climate mitigation can provide multiple opportunities to improve health. The degree to which these actions benefit public health will depend on how — and to what extent — they are implemented. This report examines climate mitigation actions that can improve health outcomes toward our vision of a carbon-neutral, resilient, and equitable Minnesota.

Health harms of climate change

Rising temperatures, wildfires, wildfire smoke, stronger storms, flooding, and changing precipitation patterns are destabilizing the systems that support health, including clean air, safe drinking water, food production, community well-being, and much more. Reducing GHGs can slow down and lessen these impacts. This section draws on peer-reviewed studies and health data to highlight some of the current and projected health consequences of climate change that are likely to worsen without rapid and substantial climate pollution reduction.

Evidence shows climate change is worsening health outcomes, but fully measuring and forecasting the extent of the health impacts in Minnesota is difficult due to rapidly evolving conditions, uncertain future climate patterns, data gaps, and complex links between environmental exposures and health effects. Continued research and improved data collection are needed to better understand climate-related health risks and to strengthen planning, response, and preparedness efforts.

While scientific understanding continues to evolve, there is strong evidence that climate change increases the risk of illness, injury, mental health challenges, and premature death through a variety of pathways. The following section outlines how climate change impacts health both directly and indirectly, including by disrupting agriculture, damaging important infrastructure, reducing worker productivity, straining food and water systems, and contributing to broader economic losses.

Major climate-related health threats

Extreme heat

Extreme heat is the leading weather-related cause of death in the United States[2] and poses a growing threat in Minnesota. Extreme heat can cause heat stroke, worsen chronic diseases, increase hospital visits, reduce work capacity, raise health care costs, and increase mortality.[3] In Minnesota, 77 deaths were directly attributed to extreme heat between 2000 and 2023.[4] Since 2010, Minnesota has averaged about 800 heat-related emergency department visits each summer.[5] These data likely underrepresent the full scope of heat-related health impacts in Minnesota because heat is underdiagnosed, misclassified, and underreported as a cause of death and hospital visits.[6] Additionally, new research suggests exposure to extreme heat can have long-term effects, such as neurological damage, kidney disease, and accelerated aging.[7] Rising temperatures may also cause mental and behavioral health impacts including insomnia, cognition impacts,[8] interpersonal violence,[9] and mental health crises.[10, 11] Heat islands and waste heat from buildings and vehicles further amplify these risks.[12]

Air pollution

Fossil fuel combustion produces GHGs and other harmful air pollutants, including fine particulate matter ($PM_{2.5}$) and ground-level ozone. $PM_{2.5}$ is particularly harmful to health because it is made of many pollutants with particle sizes small enough to enter the bloodstream, triggering inflammation and increasing risks of heart attacks, strokes, respiratory illness, and mental health issues.[13, 14, 15]

Ground-level ozone is a secondary pollutant formed through chemical reactions between nitrogen oxides (NO_x) and volatile organic compounds (VOCs).[16] This reaction becomes more prevalent as temperatures rise with climate change, elevating levels of ground-level ozone and risks to human health.[17] Ozone can irritate the eyes, nose and throat, aggravate lung diseases, or increase the risk of premature death in people with heart or lung disease.[18, 19] In Minnesota, ground-level ozone levels are relatively close to the national standards.[20]

Wildfire smoke

Wildfire smoke has become a major health concern in Minnesota. Since 2021, the state has experienced unprecedented smoke events. Wildfire smoke, which contains thousands of chemical compounds and particles,[21] is a growing source of $PM_{2.5}$ and the pollutants that form ground-level ozone.[22] Exposure is linked to reduced lung function, asthma attacks, heart attacks and strokes, weakened immune systems, and increased mortality.[23] Additionally, wildfire smoke exposure can impact sleep and mental health.[24]

Data analyses conducted by the Minnesota Department of Health indicate measurable associations between wildfire smoke events and adverse respiratory outcomes. A study found a statistically significant increase in respiratory-related emergency department visits during the 2021 wildfire season in Minnesota,[25] which triggered a record 13 air quality alerts covering 42 days. A subsequent review of wildfire smoke events in 2025 likewise indicated higher-than-expected emergency department visits for respiratory issues from a five-day wildfire smoke event (July 29 to August 2, 2025) in both the Twin Cities metro region and in the northeast region of the state.[26]

It is important to distinguish wildfires from prescribed fires, which along with fire suppression, can help reduce safety and health risks from wildfires.[27]

Pollen and allergies

Rising temperatures in Minnesota are shortening winters, shifting plant hardiness zones northward, and extending growing seasons. Combined with higher atmospheric carbon dioxide levels, these changes increase pollen production, intensifying exposure to airborne allergens that trigger conditions such as asthma and other respiratory illnesses.[28, 29] The season for ragweed pollen, a major trigger of seasonal allergies in Minnesota, lengthened by 18-21 days between 1995 to 2015, increasing the risk of allergy and asthma symptoms.[30]

Vector-borne diseases

Warmer temperatures and changing weather patterns impact the lifecycles and geographic range of ticks, mosquitos, and other disease-carrying insects and insect-like creatures. Diseases transmitted by ticks, including Lyme disease, anaplasmosis, and babesiosis have increased significantly in Minnesota, rising from less than 300 cases per year in 1996 to nearly 4,400 cases per year in 2025.[31, 32, 33] Areas considered to be at high or moderate risk for these diseases have also expanded, going from a small number of counties in east central Minnesota in the 1990s to nearly two-thirds of the state in 2025.[34] New or emerging diseases transmitted by ticks have also been detected in Minnesota, including Powassan virus disease, ehrlichiosis, spotted fever rickettsiosis, and hard tick relapsing fever.[35, 36]

Water-related health risks

Warming lake temperatures and changing precipitation patterns in Minnesota are increasing the risk of water-related health hazards. Warmer, nutrient-rich conditions promote harmful algal blooms, which produce cyanotoxins that pose health risks to people and pets through ingestion, skin contact, or inhalation during water activities and can cause symptoms such as vomiting, diarrhea, rash, eye irritation, cough, sore throat, and headache.[37] At the same time, rising water temperatures in lakes and rivers may expand the range of the *Naegleria fowleri* ameba that causes primary amebic meningoencephalitis,[38] a rare but almost always fatal brain infection.[39]

Extreme precipitation and flooding

Climate change is increasing the frequency and intensity of extreme precipitation and floods. These events can cause deaths, injuries, illness, and long-lasting psychological distress;[40] contaminate drinking water; spread infectious diseases; and promote mold growth in flooded homes and businesses.[41]

In Minnesota, mega-rain events have become 2.5 times more common between 2000 and 2021 than between 1973-1999. A mega-rain event is an event in which six inches of rain covers more than 1,000 square miles in 24 hours or less, with at least eight inches falling somewhere in that area. These events can be catastrophic, destroying homes and businesses; contaminating wells; damaging essential infrastructure, such as roads for people to access health care, food, and medicine; and disrupting water supplies.[42]

Drinking water impacts

Safe drinking water is essential for protecting public health and supporting a healthy economy. Minnesota has an outstanding record of providing safe and sufficient drinking water for customers on public water systems and continuously maintains a high rate of compliance with the federal Safe Drinking Water Act.[43] Throughout 2025, more than 99% of Minnesota's 6,582 public water systems met all federal health-based drinking water standards.[44]

However, climate change poses growing drinking water challenges — due to increases in heavy precipitation, winds, ice storms, droughts, and loss of power — which can disrupt the ability of public water supplies to provide safe drinking water and impact water quality and quantity for private well users. Climate change may disproportionately affect private well users. For example, heightened demand for groundwater in response to drought can draw down water levels in nearby private wells and can even leave households without drinking water. Flooding can temporarily make private wells unsafe to use; wells should be treated and tested before the water is used again.[45] Compromised drinking water can cause a wide range of acute and chronic health effects including disease outbreaks, depending on the type and concentration of contaminants present.[46,47] The Minnesota Drinking Water Action Plan includes strategies to respond to these challenges and protect drinking water in our changing climate.[48]

Food systems impacts

Agriculture is increasingly strained by erratic precipitation patterns — including drought, extreme rainfall, and flooding — as well as extreme heat. These conditions can severely reduce crop yields and lead to livestock stress, illness or mortality, contributing to higher food prices and heightened food insecurity. At the same time, farmers face growing financial pressures as weather-related losses make yields more variable and less predictable. When combined with broader global economic trends and supply chain disruptions, these stresses contribute to rising mental health challenges in farming communities.[49,50]

Wild foods including game, fish, and wild rice are an important, nutrient-rich component of the diet in many Minnesota communities.[51, 52, 53] The loss of natural lands can impact access to these food sources and the health of everyone who depends on or supplements their diet with wild foods.

For the Tribal communities that share Minnesota's geography, wild foods are integral to their food systems and traditions. During the development of the Climate Action Framework, Tribal Nations and American Indian communities recounted impacts to wild foods and traditional food gathering practices that are central to their culture and health. These included shrinking wild rice beds, increasing tick infestations that kill game, increasing flooding that pollutes fisheries, and sporadic weather affecting maple sugar harvesting. This loss of traditional food access and cultural practices harms Tribal and urban American Indian communities' physical, mental, social, economic, and spiritual health.[54, 55] For example, in recent years, heavy rainfall and precipitation in the spring and summer have hampered wild rice growth for the Bois Forte Band of Chippewa and Fond du Lac Band of Lake Superior Chippewa, reducing the amount of wild rice that could be harvested and negatively impacting nutrition and income for families in these communities. In addition to being a staple food and source of income for Tribal communities, wild rice is integral to their traditions, cultural heritage, social connections, and relationships with the land.[56]

In addition to extreme-weather-related impacts on agricultural and wild food sources, studies indicate elevated carbon dioxide levels could result in reduced nutritional value in crops, including decreased concentrations in zinc, iron, and protein, which could lead to nutrition deficiency in some populations depending on the types of foods they rely on. While the effects of climate change on the nutritional value of crops are highly complex and uncertain, research underscores the need to better understand the risks and advance a climate-resilient food system that supports both caloric and nutritional needs.[57]

Impacts due to changing landscapes

Climate change affects health not only through physical hazards but also through social disruption and psychological stress. Loss of access to nature, cultural traditions, and outdoor recreation can harm mental well-being and social connections. Research suggests that access to nature is linked to improved mental health outcomes through intertwining pathways including social connections, physical activity, and stress.[58]

Changes in natural landscapes can cause a sense of profound loss that researchers have termed solastalgia, "a form of homesickness one gets when one is still at 'home' but because it has changed so much it no longer feels like home."[59] Experiencing environmental change has been associated with post-traumatic stress disorder (PTSD), depression, anxiety, suicide, substance or alcohol abuse, aggressiveness and violence, and difficulties in interpersonal relationships and loss of social ties.[60]

Severe weather

Extreme weather disasters can lead to anxiety, depression, PTSD, and increased violence or suicide. For example, wildfires can cause long-term mental health impacts, such as PTSD, depression, and insomnia among firefighters.[61] Children, evacuees, and those who experience property loss are also likely to experience long-term mental health impacts.[62] Additionally, these stressors often disproportionately impact people who are economically or socially vulnerable.[63]

Extreme weather, even beyond our state borders, can pose disruptions and stressors on health care systems and supply chains in Minnesota. In 2024, climate change increased the severity of Hurricane Helene — the third deadliest hurricane of the modern era in the United States.[64] The hurricane's impact on Baxter International's manufacturing facility in North Carolina created an ongoing intravenous fluid (IV) shortage, posing significant challenges to health care providers across the country, including Minnesota. The shortage forced Minnesota providers to implement conservation measures to preserve their IV fluid supplies. Some Minnesota facilities were forced to postpone non-emergency procedures.[65]

Unequal burdens of climate change

Children and climate change

Climate change affects everyone, but its impacts are not experienced equally. Children today, and successive generations of children, will face more and compounding harms from increasing climate hazards over their lifetimes as compared to previous generations.[66] Projections (based on a 3°C global warming pathway) show a 10-year-old in 2024 could experience "twice as many wildfires and tropical cyclones, three times more river floods, four times more crop failures, five times more droughts, and 36 times more heat waves" in their lifetime than a child born in 1960.[67] In short, children today — and future generations — stand to lose the most from climate change.

Children are uniquely vulnerable to climate change. Their dependence on caregivers and their physiological differences increase their risk of adverse health impacts. Compared to adults, their skin is more permeable, and they breathe more air and drink more water per pound of body weight. Children are less able to recognize hazards, remove themselves from harm's way, and communicate exposures.[68]

Inadequate infrastructure and disruption of education

Climate change poses health risks to children by way of school infrastructure and school closures, disrupting learning and straining resources in communities.[69] Many school buildings were designed for cooler climates and lack adequate ventilation, filtration, or air conditioning. While data on Minnesota school infrastructure conditions are limited, an estimated 41% of districts nationwide need to update or replace heating, ventilation, and air conditioning (HVAC) systems in at least half of their schools.[70]

Unplanned school closures due to extreme weather disrupt learning and strain resources in communities. June 2021 marked the first time St. Paul Public schools closed and the second time that Minneapolis Public Schools closed buildings due to high heat. These school buildings were without air conditioning and reached temperatures in the 90s, with some classrooms reaching 97 degrees.[71] As heat waves and temperatures increase, Minnesota's children and families may face more school closures. Additionally, the poor condition of many school buildings poses health risks to children — compounded in a changing climate — because extreme weather events can release environmental contaminants in the air, water, ground, or walls of school buildings.[72] Increased heat is also shown to contribute to learning loss, even without building closures.[73] Updating school infrastructure and HVAC systems will be increasingly essential to protect children's learning and health.

Disruptions in access to nature and outdoor play

Exploring, playing, and spending time in nature in childhood leads to better physical and mental health, improved performance in school, more positive self-image, stronger social skills, and more fulfilling lives.[74,75,76] However, climate change is posing risks to children's access to the outdoors as wildfire smoke and heat waves make outdoor recreation unsafe and less available.

Overburdened communities and climate change

People and communities do not experience climate change uniformly. Certain populations are more vulnerable due to a combination of factors that shape their ability to withstand and respond to climate-related hazards. Vulnerability is defined by three interrelated components: exposure, sensitivity, and adaptive capacity.[77] Communities already facing social and economic inequities often bear the greatest risks because these inequities heighten their exposure, sensitivity, and limit their capacity to adapt. Within the Climate Action Framework, groups experiencing disproportionate social, economic, and environmental burdens due to long-standing systemic inequities are referred to as *overburdened communities*. However, even within overburdened communities, individuals may experience climate-related risks differently depending on their specific circumstances.

In general, people at greater risk of climate-change-related harms, due to increased exposure, sensitivity and/or adaptive capacity, include (but are not limited to) those who:

- Are from historically marginalized groups, particularly those who are Black, Indigenous, Latine or Hispanic, Asian American, and people of color
- Face high energy burdens, for whom household energy costs are 6% or more of annual household income
- Are experiencing homelessness
- Are older adults, infants, children, or teens
- Are pregnant
- Have a disability, access or functional needs, or are homebound
- Are affected by chronic health conditions or other illnesses
- Are immigrants or refugees
- Are English language learners
- Have lower incomes or are experiencing poverty
- Live in manufactured homes or rental housing
- Work outdoors (e.g., agricultural or construction workers)
- Work indoors in non-cooled spaces (e.g., warehouse workers)
- Are incarcerated or formerly incarcerated
- Depend on the land for subsistence living, cultural practices, medicine, or income

Health benefits of climate change mitigation

Climate change mitigation strategies can benefit human health in a variety of ways. Some strategies can improve environmental conditions or foster behavioral changes that have health benefits. For example, cutting fossil fuel combustion can reduce exposure to harmful air pollutants, and expanding safe and connected infrastructure for walking, biking, and rolling can encourage increased physical activity. Mitigation strategies may also benefit health by influencing economic and social conditions, such as by creating new jobs.

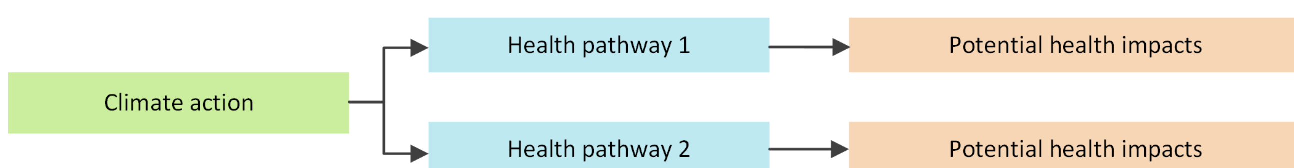
This section examines the potential health benefits of eight categories of climate change mitigation strategies and then reviews how these strategies together — along with workforce development and actions to increase business resilience — can support economic security and opportunity, which in turn can positively impact health outcomes for Minnesotans.

Due to the large number of action steps in the framework, this section does not cover every action nor identify all possible health outcomes. It focuses on major strategies in the framework for which large bodies of evidence demonstrate links to beneficial health outcomes. It also includes some strategies for which emerging research shows promising opportunities for protecting health. Many of these strategies and health outcomes were also identified as community priorities during the public engagement process that informed the framework. The following eight categories of major climate change mitigation strategies are included:

- Clean transportation: travel options and zero-emission vehicle adoption
- Climate-friendly food systems
- Wetland and grassland protection and restoration
- Forestland and tree canopy conservation, management, and expansion
- Clean energy
- Residential building electrification and efficiency
- Industrial decarbonization
- Circular economy

For each category and for economic security and opportunity, this section examines how current systems impact health in Minnesota and the pathways by which the mitigation strategies connect to health. These are referred to as *health pathways*. Each category includes a diagram depicting a high-level overview of the health pathways (Figure 1). For most actions, the health pathways are longer, interrelated, and more complex than illustrated in the diagrams. Some actions can help reduce the risk of a very lengthy list of chronic diseases/illnesses. These diagrams provide a high-level overview to illustrate the connections to health, rather than a detailed, exhaustive list of all potential health outcomes and explanation of the complex linkages and multiple factors that influence health outcomes.

Figure 1: Example of a health pathway diagram.



Clean transportation: travel options and zero-emission vehicle adoption

Framework goals referenced: 1 and 2

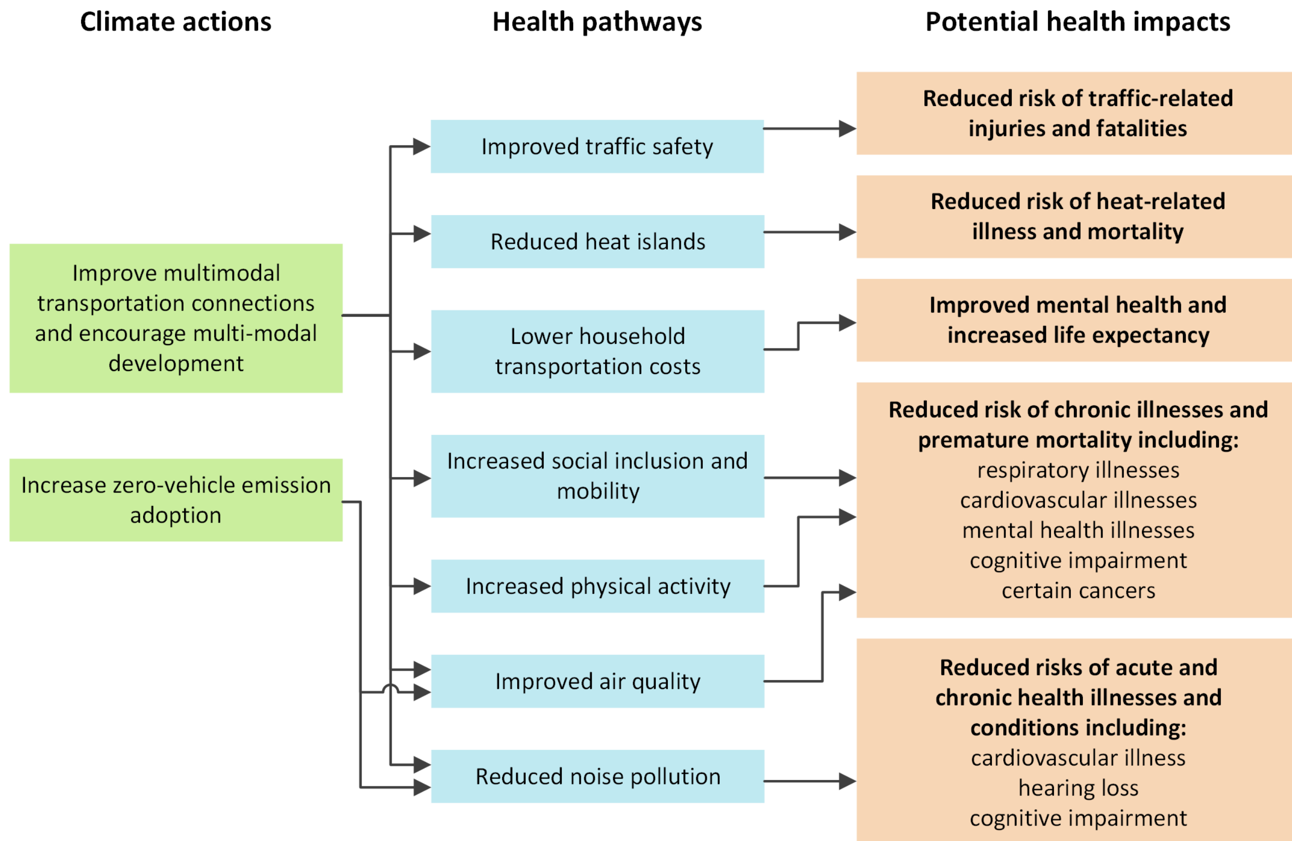
Transportation is the largest source of climate pollution in Minnesota, contributing to about 29% of the state's net total GHG emissions.[78] Goal 1: Clean Transportation in the framework includes two key initiatives to reduce GHG emissions that also protect public health.

Initiative 1.1: Travel Options aims to reduce vehicle miles traveled (VMT) per capita by 20% by 2050 through multiple, interrelated multimodal transportation and land use strategies. These include active transportation network improvements, land use policies that encourage compact and multimodal oriented development, and expansion of transit service and shared mobility options. Additionally, action steps in Goal 2: Climate-Smart Natural and Working Lands include compact and efficient land use planning and development strategies to avoid conversion of natural and working lands, which are mutually supportive with travel option strategies. An extensive body of scientific literature, described below, shows these strategies improve health outcomes and save lives through multiple pathways: increased physical activity, reduced heat islands, improved traffic safety and air quality, reduced noise pollution, lower household transportation costs, improved air quality, and increased social inclusion and mobility.

Initiative 1.2: Clean and Efficient Vehicles includes strategies to increase adoption of zero-emission light-, medium-, and heavy-duty vehicles and off-road vehicles across the state and sets a target to increase the proportion of zero-emission vehicles among all light-duty vehicles registered in Minnesota by 65% by 2040. Achieving this progress involves incentives, marketing, coordination, and expanding zero-emission vehicle charging infrastructure and accelerating the adoption of light-duty vehicles. Research demonstrates these strategies can benefit public health through two key pathways: improved air quality and reduced noise pollution.

Figure 2 provides a high-level overview of some of the key clean transportation health pathways and examples of some of the potential health impacts, which are further described below.

Figure 2: High-level overview of clean transportation health pathways.



Increased physical activity

Transportation system design is a strong predictor of physical activity because car-oriented environments reduce walking and biking and increase sedentary behavior.[79, 80] In Minnesota only about 30% of adults and 28% of children ages 6-11 are sufficiently active, dropping to 20% in adolescence. Widespread inactivity is linked to major health risks including cardiovascular disease, type 2 diabetes, cancer, poor mental health, and increased mortality.

Research shows that one of the greatest health benefits of shifting to active transportation modes (such as walking and biking) comes from physical activity.[81] VMT reduction strategies increase travel options, including active transportation, that increase opportunities for physical activity. The Rocky Mountain Institute Smarter MODES Calculator V1.2 estimates that achieving Minnesota's target to reduce VMT per capita by 20% by 2050 will save more than 800 lives annually in Minnesota by increasing physical activity. The Smarter MODES Calculator, developed by the Rocky Mountain Institute, uses state-specific data to estimate the emissions reductions and co-benefits of various combinations of vehicle electrification and VMT reduction. See endnotes for links to the calculator[82] and more information on methodology.[83]

Improved air quality

In Minnesota, transportation sources contribute the largest portion of air pollutants that pose health risks — 42% statewide and 48% in the Twin Cities metro. Most of the pollution from transportation is from combustion of gasoline or diesel fuel. Dust from brake pads and rubber from tires also contribute to air pollution.[84] Air pollutants from motor vehicle emissions include NO_x, $PM_{2.5}$, and VOCs, all of which have well-documented consequences for respiratory and cardiovascular health.[85] Higher exposure to air pollution contributes to elevated rates of asthma, cardiovascular disease, mental health impacts, and premature death.[86,87,88]

Reducing the amount of fossil fuels burned for transportation through VMT reduction and increasing the proportion of zero-emission vehicles reduces localized air pollution, contributing to improved air quality. Improved air quality is linked to improved respiratory and cardiovascular health, and reduced asthma rates and hospital admissions.[89,90,91] If school bus electrification is included, research shows benefits for children can include reductions in hospital admissions and emergency department visits, improved cognitive functioning and gains in academic performance.[92,93,94]

Reduced heat islands

Heat islands are areas that experience higher temperatures than outlying areas because structures such as buildings and roads absorb and re-emit the sun's heat more than natural landscapes such as forests, grasslands, and water bodies.[95,96] As a result, daytime temperatures in urban areas in the United States are often about 1-7°F higher than temperatures in outlying areas, and nighttime temperatures are about 2-5°F higher.[97] Heat islands are also known as "urban heat islands." However, rural areas also experience heat islands.

Heat island intensity is distributed unevenly and inequitably. Practices such as *redlining* have contributed to this inequitable distribution. Redlining refers to a banking practice that restricted loans for properties in racially mixed and predominantly Black neighborhoods, leading to lack of access to credit, reduced home ownership, and lower home values. A study comparing 108 urban areas across the United States on selected sunny days between 2014 and 2017, found that former redlined neighborhoods were 5°F hotter on average than other parts of the same city. The disparity was even more pronounced in Minneapolis, where the surface temperature difference was nearly 11°F between redlined districts and non-redlined districts.[98]

Car-oriented environments contribute to heat islands, where paved surfaces and vehicle emissions raise temperatures. High temperatures accelerate the chemical reactions with VOCs that in turn can increase ground-level ozone, further worsening air quality.[99]

Heat islands amplify heat exposure during the day and inhibit the body's ability to recover at night, elevating the health risks from heat.[100] These risks include dehydration; heat exhaustion; and heat stroke; and exacerbating existing medical conditions, like cardiovascular and cerebrovascular disease, diabetes, chronic obstructive pulmonary disease, pneumonia and asthma, and increased mortality.

Compact and multimodal-oriented development presents opportunities to align density, mobility, and greening to help mitigate heat islands. This form of design reduces motorized transportation — a heat source — while creating opportunities and space to integrate green infrastructure and reduce paved surfaces,[101] lowering health risks associated with extreme heat and air pollution.

Improved traffic safety

Traffic crash injuries and fatalities are an acute health consequence of our transportation system, and pedestrians and cyclists face a disproportionate risk. Action to address traffic injuries and fatalities is becoming increasingly urgent as traffic fatalities increased by 25% from 2010 through 2021 across the country, and pedestrian and cycling fatalities from vehicle collisions increased by 77%.[102] In 2023, the most recent year for which an annual report from the Minnesota Department of Public Safety was available, 402 people lost their lives in traffic crashes and 23,771 more were injured. Translated into economic terms, traffic crashes in 2023 resulted in the equivalent of nearly $2.4 billion in economic loss from fatalities, injuries, and property damage.[103] Data for 2024 show an increase in deaths — 475 people died in traffic crashes — and 23,753 injuries.[104]

Goal 1 includes a set of action steps to make nonmotorized transportation safe and attractive for all and sets a target to eliminate traffic deaths and serious injuries among nonmotorized users. The Rocky Mountain Institute Smarter MODES Calculator V1.2 indicates that achieving the VMT reduction target could prevent nearly 1,500 injuries and could save nearly 100 lives annually[105] through fewer traffic crashes based on research that shows increasing the proportion of people who walk and bike improves traffic safety.[106, 107, 108]

Reduced noise pollution

In urban areas, motor vehicles are the largest source of noise pollution.[109, 110] Road traffic noise pollution can contribute to sleep disturbance,[111] cardiovascular disease, metabolic dysregulation, high blood pressure, tinnitus (ringing in the ear), hearing loss, stress, anxiety, cognitive impairment, neurodegenerative disorders, and sleep disturbance. Long-term exposure to noise-induced stress can cause chronic inflammation and oxidative stress which plays a role in noise-induced vascular dysfunction, circadian rhythm disruption, neuroinflammation, accelerated aging, and microbiome changes.[112]

VMT reduction decreases the source of traffic-generated noise. Increasing the proportion of zero-emission vehicles can also reduce traffic-generated noise, because electric motors are quieter than internal combustion engines, especially at lower speeds. Together these climate pollution reduction strategies can reduce the negative health impacts associated with traffic generated noise.[113]

Lower household transportation costs

For low-income households in car-dependent neighborhoods where owning a car is necessary for mobility, the costs of owning and maintaining a car can substantially reduce household disposable income. Lower household disposable income is a strong predictor of poor health.[114]

On average, achieving a 20% VMT reduction per capita could save Minnesota households an average of nearly $1,500 annually from decreased fuel, parking, maintenance, and depreciation costs.[115] Lower transportation costs can improve financial and housing stability for low-income households, which are critical for physical and mental health outcomes, including increased life expectancy.

Increased social inclusion and mobility

Social inclusion, connection, and mobility are often overlooked but critical contributors to health. While each communities' needs and barriers are distinct, auto-oriented environments in both the metro and Greater Minnesota are shown in the research to contribute to social isolation and loneliness as well as inequities in access to destinations.[116, 117, 118] In auto-oriented environments, long distances, high travel costs, physical barriers, such as highways, limited public transportation, and dependence on private vehicles can increase social isolation and make it more difficult for people to access health care, employment, community activities, and social support, particularly for people with low incomes, older adults, and people with disabilities.[119, 120] In Minnesota, 25% of people are not licensed drivers for many reasons — including age, ability, income, and personal choice[121] — yet many communities are designed to prioritize private vehicle transportation.

Isolation is a public health concern as it increases risks for cardiovascular disease, cognitive deterioration, mortality, depression, psychosis, suicidal ideation, and dementia. These health issues can affect people's coping ability during emergencies, which are more common because of climate change.[122, 123] For example, isolated older adults are more at risk during extreme heat events.[124] Social isolation and loneliness are pervasive across the population, but it is especially significant and complex for people who are marginalized because of race, poverty, geography, sexual orientation and identity, and immigration status. In Minnesota, an estimated one-third of adults feel lonely sometimes, usually, or always.[125] Low-income, people of color, elderly, and disabled populations often have lower access to cars and public transit, resulting in lower travel frequency and limited access to jobs, education, and health care. People facing transportation disadvantages reported the lowest well-being scores.[126]

Actions to increase travel options — such as expanding transit service and shared mobility options and shortening trip distances through compact and multimodal-oriented development — are opportunities to increase mobility, reduce risks of isolation and loneliness, and strengthen social connections. Research indicates a significant association between increased mobility and reduced risk of social exclusion.[127] For example, promoting public transport options can increase social networking and reduce loneliness in older adults,[128] and improved transportation access can support social connectedness and better health outcomes for people with disabilities.[129] Better social connections are linked to improved mental health and cognitive function[130] and social connection is vital for climate resilience.[131]

Equity discussion

Transportation systems and policies in Minnesota have historically underserved and harmed Black, Indigenous, low-income, and other marginalized communities. Historic redlining practices contributed to segregating communities by race, and the subsequent placement of freeways in Black neighborhoods has contributed to exposing historically-underserved communities to more pollution and limiting their full access to transportation benefits.[132, 133] As a result, these communities continue to face disproportionate exposure to traffic-related risks, including higher rates of air and noise pollution, traffic injuries and fatalities, and heat islands.[134, 135, 136] For example, a 2020 study by the Minnesota Pollution Control Agency found that traffic-related air pollution in *environmental justice areas* is 54% higher than the Minnesota average. Moreover, this analysis showed that in environmental justice areas with at least 40% residents of color, traffic pollution is 145% higher than the Minnesota average.[137] As noted above, higher exposure to air pollution contributes to elevated rates of asthma, cardiovascular disease, mental health impacts, and premature death.[138, 139, 140]

The framework defines transportation equity as fair and just benefits, burdens, services and spending in transportation systems, as well as ensuring over-burdened communities have influence in decision-making. Travel options strategies help advance transportation equity because they can improve the health benefits of transportation through improved mobility, social connections, access to destinations and economic opportunities, increased disposable income, and minimize the disproportionate health harms from air pollution, traffic crashes, and noise for overburdened communities.

Environmental justice areas

Minnesota statute defines environmental justice areas as census tracts in which at least 40 percent of the population is "nonwhite;" at least 35 percent of households have income at or below 200 percent of the federal poverty level; at least 40 percent of the population over the age of five has limited proficiency in English; or which are located within Indian Country, which is defined as federally recognized reservations and other Indigenous lands. Census tracts need to meet only one of these criteria to be considered an environmental justice area.

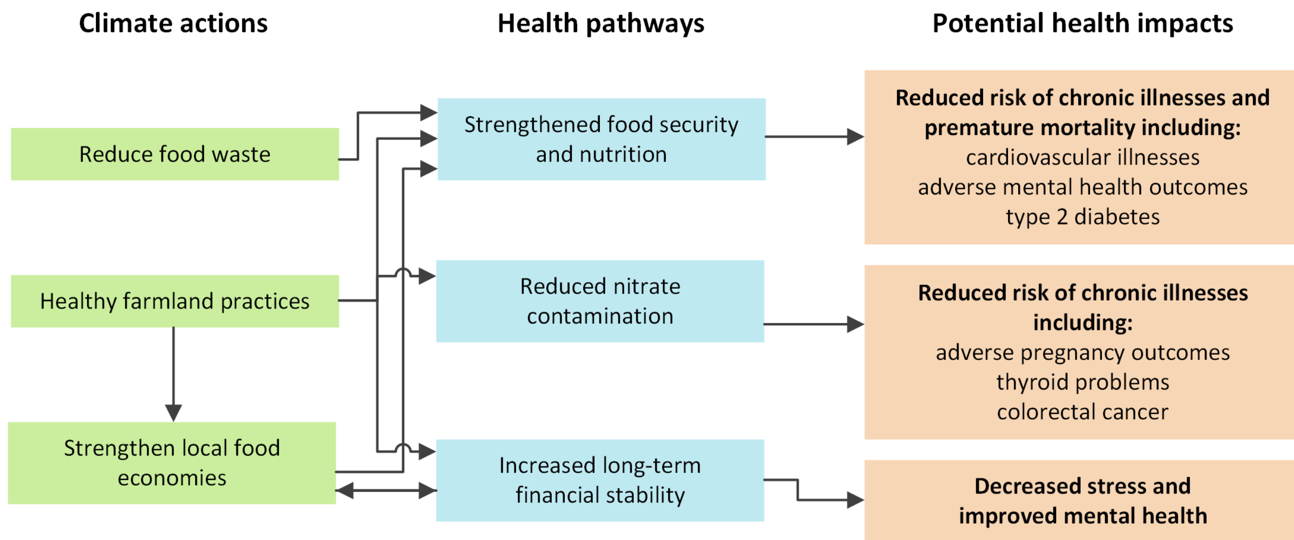
Climate-friendly food systems

Framework goals referenced: 2, 5, and 6

Minnesota's second-largest source of climate pollution is the agriculture sector, accounting for about 25% of the state's net GHG emissions.[141] To reduce climate pollution in Minnesota's agriculture sector, Goal 2: Climate-Smart Natural and Working Lands calls for expanding healthy farmland practices, strengthening local food economies, and reducing food waste. Goal 6: Clean Economy outlines strategies to reduce food waste from businesses, households, and institutions. Action steps to reduce food insecurity in Goal 5: Healthy Lives and Communities support these strategies. Together, these food system decarbonization strategies can protect public health through strengthened food security, increased long-term financial stability, and reduced nitrate contamination.

Figure 3 illustrates a high-level overview of some of the health pathways related to food systems mitigation actions and examples of some of the potential health impacts, which are further described below. The figure is simplified to demonstrate the connections to health, but, as with most mitigation actions and pathways, the relationships are more complex, interrelated and nonlinear; for example, some healthy farmland practices and increased farmer financial stability can also contribute to strengthening local food economies.

Figure 3: High-level overview of food systems health pathways.



Reduced nitrate contamination

Most Minnesota households have access to safe drinking water. However, in areas vulnerable to groundwater contamination, some public and private wells have nitrate levels that exceed the Health Risk Limit for nitrate.[142] A Health Risk Limit is the concentration of a chemical in drinking water that, based on the current level of scientific understanding, is likely to pose little or no health risk to humans, including vulnerable subpopulations. While elevated levels of nitrate in groundwater can result from several factors, more than 70% of the nitrate in Minnesota waters comes from cropland.[143]

Nitrate contamination in drinking water poses risks to human health, including methemoglobinemia ("blue baby syndrome"), which can result in serious illness or death.[144] Emerging research suggests long-term exposure to nitrate in drinking water at concentrations below the current regulatory standard may increase risks of thyroid problems, adverse pregnancy outcomes, and colorectal cancer.[145] Continued research will be important for clarifying the nature and severity of these risks.[146] Nitrate contamination mitigation is costly for small public water systems and households relying on private wells.

Healthy farmland practices in the framework such as cover crops, conservation tillage, diverse crop rotations, and perennial buffers can reduce fertilizer runoff, improve soil health, and protect water quality. These practices can lower nitrate contamination in water, which would lower health risks associated with nitrate contaminated drinking water and reduce water treatment costs.

Increased long-term financial stability for farmers

Multiple indicators show farmers are facing extreme economic strain due to declining profitability, climate variability, and market uncertainties,[147, 148] which contributes to stress and mental health challenges for farm families.[149] Farm profitability in Minnesota has declined markedly since 2022, putting many farmers under financial strain.[150] In 2021, one of the worst droughts in recent memory resulted in nearly 3,000 applications for the Agricultural Drought Relief Program, requesting assistance for a total of $19 million in eligible expenses.[151] In 2024, Minnesota farmers faced another difficult year and even greater financial difficulty. Median net farm income for Minnesota farms declined to $21,964 and net farm income for crop producers was nearly $0.[152] From 2024 to 2025, bankruptcies in Minnesota increased 300% for farm families that earn the majority of their income from farming. Farm bankruptcy filings are a lagging indicator that spike when extended financial pressures leave farms with few remaining options.[153]

Climate change is expected to worsen economic pressures through more extreme weather and crop production risks. Without action, annual crop productivity losses in Minnesota could reach $3.1 billion annually by the end of the century under a high emissions scenario. These costs are primarily borne by farmers (individuals and corporations), mostly in rural areas.[154]

Healthy farmland practices can reduce phosphorous and nitrate leaching, prevent soil loss, build resilience to flooding and drought,[155, 156] and can increase farm profitability in some cases.[157] Many Minnesota farmers already implement climate-smart land management practices. Supporting more farmers in their transition to climate-smart agricultural practices can increase financial stability and strengthen local economies in rural communities, ultimately leading to improved farm profitability and mental health outcomes.

Strengthened food security

An estimated 9% of Minnesota households experience food insecurity,[158] defined as "the limited or uncertain availability of nutritionally adequate and safe foods, or limited or uncertain ability to acquire acceptable foods in socially acceptable ways."[159] A large body of research demonstrates food insecurity is associated with a wide array of negative health outcomes such as cardiovascular disease, type 2 diabetes, adverse mental health outcomes in adults[160, 161] and cognitive problems, birth defects, asthma, and anemia in children.[162] Climate change further threatens food system stability, increasing risks of food insecurity globally.[163]

Climate change will continue to impact crop yields in Minnesota[164] and pose an accelerating threat to global food security.[165] In addition to reducing GHG emissions, healthy farmland practices help build resilience to climate impacts, making farms better able to withstand drought, flooding, and other extreme weather while stabilizing crop yields. Practices that improve soil health increase the soil's ability to retain water during droughts and absorb excess rainfall during heavy precipitation. Diversified crop rotations can also reduce the need for fertilizers and pesticides, lower pest and disease pressures, and increase production of crops for direct human consumption rather than those primarily used for livestock feed and biofuels.[166]

The framework incorporates many actions to strengthen local food economies. For example, Initiative 2.5: Enhanced Investments in Emerging Crops, Products, and Local Economies includes a suite of many action steps such as market development and integrating perennial crops, small grains, legumes, and other climate-beneficial crops into farm-to-institution programs. Healthy farmland practices and more resilient and profitable farms can also play a role by contributing to strengthening local economies and food systems. Supporting local food markets and regional food systems can strengthen Minnesota's food security in a changing climate by diversifying food sources, shortening supply chains, and creating more reliable markets for local farmers, making communities less vulnerable to disruptions from extreme weather and other shocks. Some research suggests that localized and diversified food systems are generally more resilient to climate-related disruptions because they rely on a broader network of producers, markets, and distribution channels rather than a few centralized supply chains.[167] Investments in local food infrastructure can play a role in supporting the resilience of producers and communities.[168] Context-specific analysis is needed to identify the benefits of specific programs. Outcomes vary depending on multiple factors such as product, supply chain, and scale. [169,170]

Initiative 6.3: Strong Circular Economy in Goal 6 includes action steps to prevent wasted food, including preventing waste from businesses and organizations that throw away large quantities of food, by offering incentives for food donation and rescue, providing technical assistance to improve food management practices, and requiring annual tracking and reporting. Efforts to distribute extra food to food shelves and other organizations can improve food security for food-insecure households, which is linked to a wide range of health benefits. Reducing wasted food can also reduce costs for households, businesses, and organizations. Together, these strategies can help strengthen food security.

Equity discussion

Food insecurity disproportionately affects low-income households and historically oppressed communities, while groundwater contamination places greater burdens on residents in Greater Minnesota and those relying on private wells. Tribal communities face additional challenges due to reduced access to traditional foods and ongoing threats to food sovereignty, which is linked to declines in overall health and food security.[171,172] At the same time, farmers, especially small and mid-sized producers, experience financial instability and limited access to resources needed to adapt to climate change.

Climate action strategies offer significant opportunities to advance equity by improving access to healthy, affordable, and culturally appropriate foods, while reducing environmental health risks. Investments in climate-smart agriculture can lower pollution burdens, reduce water treatment costs, and support more resilient rural economies. Strengthening local food systems and advancing Tribal food sovereignty initiatives empowers communities, supports self-determination, and promotes culturally relevant food access. By prioritizing community-led solutions and inclusive participation, these strategies help ensure that the benefits of a more resilient food system are shared equitably by all Minnesotans.

Wetlands and grasslands protection and restoration

Framework goal referenced: 2

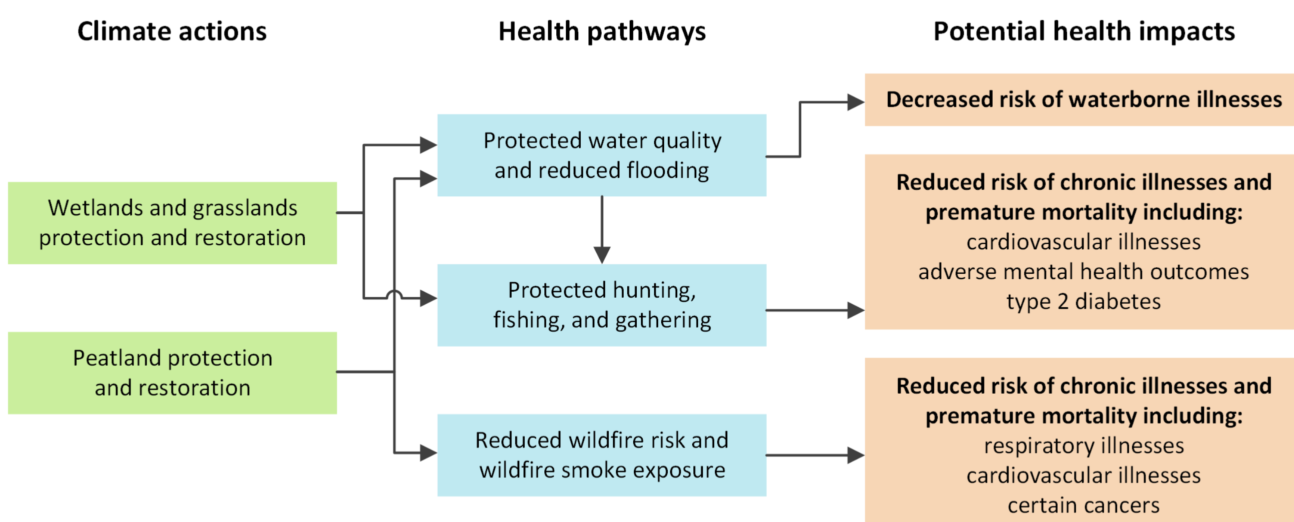
Wetlands and grasslands perform valuable functions in mitigating the effects of climate change while simultaneously benefiting public health by maintaining water quality and ecosystems that support culturally important plants and wildlife species. For example, prairie pothole wetlands, which are common in western Minnesota, support more than half of North America's migratory waterfowl and provide recreational opportunities for hunters and birders. Wetland and grassland habitats absorb, slow, and filter rainwater and snowmelt, reduce downstream flooding, and contribute clean water to our aquifers, lakes, and rivers, sustaining plants such as wild rice,[173] which is important for wildlife and as a traditional food source.

A peatland is a type of wetland where constantly saturated conditions lead to a build-up of plant materials over time, forming deep organic soils that effectively store carbon. Minnesota has more peatlands — nearly 7 million acres, and more than 10% of the state's land area — than any other state outside Alaska. However, significant drainage and tillage of peatlands for crop production in the 20th century has made drained peatlands the largest source of carbon dioxide emissions in the agriculture sector.[174]

Goal 2 of the framework includes coordinated action steps to protect, restore and manage Minnesota's wetlands and grasslands. These strategies not only reduce carbon dioxide and nitrous oxide emissions but increase carbon sequestration and storage and protect health by protecting natural hydrology, filtering pollutants, reducing fire risk, and preserving hunting, gathering, and fishing for all Minnesotans as well as Tribal communities' food sovereignty, treaty rights, and cultural health. As part of the Minnesota Climate Smart-Food Systems initiative, state, Tribal, and local governments and private landowners are working together to restore over 10,000 acres of peatlands.

Figure 4 provides a high-level overview of some of the health pathways related to wetlands and grasslands restoration and protection and examples of some of the potential health impacts, which are further described below. Note that while peatlands are a type of wetland, the diagram calls out the unique role of peatland restoration and protection in helping to reduce the risk of wildfires and wildfire smoke.

Figure 4: High-level overview of wetland and grassland health pathways.



Protected water quality and reduced flooding

Wetlands and grasslands play a critical role in protecting water quality by filtering pollutants, such as nitrate, and sediment out of water and lessening the threat of floods by storing water during snowmelt and rainstorms.[175] Studies have shown that watersheds with more intact wetlands and grasslands are less prone to flooding. When wetlands are drained, however, they lose their natural capacity to store and filter surface water and to recharge groundwater, resulting in degraded water quality and increased downstream flooding risks.[176] Grasslands that are converted to row crop agriculture or urban development lose most of their ability to capture rainfall and snowmelt and filter water from harmful pollutants.[177] Restoring grasslands, peatlands and other wetlands, typically by blocking ditches and removing drain tiles, can improve their capacity to store and filter water, reducing flood risks and enhancing water quality.[178, 179] These water quality and flood mitigation benefits help protect drinking and recreational waters, thereby reducing the risks of exposure to contaminants and waterborne pathogens.

Protected hunting, fishing, and gathering

Drainage and conversion of wetlands and grasslands threaten ecosystems that support hunting, fishing, and gathering. Grasslands and wetlands provide essential habitat for fish, waterfowl, and other wildlife, while supporting wild rice and other culturally and ecologically important resources that sustain communities across Minnesota, including Tribal Nations and the 1854 Ceded Territory.[180] Specifically for Tribal communities, the degradation of wetlands and grasslands threatens their ability to exercise their treaty rights to hunt, fish, and gather in ceded lands and waters. Climate change further disrupts these ecosystems, reducing access to fish, game, and gathered foods and medicinal plants and affecting the quality and abundance of these natural resources.

Exercise from hunting, fishing, and gathering can support a healthy lifestyle and potentially reduce health impacts associated with physical inactivity. Additionally, game, fish, and wild rice are healthy food sources, with less fat and more nutrients than highly-processed foods, which can help reduce the risk of chronic diseases associated with a poor diet.[181, 182, 183] The loss of wetland and grassland landscapes impact food security, cultural practices, recreation, local economies, and the health of everyone who participates in hunting, fishing, and gathering and those that depend on or supplement their diet with culturally significant foods.

Reduced wildfire risk and wildfire smoke exposure

As climate change increases the frequency and strength of wildfires, peatlands are at a greater risk of burning, due to their carbon-rich content. Drained peatlands can fuel intensely hot wildfires and enable them to smolder for weeks or even months at a time.[184] The 2021 Greenwood Fire in northern Minnesota, which burned nearly 27,000 acres and up to several feet of peat in some areas, became a worrying sign of peatland vulnerability to wildfires.[185] As noted earlier in the document, wildfires release harmful smoke and air pollutants that are dangerous to health with short and long-term risks.

Rewetting peatlands reduces fire risk and the corresponding risks associated with wildfire smoke exposure across the state. The public health protection benefits extend well beyond the areas surrounding peatlands to all corners of the state where wildfire smoke exposure is an increasing risk.

Equity discussion

Wetland and grassland restoration and protection provide important equity benefits by reducing environmental health risks from poor water quality and flooding and by sustaining healthy ecosystems that support culturally important foods and lifeways. These actions help sustain Tribal treaty rights, harvesting traditions, spiritual relationships, ceremonies, language, and stories, which strengthen American Indian communities' social cohesion, food security, economic resilience, and mental and physical health.[186, 187]

Forestland and tree canopy conservation, management, and expansion

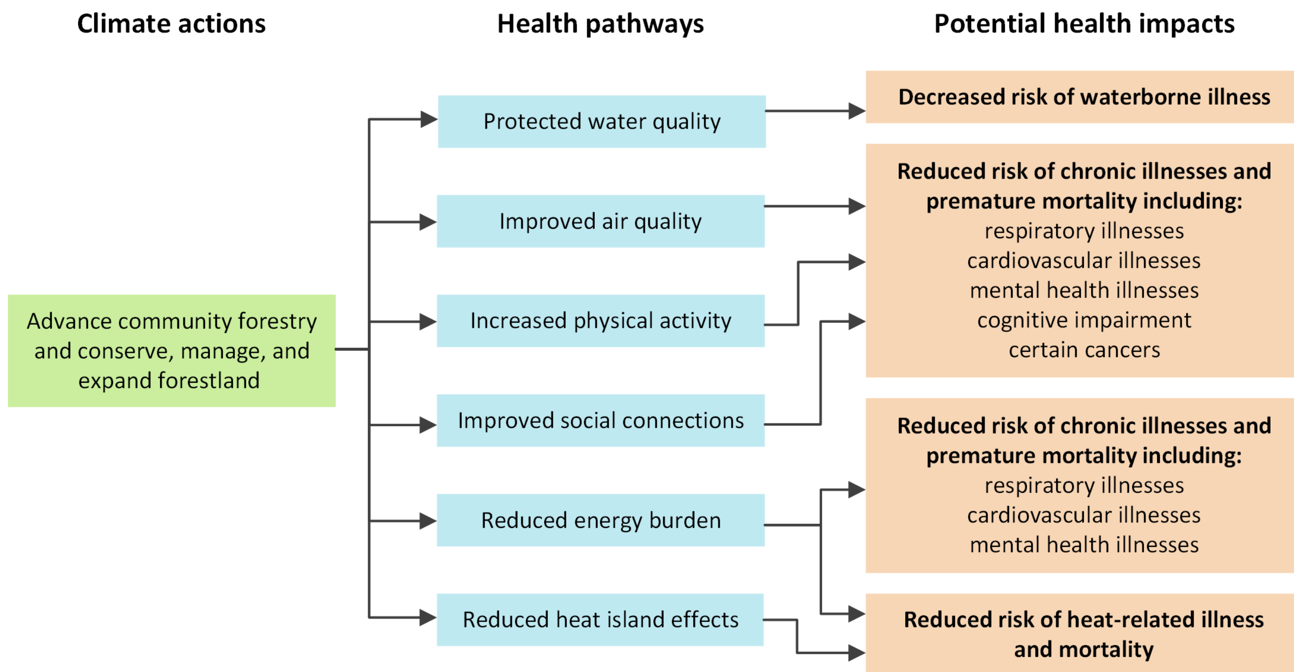
Framework goals referenced: 2 and 3

Minnesota's forests provide multiple benefits including wildlife habitat, recreation, water quality, timber and other forest products, and scenic beauty. They also sequester significant amounts of carbon dioxide each year, equal to about 15% of total annual statewide emissions.[188] Continued regrowth and sustainable timber harvesting practices have been critical to reestablishing Minnesota's forest carbon sink following the decades of widespread forest clearing for agriculture and unsustainable forest management practices during the late 19th century and early 20th century.[189, 190]

Building on this success, the framework outlines multiple actions to conserve, manage and expand forestland and tree canopy. Goal 2 of the framework includes action steps to maintain, expand, and actively manage forestlands, including accelerating tree planting to expand forest cover where ecologically appropriate and avoiding conversion of forestland to other uses. It also includes an action step to plant, seed, or promote tree species expected to do well under projected future climate conditions. Goal 3: Resilient Communities includes multiple action steps to advance community forestry with a target to achieve 30% tree canopy coverage by 2030 and 40% by 2050 in all Minnesota communities. Together these actions increase carbon sequestration while delivering significant co-benefits for public health.

Figure 5 illustrates a high-level overview of some of the key health pathways related to forestland and tree canopy conservation, management and expansion and examples of potential health impacts associated with these pathways, which are further described below.

Figure 5: High-level overview of health pathways associated with forestland and tree canopy conservation, management, and expansion.



Reduced heat island effects

As noted above under the clean transportation section, heat islands amplify heat exposure during the day and inhibit the body's ability to recover at night, elevating the health risks from heat.[191] Actions to expand tree canopy and community forests reduce surface and air temperatures, helping prevent heat-related illnesses and deaths.[192] Trees provide shade and cooling, improving thermal comfort, lowering heat exposure, and supporting safer living conditions during extreme heat events. Forests provide a substantial adaptive cooling benefit and can help with adaptation to rising temperatures by cooling surface and air temperatures over large areas, including nearby communities. The amount and geographic extent of this cooling effect depend on multiple factors such as solar radiation, season, and time of day. For example, a study in China found forests provide a cooling effect of up to 8.4°C compared to urban reference sites and cool air from forests can extend over a half mile into nearby built-up areas.[193] Another study found that forests in the eastern United States have cooling effects up to 5°C and locations surrounded by reforestation were up to 1°C cooler as compared to neighboring locations that did not undergo reforestation.[194]

Reduced energy burden

Energy burden refers to the financial strain of spending a large share of household income on energy bills. Energy insecurity is the inability to maintain safe and adequate heating, cooling, and electricity services. When households have high energy burden, they are more likely to face energy insecurity and be unable to maintain a safe temperature in their homes. Both are expected to increase as rising temperatures drive higher cooling costs.

Minnesotans must be able to efficiently and affordably maintain safe indoor air quality and temperatures in their homes. However, the U.S. Census Household Pulse Survey conducted in March 2024 indicates this is a challenge for many Minnesotans, with an estimated 1 in 5 Minnesota households unable to pay energy bills in full.[195] Warmer temperatures and increased humidity in Minnesota mean a growing demand for cooling energy. On average there were 40 more *cooling degree days*[196] per year in 1960-2023 than in 1895-1959 in the state.[197] This places more energy burden and risk of energy insecurity on households, especially those already struggling to pay their energy bills.

Energy insecurity is associated with acute and chronic health implications including asthma, poor sleep, and mental health impacts. When households experience energy insecurity they are more likely to reduce or forgo food or medicine, take financial risks, and engage in unsafe coping strategies to pay their energy bills and avoid utility disconnection.[198] Energy insecurity is associated with a higher likelihood of respiratory illness, cardiovascular illness, and mental illness,[199] as well as a greater risk of premature death.[200] Children in households experiencing energy insecurity are more likely to face food insecurity, hospitalization, reported poor health, and developmental risks.[201]

Strategies described in the framework for increasing tree canopy and forest cover play an important role in reducing household energy burden and ultimately protecting public health. Trees reduce energy demand by shading buildings in summer and blocking wind in winter, lowering cooling and heating costs.[202, 203] In Minnesota, strategically placed shade trees can reduce air conditioning bills by nearly 25%. Trees throughout the community (community forests) can help keep Minnesotans cool in the summer and sheltered from harsh winds in the winter.[204] This helps make homes more affordable to keep at safe temperatures, reducing heat-related health risks and energy burden.

Improved air quality

Air pollution contributes to respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD), as well as cardiovascular disease. Trees filter air pollutants, which can improve air quality and reduce respiratory and cardiovascular health risks.[205, 206]

The role of forests and trees in improving air quality is especially important in dense urbanized areas with air quality issues. Communities with limited green space often experience worse air quality. Increased canopy cover is associated with lower asthma rates and overall improved respiratory health.[207]

One of the many objectives of sustainable forestry is to reduce the risk of wildfire. As mentioned above, smoke from wildfires pollutes the air, making it harmful to breathe and impacting health. Prescribed fire is a multifaceted land management tool that can help improve forest health and reduce wildfire risk,[208] thus protecting air quality and public health and safety. While this tool generates smoke, projects can be designed to minimize negative impacts to public health.[209]

Protected water quality

Retaining and managing forests is one of the best ways to protect water quality. Trees and understory plants slow down and guide rain as it falls to the ground. This umbrella effect prevents soil from washing away into lakes and streams, while letting water seep deep to replenish groundwater in aquifers. In forests, numerous pore spaces in soils trap sediment, nutrients, and pollutants suspended in rainwater. This filter effect helps prevent contaminants from entering ground and surface waters. The pore spaces that filter contaminants also soak up and store rainwater and snowmelt like a big sponge. Over time, the forest soil slowly releases water and helps keep soil in place, reducing flooding and erosion. Urban trees are also important because they decrease water entering storm sewers by capturing rain, increasing flow of water into the soil, and transpiring water into the air.[210] This is important because 75% of Minnesotans get their drinking water from the forested parts of the state.[211] A 10% increase in forests in a watershed results in a 20% decrease in treatment and chemical costs downstream.[212] Clean drinking and recreational waters help prevent disease, reduce exposure to contaminants, and support healthier communities.

Increased social connection and physical activity

Lack of access to green space is associated with higher stress, poorer mental health outcomes, and reduced opportunities for social interaction and physical activity. Tree canopy cover can benefit both mental and physical health and encourage outdoor physical recreation and active transportation such as biking and walking.[213, 214] Being near trees is linked to improved social cohesion, reduced stress, and improved mental health.[215, 216, 217, 218] More tree canopy coverage is linked to increased physical activity, reduced obesity rates, reduced traffic speeds, and reduced neighborhood crime.[219, 220] The amount and proximity of neighborhood green space are associated with self-reported rates of depression, anxiety, and stress.[221] Individuals living in areas with low vegetation cover (around 10%) have significantly higher odds of experiencing mild or worse depression and anxiety, while mental health outcomes improve as vegetation increases, with notable benefits emerging at approximately 20-30% coverage.[222]

Equity discussion

Historical racial segregation, discriminatory policies, and long-term disinvestment have resulted in significant disparities in tree canopy and green space across Minnesota communities. Neighborhoods with lower incomes and higher proportions of residents of color often have fewer trees, higher temperatures, poorer air quality, and greater exposure to climate risks.[223, 224, 225] These inequities contribute to higher rates of heat-related illness, asthma, energy burden, and reduced access to the physical and mental health benefits of green space. Renters, multifamily households, and residents in top-floor units are especially vulnerable to extreme heat and have limited cooling access.[226]

Targeted investments in community forestry and tree planting in environmental justice areas may reduce health disparities by lowering temperatures, improving air quality, and decreasing energy costs for those most at risk. Expanding equitable access to green space can support physical and mental health, community safety and cohesion, and more livable neighborhoods. Community-led planning and implementation can promote self-determination, workforce development, and economic opportunities.

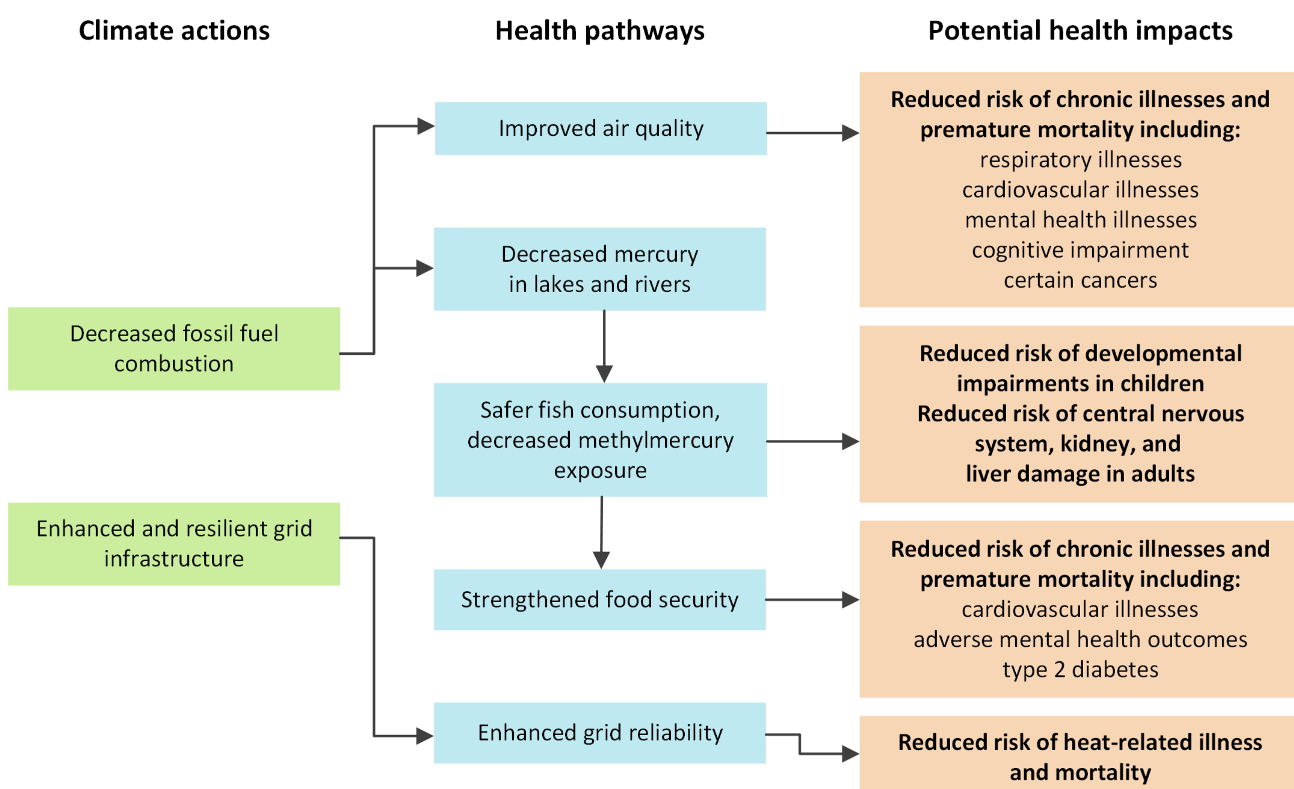
Clean energy

Framework goal referenced: 4

Electricity generation accounts for 20% of annual net total GHG emissions in Minnesota, mostly from coal and natural gas. This includes emissions from electricity generated both in state and out of state for Minnesotans. From 2005 to 2022, Minnesota cut GHG emissions in the electricity generation sector in half mainly by transitioning away from coal toward renewable energy. Renewable sources produced 32% of Minnesota-generated electricity in 2022.[227] Minnesota's Clean Electricity Standard became state law in 2023 and requires electric utilities to provide 100% carbon-free electricity by 2040. Goal 4: Clean Energy outlines strategies to implement this law and sets a course for long-term sustainable clean energy in the state. As part of the clean energy transition, Goals 3, 4 and 7 (Efficient and Resilient Buildings) include multiple strategies to reduce the risk of power outages, enhance system flexibility during extreme weather, and ensure access to reliable energy, which can help protect health through improved air quality and decreased mercury in lakes and rivers.

Figure 6 depicts a high-level overview of some of the key health pathways related to clean energy and examples of potential health outcomes associated with these pathways, which are further described below.

Figure 6: High-level overview of clean energy health pathways.



Improved air quality

In Minnesota, electricity generated from fossil fuels contributes to air pollution that harms human health. Exposure to $PM_{2.5}$ and ground-level ozone contributes to premature death, asthma attacks, respiratory disease, cardiovascular disease, and hospitalizations, even at pollution levels that meet federal air quality standards.[228] Communities located near heavy industry and fossil fuel infrastructure often experience greater exposure and disproportionate health burdens, particularly low-income communities and Black, Indigenous, and other communities of color.

Transitioning Minnesota's energy sector away from fossil fuels toward renewable and carbon-free electricity would reduce emissions of $PM_{2.5}$, ozone precursors, mercury, and other toxic pollutants, producing substantial public health benefits. Cleaner electricity would lower rates of asthma attacks, respiratory illness, cardiovascular disease, hospitalizations, and premature deaths associated with air pollution exposure.[229]

Reduced methylmercury exposure

Mercury released into the air from coal-fired power plants can transform into methylmercury in lakes and rivers, bioaccumulate in fish, and expose humans through fish consumption.[230] Climate change may further exacerbate mercury cycling and bioaccumulation.[231] When people eat fish with higher methylmercury on a regular basis, mercury concentrations can become high enough to pose a risk to their health. Exposure to methylmercury can damage the central nervous system, kidneys, and liver, with heightened risks for fetuses and children, including lasting problems with learning and development.[232] Fetuses are exposed to mercury through their mothers' blood, which passes through the placenta. Developing fetuses are most at risk because small amounts of mercury can damage the developing brain and nervous system. Mercury exposure can affect a child's learning abilities, memory, and attention, and lead to learning problems later in life.[233]

State regulations and national standards for mercury and air toxics emissions from coal-fired utility boilers have resulted in significant reductions of mercury emissions in Minnesota. In 2006, Minnesota passed the Mercury Emissions Reduction Act (MERA), which set a schedule for coal-fired utility boilers in the state to reduce mercury emissions by 90% compared to 2005 levels. As of 2015, all Minnesota utilities had achieved this reduction. Minnesota's emissions inventory data show that electric utilities emitted approximately 118 pounds of mercury in 2023. This is an increase from 2021's 105 pounds of mercury emissions, but in line with emissions from 2022 (121 pounds).[234]

Utilities continue to reduce their reliance on coal-fired plants in Minnesota as they shift to renewable energy. Mercury emissions will be further reduced as Xcel Energy retires its coal-fired power plants by 2030 and when Minnesota Power stops using coal by 2035.[235] These retirements will help lessen mercury contamination in lakes, reducing the risk of health harms associated with eating mercury-contaminated fish.

Strengthened food security

A large body of research demonstrates food security is critical for health. Food insecurity is associated with a wide array of negative health outcomes such as cardiovascular disease, type 2 diabetes, and adverse mental health outcomes in adults[236, 237] and cognitive problems, birth defects, asthma, and anemia in children.[238]

Fish is a beneficial and integral part of cultures and diets in many communities in Minnesota. For communities that rely on fish for subsistence and cultural practices, lowering methylmercury contamination can support safer fish consumption and, in turn, support food security and nutrition for these communities.

Reduced risk of power outages during extreme weather

While Minnesotans are accustomed to short-term electricity disruptions due to weather events, the risks to the grid are evolving due to several factors affected by climate change's impact on the number and severity of extreme weather events.[239] At the national level, most electrical grid failures occur during the summer months when the demand for electricity is maximized, which can have public health implications due to extreme heat and the inability to cool off using air conditioning or fans. A recent study showed that the concurrence of multiday electrical grid failures with heat wave events in the United States increases heat-related mortality, emergency department visits, and other heat-related morbidities.[240, 241]

Electrical grid failures pose additional health risks. For example, loss of refrigeration can result in loss of medications that require refrigeration, as well as jeopardize the safety of food.[242] Additionally, during engagement on the framework, participants highlighted how power disruptions and voltage fluctuations can damage household appliances and electronics, leading to unexpected repair or replacement costs. These expenses can create additional economic hardship for households already facing higher energy burdens or limited financial resources.

Grid modernization and resilience strategies help improve system reliability, reduce strain on the grid, and enhance the ability to meet peak demand, reducing the likelihood of widespread disruptions. This ensures continued access to cooling during extreme heat, protecting against heat-related illness and death, supporting food safety and preventing food loss, and continued refrigeration for medications that require refrigeration, which is especially critical for medically vulnerable individuals.

Equity discussion

Existing inequities in housing, infrastructure, and access to resources leave some communities more vulnerable to grid disruptions and their health impacts. Low-income households, renters, and communities of color are less likely to have access to backup power, energy-efficient housing, or resources to cope with outages. These communities are also more likely to experience higher energy burdens and limited access to cooling, increasing vulnerability to extreme heat and related health risks. Historical disinvestment and structural inequities have compounded these challenges, leading to disproportionate exposure to energy insecurity and climate-related hazards.

Grid reliability and resilience strategies can improve access to reliable, affordable, and resilient energy systems. Expanding distributed energy resources, community energy systems, and targeted infrastructure investments in underserved areas can help ensure that vulnerable populations are better protected during outages and extreme weather events. By reducing outage risks, lowering energy costs, and improving access to cooling, these strategies help advance health equity and support safer, more resilient communities for all Minnesotans.

Residential building electrification and efficiency

Framework goal referenced: 7

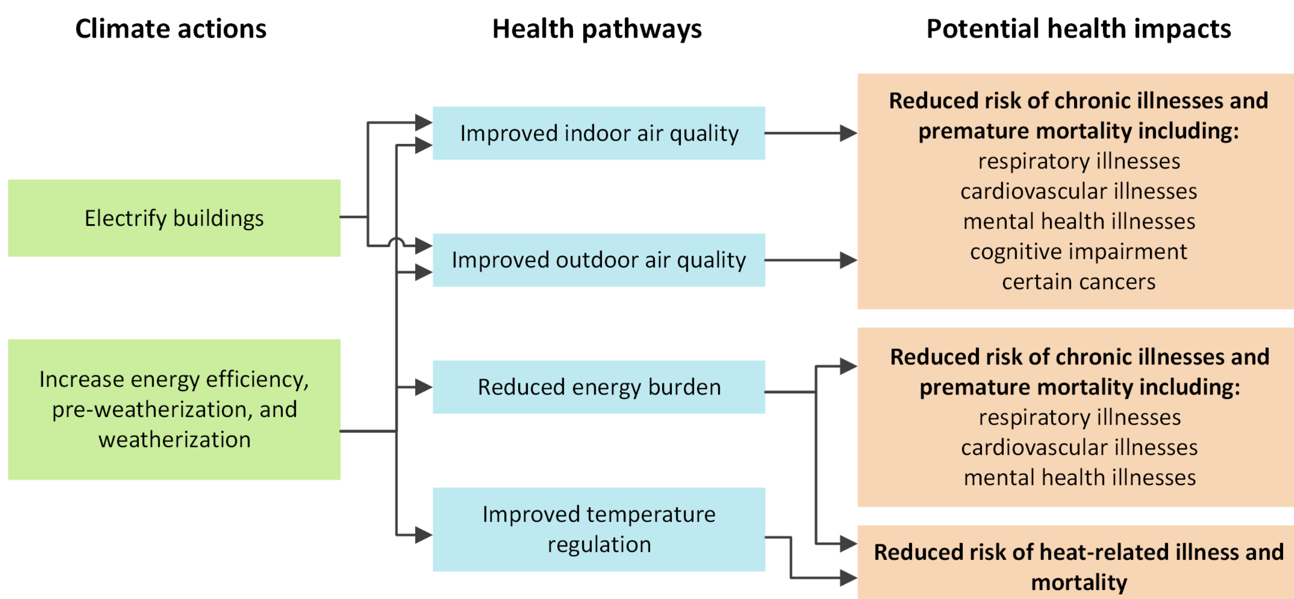
The residential sector is the fifth-largest source of GHG emissions in Minnesota, accounting for about 8% of the state's annual net total emissions, and its emissions have increased by 38% since 2005. Within this sector, natural gas combustion for heating and appliances is the largest GHG emissions source and is rising.[243]

Goal 7: Efficient and Resilient Buildings outlines actions to reverse this trend and reduce GHG emissions from residential buildings by 40% by 2050 through low-carbon and energy-efficient building technology, investing in building electrification, and retrofitting existing buildings. Initiative 7.1: Decarbonized Residential and Commercial Buildings includes a suite of subinitiatives and action steps to decarbonize residential and commercial buildings. The subinitiatives most closely linked to public health include Subinitiative 7.1.1: Increase Energy Efficiency and Heat Resistance in Buildings; and Subinitiative 7.1.3: Electrify Buildings to Reduce Emissions.

This section focuses on residential strategies because research shows that safe and high-quality housing is a fundamental determinant of health. Housing conditions are linked to physical and mental health outcomes and hospitalization rates, even after accounting for socioeconomic factors and neighborhood conditions.[244] Given housing's role in public health, Goal 7 strategies provide critical opportunities to improve some of the housing conditions associated with better health outcomes, through health pathways such as reduced energy burden, improved indoor and outdoor air quality, and improved temperature regulation. All these improvements are increasingly important to protect Minnesotans from a changing climate.

Figure 7 illustrates some of the key health pathways related to residential building electrification and efficiency and examples of potential health impacts associated with these pathways, which are further described below.

Figure 7: High level overview of health pathways associated with residential building electrification and efficiency.



Improved temperature regulation

With climate change, Minnesotans are facing more extreme heat events and will need to be able to protect themselves during these events by maintaining safe indoor temperatures. As described earlier in the document, heat exposure can have acute and chronic health impacts, and some populations are more at risk due to unequal exposure.[245] Housing conditions are important factors that can protect people from heat exposure. Weatherization strategies such as insulation and air sealing support maintaining safer indoor temperatures, which are especially important during extreme heat events.[246] Energy efficiency strategies can help households more affordably cool their homes. Research shows these improvements help lower the risks of heat-related illness and premature death.[247, 248] Improved temperature regulation is also important for households to be able to maintain safe indoor air quality and temperatures during wildfire smoke events.

Improved indoor air quality

Indoor air quality is a major determinant of health because people spend approximately 90% of their time indoors, with much of that time spent at home.[249] Inefficient and poorly maintained housing can lead to air leakage, inadequate ventilation, and exposure to indoor pollutants, contributing to cardiovascular disease, cancer, and respiratory conditions such as asthma and other chronic health issues.[250, 251] Children, older adults, people with chronic health conditions, and households with lower incomes often face the greatest health risks.[252]

The framework's energy efficiency, pre-weatherization, and weatherization strategies can improve health outcomes through improved air quality when paired with home performance upgrades such as air sealing, insulation, mechanical ventilation, filtration, moisture control, and replacement of old and inefficient combustion appliances and wood burning stoves that release indoor air pollutants.[253, 254, 255] These improvements can reduce indoor concentrations of radon, mold, bacteria, house dust mites, carbon monoxide, black carbon, VOCs, and other harmful pollutants, which research indicates can support a range of positive health outcomes, including decreased respiratory and asthma symptoms, and improvements in general physical and mental health.[256, 257, 258] It is essential that building upgrades include adequate ventilation, checking for carbon monoxide back-drafting, and testing for radon, to avoid the risk of worsening indoor air quality.[259] Proper and efficient ventilation removes unhealthy contaminants (such as smoke from cooking or combustion products from heating systems) and brings fresh air into the living spaces.[260]

Improved outdoor air quality

Building efficiency upgrades can protect health through reduced emissions from electricity generation and on-site fuel use. By reducing harmful air pollutants, energy efficient buildings in the United States were estimated to have averted between 172 and 405 premature deaths, 171 hospital admissions, 11,000 asthma exacerbations, 54,000 respiratory symptoms, 21,000 lost days of work, and 16,000 lost days of school from 2000 to 2016.[261] Overall, as described throughout this document, air quality is a critical driver of health outcomes.

Reduced energy burden

As described above in the Forestry section, Minnesotans must be able to efficiently and affordably maintain safe indoor air quality and temperatures in their homes, especially with warmer temperatures and increased humidity. The March 2024 U.S. Census Household Pulse Survey indicates this is a challenge for many Minnesotans, with an estimated 1 in 5 Minnesota households unable to pay energy bills in full.[262] The public health implications are multifaceted. Energy insecurity is associated with a higher likelihood of respiratory illness, cardiovascular illness, poor sleep, and mental health impacts,[263] as well as a greater risk of premature death.[264] When households experience energy insecurity, they are more likely to reduce or forgo food or medicine, take financial risks, and engage in unsafe coping strategies to pay their energy bills and avoid utility disconnection.[265] Children in households experiencing energy insecurity are more likely to face food insecurity, hospitalization, reported poor health, and developmental risks.[266]

Increasing the energy efficiency of buildings through programs like weatherization not only reduces emissions but also has demonstrated reduced energy costs and improved energy affordability and security. Weatherization programs can save households approximately $427 per year in energy expenses (expressed in 2025 dollars and calculated from $372 in 2022 dollars as expressed in the referenced study).[267] These actions reduce the energy burden and financial stress of maintaining safe indoor temperatures for households, which can support improved physical and mental health outcomes. Additional energy use due to extreme temperatures places more energy burden and risk of energy insecurity on low-income households, especially those already struggling to pay their energy bills. Weatherization and efficiency upgrades will become increasingly important to reduce energy burden and protect public health in a warmer, wetter Minnesota.

Equity discussion

Historical and structural inequities — including housing segregation, disinvestment, and disparities in homeownership — have left low-income households and communities of color with fewer resources to invest in housing weatherization and efficiency. These populations are more likely to experience energy insecurity, live in housing with poor insulation and ventilation, and face higher energy burdens and higher exposures to indoor air pollutants.[268, 269, 270] Data from the 2020 U.S. Energy Information Administration survey on household energy consumption show that, nationally, Black and Latino households in the United States are more likely than white households to experience energy insecurity and keep their homes at unhealthy temperatures. Seventeen percent of respondents identifying as Hispanic or Latino and 17% of those identifying as Black reported leaving their homes at an unhealthy temperature, as compared with 7% of households identifying as non-Hispanic/Latino and white.[271]

Housing type and condition are contributing factors to energy insecurity, and on average, low-income houses in the United States are 20% more energy intensive and have 145% higher air leakage than non-low-income houses.[272] Both small multifamily homes and manufactured homes consume more energy per square foot than all other housing types.[273, 274] People living in multifamily rental housing face the highest heat risk compared to other housing types.[275] Staying indoors is a top public health recommendation during wildfire smoke events, but the protective value of staying indoors to minimize wildfire smoke exposures is dependent on factors such as how well a home prevents the infiltration of wildfire smoke, and the ability to maintain a safe and acceptable temperature and indoor air quality.[276] Lower income households may not have the resources to follow this public health guidance and limit exposure at home during a wildfire smoke event due to energy cost burden, energy inefficiency, and lack of cooling and air filtration. These inequities can contribute to higher risks of exposure to extreme heat, poor indoor air quality, and associated health outcomes.

Investments in energy efficiency, weatherization, and resilient housing can improve living conditions and lower energy costs for those most burdened. Expanding access to pre-weatherization and weatherization programs for income-eligible households can support energy security, reduce financial strain, and support healthier indoor environments. These strategies also can improve resilience to extreme weather and wildfire smoke, particularly for vulnerable populations. By ensuring all Minnesotans have access to safe, affordable, and climate-resilient housing, these actions advance health equity while supporting climate mitigation goals.

Industrial decarbonization

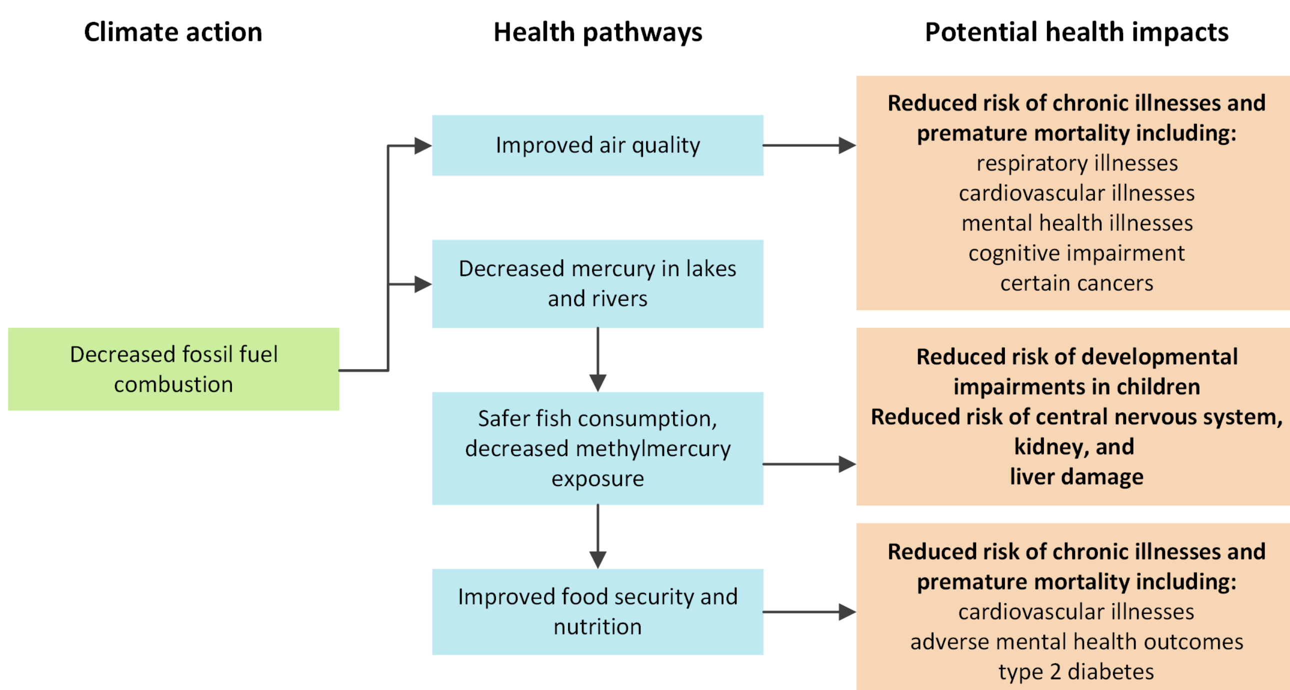
Framework goal referenced: 6

Minnesota ranks among the top 15 states for industrial emissions.[277] The industrial sector is the fourth-largest source of GHG emissions in Minnesota, accounting for about 18% of the state's net emissions. Emissions from this sector have increased 23% since 2005.[278] The industrial sector includes direct emissions from industrial facility processes and fossil fuel combustions.

The Goal 6: Clean Economy chapter sets a target to reduce GHG emissions from the industrial sector by 30% by 2050. To help reach this sector target, it includes a target to increase the share of onsite renewable energy use in the industrial sector by 50% by 2040. Strategies include improving energy efficiency and transitioning to cleaner fuels and electrification. In addition to lowering GHG emissions, these strategies present important opportunities to protect public health through improved air quality and reduced mercury emissions.[279]

Figure 8 provides a high-level overview of some of the key health pathways related to industrial decarbonization and examples of potential health impacts associated with these pathways, which are further described below.

Figure 8: High-level overview of industrial decarbonization health pathways.



Improved air quality

Industrial permitted facilities are the second largest source of air pollutants that pose health risks in Minnesota, contributing to 36% of air pollution health risk statewide, 34% in the metro and 45% in Greater Minnesota. The two broad categories of industrial pollution come from industrial processes and fuel combustion to power or heat those processes. Industrial pollution includes many types of air pollution including $PM_{2.5}$, VOCs, metals, greenhouse gases, and hazardous air pollutants and can contribute to a wide range of health outcomes including chronic respiratory disease, asthma exacerbation, heart disease, pneumonitis, decreased lung function, neurological damage, kidney damage, nausea, and cancer risks. [280] Increasing onsite renewable energy use and reducing fossil fuel combustion in the industrial sector provides an important opportunity to reduce air pollution and the associated health risks for people statewide.[281, 282]

Reduced methylmercury exposure

While state regulations and national standards for mercury and air toxics emissions from coal-fired utility boilers have resulted in significant reductions of mercury emissions in Minnesota, industrial activities still generate mercury emissions that can transform into methylmercury in lakes and rivers, bioaccumulate in fish, and contribute to mercury exposures and health risks to humans.[283]

Replacing coal-powered industrial processes with renewable energy will help contribute to mercury emissions reductions, which can ultimately bring health benefits through safer fish consumption and reduced mercury exposure.

Equity discussion

The relationship between air pollution exposure and disease is complex — we live, work and play in many places and the amount of pollution we breathe varies over time and place. Despite this complexity, air pollution poses higher risks for some people, including children, people over age 65, and people with pre-existing health conditions.[284] Communities near industrial facilities often face greater risks of exposure.[285, 286] National studies have shown racial and socioeconomic disparities in the distribution of industrial facilities and exposure to environmental pollution over multiple generations. In Minnesota, 76 out of about 2,000 facilities in Minnesota have modeled risks above guidelines. Only about 6% of communities in Minnesota are near one or more of these facilities. However, 14% of communities of color, which include Indigenous peoples, and 9% of low-income communities are located near one or more of these facilities.[287] Due to systemic inequities in policy enforcement, urban planning, and corporate practices, these communities are often disproportionately exposed to industrial air pollution, which exacerbates health, social, and economic disparities.[288, 289, 290]

Industrial decarbonization presents an opportunity to reduce environmental health disparities by lowering pollution levels in overburdened communities near industrial pollution sources.[291]

Circular economy

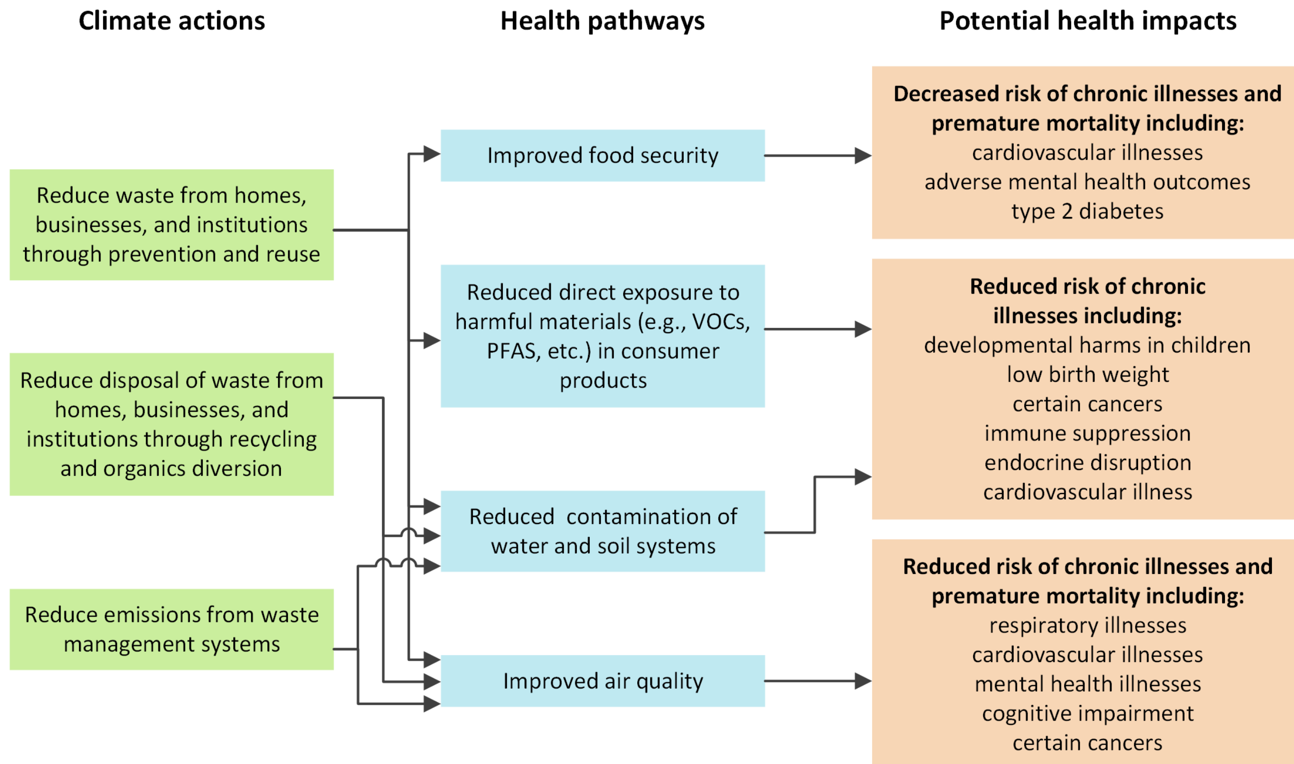
Framework goal referenced: 6

The waste sector produces about 1% of the direct GHG emissions accounted for in Minnesota's GHG emissions inventory. GHG emissions from the waste sector have decreased by about 40% since 2005 due to a combination of factors including landfill gas capture technologies.[292] However, the state's inventory does not include all consumption-based emissions — the GHG emissions released globally throughout the entire life cycle of the products and materials we consume from mining, manufacturing, transportation, use, and disposal of products and materials. These emissions are all important to consider regardless of whether they occur in Minnesota, in another state, or in a country on the other side of the world. When these indirect emissions are factored in, the total emissions attributed to Minnesota are at least an estimated 40% higher than the levels reflected by the "in-state" GHG emissions inventory alone.[293]

Initiative 6.3: Strong Circular Economy in Goal 6 includes actions to reduce emissions and waste through reuse, repair, recycling, and decreasing demand for new materials. Initiative 6.3 aims to decrease landfilling and incineration and sets a target to reduce trash in Minnesota by 70% by 2050. Examples of strategies include increasing reuse and waste prevention, expanding composting and other organics management practices, and preventing wasted food through efforts such as food donation, rescue programs, and improved tracking and reporting. By decreasing demand for new materials and diverting items from the waste stream entirely, Minnesotans can have an impact on reducing emissions locally and globally while protecting public health by reducing environmental health risks and supporting food security.

Figure 9 provides a high-level, simplified overview of some of the potential health pathways related to circular economy strategies and potential health impacts, which are further described below. These climate actions are interrelated; for example, climate actions that reduce waste can in turn help reduce emissions and public health impacts from waste management systems.

Figure 9: High-level overview of circular economy health pathways.



Reduced waste and pollution exposure

Materials that become waste in Minnesota contribute to pollution and related public health risks. While our waste management system helps keep the public safe, no approach mitigates all public health risks entirely.

Landfills generate the most GHG emissions within waste management and can contribute to public health risks through air pollution, leachate, and toxic contaminants. Even well-managed landfills can release VOCs, particulate pollution including $PM_{2.5}$, and hazardous substances into surrounding environments, while landfill leachate can contaminate groundwater with nitrates,[294] heavy metals, per- and polyfluoroalkyl substances (PFAS), and other pollutants linked to cancer, endocrine disruption, neurological effects, and other chronic health harms. [295]

Waste-to-energy facilities combust mixed municipal solid waste to reduce waste volume and recover energy. These facilities are regulated air emission sources and use pollution control technologies, but they still emit pollutants that can affect human health, including acid gases, particulate matter, metals, nitrogen oxides, sulfur dioxide, and dioxins/furans.[296] While waste-to-energy may avoid some landfill-related impacts, such as methane generation from landfilled organic material, it remains lower on the waste management hierarchy than waste prevention, reuse, recycling, and organics recovery. For communities located near waste-to-energy facilities, cumulative pollution burdens and environmental justice impacts are important considerations.

Material and waste collection and transportation further contribute to pollution exposure in Minnesota through diesel exhaust from trucks and hauling equipment. Diesel emissions contain particulate matter, nitrogen oxides, and other traffic-related pollutants associated with asthma attacks, lung cancer, cardiovascular disease, adverse birth outcomes, and premature death.[297] In rural Minnesota communities, long distances between pickup locations can increase fuel use and transportation emissions. In areas without organized waste collection, multiple waste haulers often travel overlapping routes through neighborhoods, increasing traffic emissions and community exposure to diesel pollution.

Prioritizing sustainable materials management and waste prevention, expanding reuse systems, recovering materials for recycling and organics management (composting, anaerobic digestion, etc.), and building a circular economy provide significant public health benefits by reducing the amount of material that must be extracted, manufactured, transported, incinerated, or landfilled. It is important to note that reuse and recycling can lower overall emissions of particulate matter even when these processes involve some emissions. Because of the lowered life cycle impacts of preventing, reusing, or recovering materials, these actions can lower diesel exhaust, GHGs, dioxins, heavy metals, and hazardous chemicals while decreasing groundwater contamination risks and reducing exposure to toxic substances.

Reduced harmful exposures from consumer products

A consumption-driven economy encourages rapid manufacture, transportation, use, disposal, and replacement of short-lived consumer goods that sometimes contain harmful chemicals, increasing cumulative exposure to these chemicals and pollution throughout the product life cycle. Many consumer products, including plastics, electronics, furniture, textiles, carpeting, and personal care products contain or emit VOCs, PFAS, flame retardants, phthalates, bisphenols, and other hazardous substances during production, use, and disposal. These chemicals can contaminate indoor air, drinking water, soil, wastewater, landfill leachate, and food systems. For example, replacing carpet less often and reusing a stainless-steel water bottle are ways to reduce both life cycle GHG emissions and exposure to health harming chemicals.

VOC exposure is associated with headaches, respiratory irritation, asthma exacerbation, neurological symptoms, and increased cancer risk. PFAS are a family of manufactured chemicals widely used in many consumer products. PFAS exposure has been linked to immune suppression, elevated cholesterol, liver effects, developmental harms, lower birth weight, and kidney cancer. In Minnesota, PFAS contamination has affected groundwater, fish, biosolids, and drinking water systems, prompting state pollution prevention efforts including Amara's Law (Minn. Stat. § 116.943), which restricts avoidable PFAS uses by 2032.[298, 299]

Plastics and microplastics further contribute to health risks across the entire production, consumption and waste cycle. Plastic manufacturing, transportation, use, and waste expose people to microplastics and associated chemicals such as PFAS, phthalates, and bisphenols, that are harmful to humans. Studies are beginning to uncover the extent of human exposure and potential health impacts. Examples of health impacts include inflammation, endocrine disruption, cardiovascular disease, respiratory illness, developmental effects, and possible neurological harm.[300] Frequent replacement of low-durability consumer goods increases material throughput and creates repeated opportunities for exposure to health harming materials during manufacturing, shipping, household use, and disposal.

A circular economy that prioritizes prevention, reuse, repair, refill systems, product durability, recycling, reduced material consumption, and less toxic products reduces the demand for new material extraction, manufacturing, transportation, and disposal and can thereby reduce exposure to VOCs, PFAS, microplastics, and other hazardous chemicals associated with continuous production and waste cycles. Reducing the manufacture and disposal of PFAS-containing and plastic products may help limit long-term contamination of drinking water, food systems, indoor air, and ecosystems while lowering air pollution emissions from manufacturing and waste management associated with plastics and new manufactured goods.

Improved food security

As noted above in the Food systems section, an estimated 9% of households in Minnesota experience food insecurity,[301] which is a risk factor for developing or worsening chronic diseases such as heart disease, diabetes, and cancer.[302]

Initiative 6.3 includes action steps to prevent wasted food, including preventing waste from businesses and organizations that throw away large quantities of food by offering incentives for food donation and rescue, providing technical assistance to improve food management practices, and requiring annual tracking and reporting. Efforts to distribute extra food to food shelves and other organizations can improve food security for food insecure households, which is linked to a wide range of health benefits. Reducing wasted food can also reduce costs for households, businesses, and organizations.

Equity discussion

Landfills and waste facilities tend to be disproportionately located in communities with higher rates of poverty and larger populations of people of color, resulting in greater exposure to environmental hazards such as contaminated soil, air pollution, and toxic substances.[303]

Waste reduction strategies can support reduction of environmental health burdens in overburdened communities by helping to prevent landfill expansions and lowering potential pollution exposure.

Economic security and opportunity

Framework goals referenced: all

Climate change threatens Minnesota's economy by reducing labor productivity during extreme heat and wildfire smoke events and causing costly damage from severe storms and record-breaking floods. Extreme weather and changing precipitation patterns can also hinder crop productivity, disrupt supply chains, hamper worker productivity, and cause downstream economic losses. The Minnesota climate adaptation and resilience cost study projects that without further adaptation investment, climate change impacts in Minnesota will cost governments, private entities, and individuals $17 to $22 billion per year by mid-century. This is most likely an underestimation because the study only quantifies a subset of the significant and likely costs of climate change.[304] Below are some examples of the economic impacts from climate change:

- **Extreme heat and labor productivity:** Exposure to extreme heat can decrease motor-cognitive performance and physical work capacity, resulting in decreased worker productivity and increased risks of occupational health burdens.[305] The United States could lose on average $100 billion a year due to heat-induced lost labor productivity. Without meaningful GHG emissions reductions and actions to adapt to extreme heat, labor productivity losses could double to nearly $200 billion by 2030 and reach $500 billion by 2050.[306]

- **Wildfire smoke and income:** Wildfire smoke reduced earnings by nearly 2% of U.S. annual labor income ($125 billion in 2018 dollars) per year on average between 2007-2019.[307]
- **Climate change and agriculture:** Erratic periods of drought and excess rain and extreme heat cause stress to crops and livestock and impact agricultural production and decrease worker productivity.[308] In 2024, record breaking summer heat in the continental United States resulted in $5.4 billion in crop losses.[309]
- **Disasters:** Between 2020 and 2024, Minnesota experienced 23 regional disasters that cost a billion dollars or more, totaling an estimated $114.7 billion in Consumer Price Index-adjusted costs. This is one-third of the cost of all billion-dollar disasters since 1980.[310]

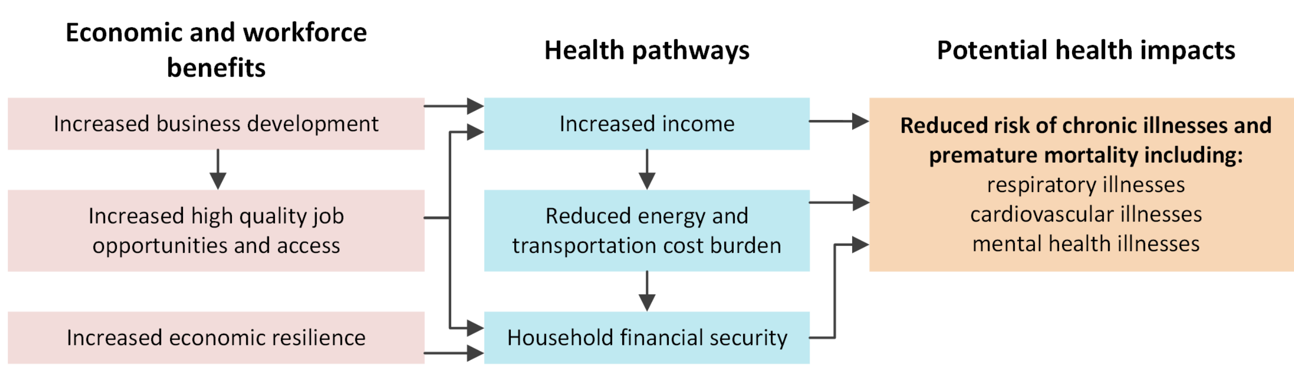
Research demonstrates that reducing GHG emissions does not mean sacrificing economic growth.[311] Minnesota has already made great strides in reducing GHG emissions while the economy has continued to grow. Since 2005, statewide greenhouse gas emissions have fallen by 15%, while overall economic activity has increased by more than 25%, employment has grown by more than 10%, and personal income per capita has grown by more than 20%.[312]

Actions across the framework offer opportunities to strengthen economic security amid uncertain climate change-driven economic pressures. For example, Goal 6: Clean Economy includes multiple action steps to increase business resilience, capitalize on emerging economic opportunities, and prepare workers for new, existing and changing career opportunities. Shifting away from fossil fuel dependence helps reduce Minnesota's exposure to volatile oil and gas markets, protecting businesses and households from future price shocks. Building a circular economy with increased reuse and local sourcing can strengthen economic stability by reducing reliance on global supply chains, thereby buffering Minnesota from supply chain disruptions and price volatility. Investments in innovation, economic development, and workforce development can create high-quality, accessible, family-sustaining employment opportunities across the state. Beyond Goal 6 of the framework, many framework actions can reduce household costs through energy efficiency and improved transportation options, strengthening household financial stability.

The economic impacts of climate change ultimately affect households through employment, income, prices, and financial security, which in turn influence health outcomes. Likewise, actions that build more efficient, resilient, and cleaner economies and communities can improve household health through these same pathways.

Figure 10 provides a high-level overview of some of the key health pathways related to economic and workforce benefits of climate action and examples of potential health impacts associated with these pathways which are further described below.

Figure 10: High level overview of economic and workforce benefits and health pathways.



Increased income and financial stability, and reduced cost burdens

Economic security supports public health. Economic factors, such as income, income inequality, wealth, job security, and occupation status, are among the strongest determinants of physical and mental health.[313, 314, 315] Higher income is linked to greater longevity and lower morbidity. Evidence also suggests economic insecurity negatively impacts mental health across the entire income distribution[316] and perceptions of future risks and loss may be even more harmful to mental health than experienced market volatilities.[317]

Transitioning to a resilient, low-carbon economy will increase demand for workers in clean-economy industries and other occupations that support climate mitigation, adaptation, and resilience. The workforce supplement to the framework shows that many of these industries and occupations provide family-sustaining wages across all regions of Minnesota, regardless of minimum education requirements, and demand for workers is expected to remain strong.[318] High-quality jobs, those that provide family-sustaining wages, benefits, safe and stable working conditions, worker voice, and pathways for advancement, can strengthen long-term economic security for workers and their families. Expanding access to these high-quality jobs can increase incomes, improve financial security, and ultimately support better health outcomes.[319]

Climate policies that support equitable access to residential electrification and efficiencies and improved multimodal transportation options can help reduce household cost burdens. Household savings can free up income for other needs and support household financial stability. Climate actions that reduce the economic damages and disruptions associated with extreme weather and changing weather patterns can also help protect household financial security and maintain the many health outcomes influenced by favorable economic conditions.

Equity discussion

Economic inequities, including income inequality, job insecurity, and unequal access to economic opportunities, contribute significantly to health disparities. Research shows income inequality is strongly associated with lower life expectancy, low birthweight, depression, mental illness, obesity, and higher rates of infant and child mortality. Income inequality has even stronger association with adverse health outcomes than poverty.[320] Low-income communities and communities of color are more likely to experience economic instability, higher cost burdens, and limited access to high-quality jobs. These inequities are compounded by climate change, which disproportionately impacts vulnerable populations through greater exposure and less resources to deal with economic disruptions and environmental hazards.

Climate action strategies that prioritize equitable access to economic opportunities can help reduce health disparities. Expanding access to green jobs, directing investments to underserved communities, and reducing household costs through energy efficiency and clean transportation can help improve financial stability and support upward mobility. By intentionally designing policies to benefit low-income communities and communities of color, Minnesota can ensure that the economic and health benefits of the clean energy transition are shared more equitably, supporting improved health outcomes for all.

Conclusion

Climate change is already affecting the health of Minnesotans through increasing exposure to extreme heat, wildfire smoke, flooding, severe storms, poor air quality, changing infectious disease patterns, and disruptions to food, water, housing, and community well-being. While climate change affects everyone, the impacts are not distributed equally. Children, older adults, Tribal Nations and American Indian communities, low-income households, people with disabilities, communities of color, outdoor workers, and others facing social and economic challenges often experience the greatest risks and have the fewest resources to adapt.

This document demonstrates that climate action is also public health action. The strategies outlined in Minnesota's 2026 Climate Action Framework offer opportunities to improve health while reducing greenhouse gas emissions. Evidence reviewed in this report shows that investments in clean transportation, climate-smart agriculture, wetland and grassland restoration, forestry, clean energy, efficient and resilient housing, industrial decarbonization, and circular economy approaches can generate substantial health benefits. These benefits include cleaner air and water, reduced exposure to extreme heat and wildfire smoke, improved physical activity and mental health, greater food and energy security, safer housing, stronger community connections, and more resilient local economies. The magnitude of these benefits will depend on how climate strategies are designed and implemented. Efforts that prioritize meaningful community engagement, address longstanding inequities, and direct resources toward communities facing the greatest burdens can help ensure that the health benefits of climate action are shared broadly across the state.

Climate change poses significant challenges, but climate action presents an opportunity to build healthier, more equitable, and more resilient communities. By prioritizing actions that deliver both climate and health benefits, Minnesota can save lives, reduce the risks of chronic and acute illnesses, advance equity, and improve quality of life. Acting now on these win-win strategies can protect health today while creating lasting benefits for future generations of Minnesotans.

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