CARBON REDUCTION STRATEGY

NOVEMBER 2023

The South Dakota Department of Transportation gives public notice of its policy to uphold and assure full compliance with the non-discrimination requirements of Title VI of the Civil Rights Act of 1964 and related Nondiscrimination authorities. Title VI and related Nondiscrimination authorities stipulate that no person in the United States of America shall on the grounds of race, color, national origin, religion, sex, age, disability, income level, or Limited English Proficiency be excluded from the participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving Federal financial assistance.

Any person who has questions concerning this policy or wishes to file a discrimination complaint should contact the Department's Civil Rights Office at 605-773-3540.

To the Carbon Reduction Strategy User

SDDOT has a history of developing an efficient, multi-modal transportation system that enhances access and mobility in both rural and urban areas. Projects like agricultural freight transfers from truck to rail increase energy efficiency. Other projects encourage active transportation, creating safer areas to walk, run, and bike. South Dakota balances projects to keep transportation emissions low and protect mobility.

Our strategy aligns transportation projects, plans, policies, processes, design, construction, operations, and maintenance to reduce emissions and promote safety, mobility, and accessibility. Our approach is sound because it also supports economic efficiency, economic and job growth, equity, and environmental stewardship. The strategy meets or exceeds all the requirements of federal guidance.

This strategy will keep transportation emissions low while we continue to provide a safe and effective transportation system for the state and the nation.

Cordially,

Joel Jundt, Secretary
South Dakota Department of Transportation

Table of Contents

List of Figures

List of Tables

Chapter 1 Introduction

The South Dakota Department of Transportation (SDDOT) Carbon Reduction Strategy meets all five major requirements of 23 U.S.C. 175(d)(2) and the minor ones by identifying projects and strategies to limit emissions.[1] It also supports USDOT Strategic Plan goals of Safety, Economic Strength, Equity, Climate and Sustainability, Transformation, and Organizational Excellence[2] and the national goals of the Federal Highway Program in 23 USC 150(b).[3]

One of the best ways to limit emissions is to not produce them since there is no need to reduce what isn't produced. Emissions and energy consumption are directly related so focusing on energy efficiency is a sound strategy to limit emissions. It is also a good investment because it supports economic efficiency and environmental stewardship as well.

SDDOT uses many methods, approaches, activities, and tactics to implement its main carbon reduction strategy to "**Allocate Resources to Improve Energy Efficiency**." The strategy goes beyond identifying eligible carbon emissions projects in the STIP. It coordinates, aligns, and balances transportation plans, polices, processes, operations, and construction to work harmoniously to improve emissions outcomes. Specific carbon reduction projects and the detailed strategy are discussed more fully in Chapter 6.

An intelligent approach to limit emissions aligns with economic and market forces to improve energy efficiency in ways that are appropriate to South Dakota's context or setting. This alignment strengthens positive outcomes. Developing a strategy that is "context sensitive" generates an effective approach while insensitivity to the setting impedes the strategy. SDDOT and South Dakota citizens understand that strategies and methods that work in an urban setting may not produce a favorable outcome in a rural setting.

In some states transportation can expose residents to increased carbon emissions and can be a barrier to mobility and equity by severing neighborhoods. South Dakota has a history of developing a well-balanced multi-modal transportation system facilitating mobility and access for remote reservations and other rural and urban areas. Otherwise, many people and places would not be connected. An example is the US Highway 83 corridor south of I-90 that recently received a 2023 America's Transportation Award in the Quality of Life and Community Development category by modernizing U.S. Highway 83. Aided by a BUILD Grant, the corridor improved access to the Rosebud Reservation and added pedestrian walkways to boost pedestrian safety (Figure 1). The result was enhanced mobility as well as creating safer areas to walk, run, and bike. This example illustrates modal balancing SDDOT has used for decades to improve mobility while reducing emissions and promoting energy savings. This is one reason South Dakota's transportation emissions remain low.

[1] https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title23-section175&num=0&edition=prelim
[2] https://www.transportation.gov/sites/dot.gov/files/2022-04/US_DOT_FY2022-26_Strategic_Plan.pdf, page IV.
[3] https://www.law.cornell.edu/uscode/text/23/150

The most unique features of South Dakota's context compared to the rest of the country are:

1. Distances to urban centers with health care and other services require long drive times.
2. Large farms and ranches require an extensive road network to obtain seed and fertilizer and to ship crops to national and international markets.
3. The state serves many dispersed Tribes, Native American communities, and rural communities.
4. A high percentage of South Dakota's road users are out-of-state freight trucks and tourists.

Figure 1: Active Transportation on the Rosebud Reservation (Used by Permission)

5. Transportation users depend on highways and motor vehicles as the main modes of travel because of the economy, population densities, and their effect on practical transportation choices.
6. A small population exists to fund the road network.

SDDOT cannot, and does not want to, dictate to its customers how they will use the state's transportation system. Tying the "invisible hand" guiding individual transportation choices hinders those complementary forces and does not nurture a harmonious and coordinated strategy that will limit emissions while supporting resilience and mobility. South Dakota's strategy will be shaped by the extent and limits of what SDDOT can control and influence.

This document explains how SDDOT will limit emissions. Overall efficiency, including energy efficiency, has always been important to SDDOT. Now, emissions language in the Infrastructure Investment and Jobs Act (IIJA) (Public Law 117-58, also known as the "Bipartisan Infrastructure Law" (BIL) § 11403) focuses SDDOT on energy efficiency as an important strategy to limit emissions. The goal of SDDOT's strategy is to implement the national Carbon Reduction Program (CRP) purpose as conveyed in the guidance of April 21, 2022:

> "The purpose of the Carbon Reduction Program (CRP) is to reduce transportation emissions through the development of a State carbon reduction strategy and by funding projects designed to reduce transportation emissions."[4]

Many locations in South Dakota allow few transportation alternatives other than automobiles and trucks. Shifting to other modes, except truck to rail, will be minimal in the rural areas. Many opportunities exist to support shuttle train loading facilities, agricultural processing facilities, and value-added plant location (Figure 2).

Figure 2: Rapid City Pierre & Eastern Assembles a Grain Train
Photo Courtesy of Ben Orsbon

Population densities are too low to support transportation options that are viable elsewhere. South Dakota is far from markets and that magnifies the importance of product weight, volume, value, and distance because these factors drive transportation efficiency, transportation costs, energy consumption, and emissions. To be effective, SDDOT emissions strategy must conform to its setting while protecting and improving safety, mobility, accessibility, equity, and economic and job growth.

Funding CRP projects supports the strategy through tangible actions. Energy consumption and emissions will be considered by SDDOT staff, contractors, and transportation users across SDDOT's broad spectrum of services, projects, and activities. This approach promotes SDDOT's Core Value of "**Innovation - Initiate and implement new ideas or methods to create value**."

Although limiting emissions isn't new, documenting an energy efficient strategy is new for SDDOT. This strategy aligns many things inside and outside SDDOT to work together in

[4] 23 U.S.C. 175 as established by the IIJA, page 3, https://www.fhwa.dot.gov/environment/sustainability/energy/policy/crp_guidance.pdf.

complementary ways. Aligning many little things harmoniously accomplishes great things by cumulatively amplifying the impact. The development of this strategy begins that process, but execution of the strategy makes it effective.

To limit transportation emissions, the Federal Highway Administration's Guidance proposes that state DOTs develop a CRP strategy to be updated every four years and fund CRP projects. Because context shapes the effectiveness of both the program and the strategy, Congress required that the program shall be appropriate to the population density and context of the State.[5] In every location context shapes what the transportation system does and how it does it. Requiring the context and setting to influence the development of the strategy aligns safety, transportation accessibility and equity, practical outcomes, sustainable economic growth, and limit emissions in the many different settings across the country.

A successful strategy results from concentrating on energy efficiency from a foundation of a healthy economy. Otherwise, it could lead to inaccessibility, weakened supply chains, loss of project resilience, environmental injustice, and mobility insecurity. The strategy must consider vulnerable populations. Good transportation access helps produce the resources necessary to limit emissions by supporting economic growth, jobs, trade, and commerce. Careful balancing is required to create a sustainable strategy that complements its context and supports accessibility for everyone.

SDDOT's strategy considers modal choices, access management, distance, weight, volume, travel speed, and accessibility unique to South Dakota. It goes beyond just the CRP eligible projects and aligns a broad spectrum of SDDOT plans, methods, and activities, and activities outside SDDOT that SDDOT might influence to reduce energy consumption, improve efficiency, save resources, and limit emissions.[6] The synergy from the positive interaction of these different approaches creates a combined effect that magnifies the outcome.

[5] https://www.fhwa.dot.gov/environment/sustainability/energy/policy/crp_guidance.pdf

[6] https://www.dakotanewsnow.com/2022/12/02/sigh-relief-heard-across-south-dakota-rail-system-vital-economy/

Chapter 2 Context Should Shape the Strategy

South Dakota has a long history of low-density farms and ranches linked by a transportation grid of roads and freight rail. The roads and rail connect to distant metropolitan areas and river and ocean ports. The large size and scale of South Dakota's farm and ranch operations and the distance between towns are foreign to many not familiar with the Northern Plains. There are few transportation modes other than automobiles and trucks and distances can be long to freight rail loading facilities.[7]

The ability of SDDOT to affect modal choices that control emissions is limited. Outside urban areas, transportation choices are shaped by travel time, distance, availability, cost, and practicality with cold winters and hot summers being important considerations. SDDOT's strategy will preserve the freedom to travel and will allow the customers to decide how they will use the transportation system. The strategy will be market-based, energy-efficient, and cost-efficient. Attention to preserving and strengthening strong, resilient global, national, and state supply chains will ensure agricultural and economic production are sustained.

Overall, South Dakota has great air quality. High winds can create dust during dry periods, but South Dakota meets all the National Ambient Air Quality Standards (NAAQS) for particulate matter, ozone, sulfur dioxide, nitrogen dioxide, lead, and carbon and has no nonattainment or maintenance areas. Because air pollution is virtually non-existent, the SDDOT's carbon reduction strategy will be simple and straightforward. The approaches between urban and rural areas will vary because in most cases rural strategies will not work in urban areas and vice versa. For example, urban approaches will include items like active transportation, more modal choices, energy-efficient project features, and Transportation System Management and Operations (TSMO) improvements to reduce traffic delay and improve traffic flow. Alternative passenger modes will not be as attractive in the rural areas because of densities.

When highway congestion is minimal, it is difficult to induce transportation users to shift to other more energy-efficient modes because travelers are not losing time sitting in traffic. But, the lack of traffic congestion is a good thing, not a bad thing for emissions. A measure that indicates system performance is travel time reliability. A formal definition for travel time reliability is the consistency or predictability to travel a certain distance, as measured from day to day and across different times of the day. Travelers value trip reliability because they can accurately plan departures and arrivals with minimal unproductive time.

Shippers and freight carriers especially rely on predictable travel times because manufacturers often use "just-in-time" and "lean manufacturing" practices to maximize economic efficiency.

[7] https://www.dakotanewsnow.com/2022/12/02/sigh-relief-heard-across-south-dakota-rail-system-vital- economy/

2.1 Travel Time Affects Emissions

The Federal Highway Administration (FHWA) collects travel time data across the nation on the National Highway System using the Regional Integrated Transportation Information System (RITIS).[8] RITIS shows how traffic moves on the National Highway System in relation to the speed limit. In 2021, South Dakota's Interstate system had a 99.9 percent travel time reliability rating and that means Interstate traffic was flowing at acceptable speeds 99.9 percent of the time. The non-Interstate National Highway System had a 95.2 percent rating in 2021, also illustrating smooth traffic flow. These data reinforce that South Dakota has minimal congestion on the state's highways.

Table 1 shows the travel time reliability for the Interstate and the non-Interstate NHS for all vehicles and the Truck Travel Time Reliability Index (TTRI) for the Interstate for the last five years. If the TTRI is close to 1.00, it shows that truck travel times are relatively uniform from the 50th percentile measure, the average, to the 95th percentile.[8,9] A number slightly greater than one indicates the 50th percentile travel time is only slightly greater than the 95th percentile travel time. Similar travel times between the two percentiles indicate very little congestion delay. Road closures are not used in the calculation of the reliability indices.

Table 1: Interstate and Non-Interstate Highway Travel Time Reliability

Year	Interstate Reliability	NHS Non-Interstate Reliability	Truck Travel Time Reliability Index
2017	99.8	94.0	1.15
2018	100.0	93.6	1.16
2019	99.9	92.8	1.19
2020	99.9	95.0	1.15
2021	99.9	95.2	1.19
Source: South Dakota Freight Plan and RITIS			

TSMO, traveler information, variable speed limits, good maintenance, limiting construction delay, and other strategies improve travel time reliability and fuel and emissions efficiency.

2.2 Population Distribution Shapes Transportation

In South Dakota's rural low-density setting, truck-to-train intermodal transfers and other energy saving enhancements to projects and operations will be incorporated into SDDOT's strategy. In every case SDDOT's approach must be simple to be successful. The strategy will address transportation's emission-producing activities, not just emissions produced by vehicles,

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8 https://www.ritis.org/intro

9 Page 2-16, National Performance Measures for Congestion, Reliability, and Freight, and CMAQ Traffic Congestion General Guidance and Step-by-Step Metric Calculation Procedures, USDOT, FHWA, June 2018'
Compute the Truck Travel Time Reliability (TTTR) metric as the 95th percentile travel time divided by the 50th percentile travel time for each of the five time periods for each reporting segment.
https://www.fhwa.dot.gov/tpm/guidance/hif18040.pdf

by encouraging energy efficient transportation system construction, operations, maintenance, and other activities in practical, feasible, and sustainable ways.

South Dakota is a very rural state with a total population of 886,667 in the 2020 Census. The average population density is a little less than 12 persons per square mile in an area of more than 77,000 square miles. In the United States the average population density is almost 94 persons per square mile.[10] South Dakota's rural density is far less than the state's average density. South Dakota is the 16th largest state ranked by size and 46th ranked by population. About half of the population is urban, with the metropolitan areas of Sioux Falls, Rapid City, and North Sioux City having a population of 192,517; 74,703; and 2,868 respectively. The sum is approximately 264,400 or 30 percent metropolitan. Seventy percent, or 622,250 of the state's population live in non-metropolitan cities, dispersed towns, and in low-density rural farming and ranching areas. Outside of the metropolitan areas, 211,976 live in urban areas of 5,000 population or greater.

The population of metropolitan areas and urban centers with populations over 5,000 is approximately 57 percent, or 505,000 of the total population. Consequently, small towns and rural areas are nearly half of the state's population. South Dakota's rural areas—with fewer houses and towns and larger farms and ranches—differ from the rural areas in more populated states. In the U. S., about 80 percent of the population is urban compared to South Dakota's 57 percent.

Figure 3 shows population growth by county from 2010 to 2020. Overall, the state grew slowly at 8.6 percent according to the U.S. Census. Most of the counties with growth of at least one percent per year were in the eastern part of the state except for Meade County in west central South Dakota. Lincoln County in the southeast, located on the south side of Sioux Falls, grew the most. Generally, western South Dakota is more rural than eastern South Dakota and the population is more dispersed. Highways often provide the only realistic access for Tribes and other rural residents.

Media mogul Ted Turner owns two ranches near Pierre that together have an area almost as large as New York City and nearly a quarter the area of the state of Rhode Island.[11] Figure 4 shows rangeland near the Turner holdings. South Dakota's sparse population and low densities greatly influence the practicality of some modal alternatives.

[10] https://www.census.gov/quickfacts/fact/table/US/POP060210

[11] https://www.tedturner.com/turner-ranches/turner-ranch-map/bad-river-ranch-south-dakota/

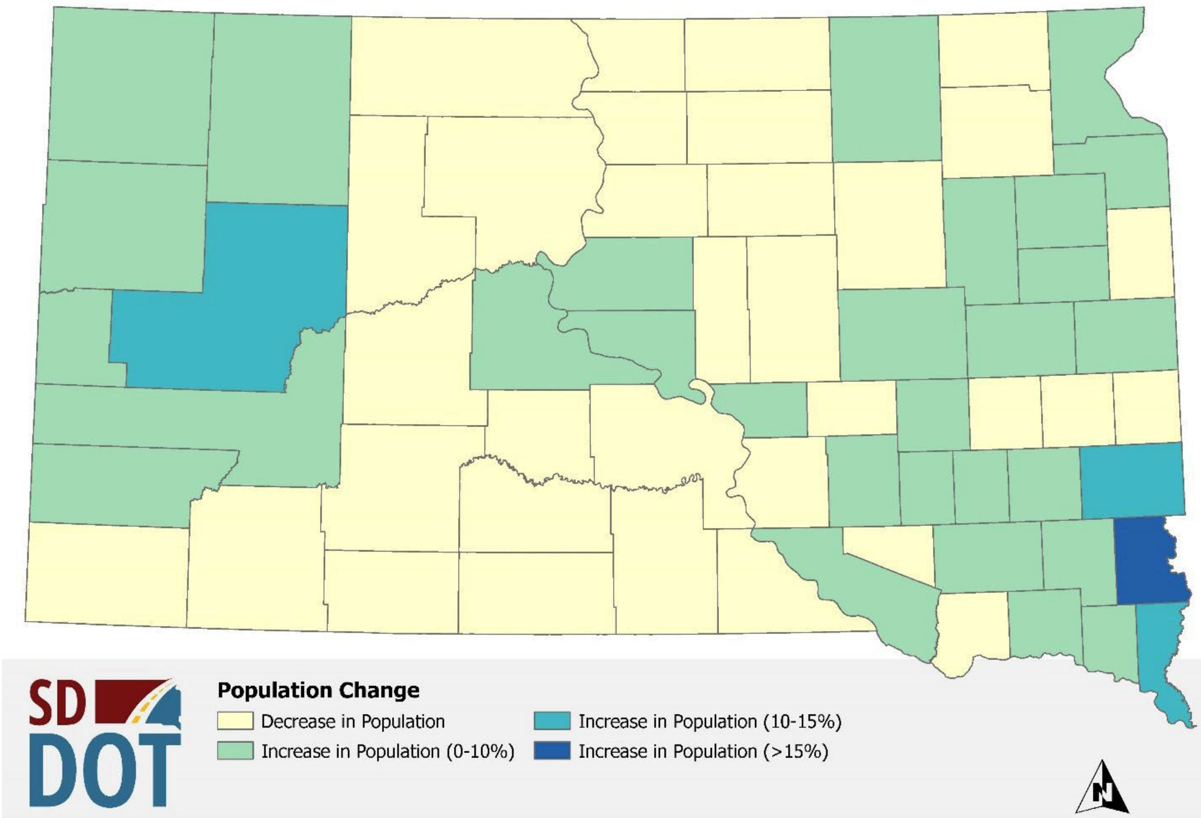

Figure 3: Percent Population Increase 2010 to 2020

Figure 4: Cattle along the Bad River
Photo Courtesy of Ben Orsbon

2.3 Transit Ridership During the Last Five Years

Transit ridership has fallen in South Dakota since 2018 and the "pandemic" did not help. The number of rural riders exceed urban riders. Rural ridership is starting to recover but urban ridership has leveled. Also, special riders like the elderly and those with challenges have also not recovered as shown in Figure 5. Over the last five years, transit ridership has dropped by almost a third. Consequently, transit ridership may not increase sufficiently to make a significant positive impact on energy efficiency or emissions reduction even if it recovers to previous levels of ridership.

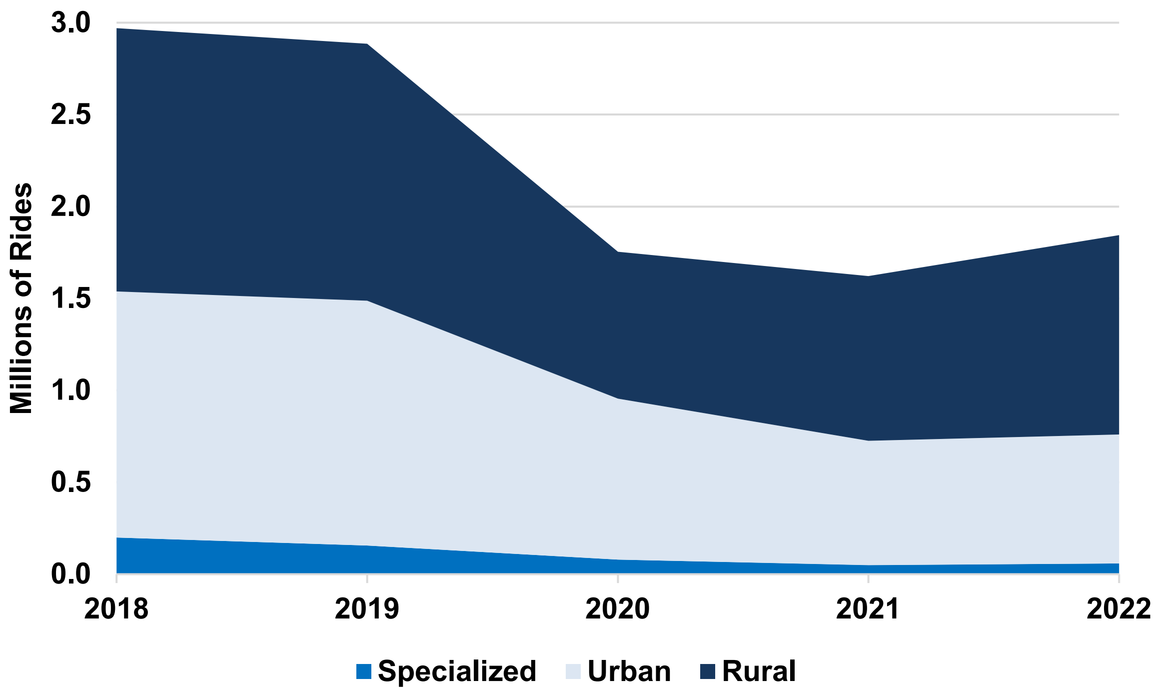

Figure 5: Transit Ridership 2018-2022
Source: SDDOT Transit

2.4 Settlement Patterns and the Economy Shape Travel and Emissions

The Northwest Ordinance of 1785 divided land into a grid pattern of one square mile parcels. In eastern South Dakota, the land use pattern and the public road network generally follow the one-mile grid to access farms. In western South Dakota, the road network and land use are influenced more by rolling terrain and physical features. The state highway system contains approximately 7,800 centerline miles and the entire public road and street network for all governments is almost 82,000 miles. The average farm size in 2017 was 1,443 acres, over two square miles. Many are much larger. Almost 20 percent of the farms are over 2,000 acres.

Western South Dakota farms and ranches normally are larger because the climate is dryer, requiring more acres to produce a sustainable income. The size of farms and ranches and the distances and locations of the towns that serve them shape the road system and modal choices.

Farms and Ranches Need Export Markets

With U.S. agricultural output growing faster than domestic demand for many products, U.S. farmers and agricultural firms have been relying on export markets to sustain their prices and revenues. As a result, U.S. agricultural exports have grown steadily over the past quarter century—reaching $177 billion in 2021, up from $66.5 billion in 1996. Exports have grown at about 6.6 percent per year.

Agricultural access is important for many reasons, not the least of which is the impact on the economy. U. S. agricultural exports in calendar year 2021 were $177.3 billion and produced an additional $190.5 billion in economic activity, for a total economic output of $367.8 billion. On average, that means every $1 of U.S. agricultural products exported generated a total of $2.07 in domestic economic activity. Every $1 billion of U.S. agricultural exports supported approximately 6,939 U.S. jobs throughout the economy. Agricultural exports in 2021 required 1,230,000 full-time civilian jobs, which included 772,000 jobs in the nonfarm sector.[12]

South Dakota agricultural exports provide similar benefits on a smaller scale. Corn is the major crop produced with a value of $4.4 billion making up 37 percent of the value of all South Dakota crops. Soybeans are next with a value of $2.7 billion with 23 percent of the value.[13] These two crops are almost half of the total acreage planted and 60 percent of the value. As the SDDOT plans for this and other economic activity the focus will be on freight efficiency.

Many agricultural production inputs are not located near areas of farm production. To be productive and profitable farms and ranches need an efficient transportation network connecting land, seeds, fertilizer, fuel, chemicals, cattle trucks, and trailers, and harvesting equipment.[14] Rail lines, pipelines and pipeline terminals, and shuttle train loading facilities served by the road network must accommodate heavy trucks, light-duty trucks, tractors, wide loads, and large harvesting combines. Figure 6 depicts the typical scale of farms.

[12] https://www.ers.usda.gov/topics/international-markets-u-s-trade/u-s-agricultural-trade/u-s-agricultural-trade-at-a-glance/
[13] https://data.ers.usda.gov/reports.aspx?StateFIPS=46&StateName=South%20Dakota&ID=17854
[14] https://www.ers.usda.gov/topics/international-markets-u-s-trade/u-s-agricultural-trade/u-s-agricultural-trade-at-a-glance/

Figure 6: Wheat Ready for Harvest Near Harrold
Photo Courtesy of Ben Orsbon

In rural areas, distances to services, education, and commercial and activity centers can require travel times of an hour or longer, so travel speed and time efficiency are critical. Summers are hot with days over 105°F common, and winters are cold with lows reaching −25°F and highs often below 0°F. Such temperatures are expected in South Dakota's continental climate, which is dominated by large land masses approximately 1,500 miles from the moderating influence of coastal water bodies. Non-vehicular travel in rural areas and even in urban areas in this setting varies seasonally to avoid life-threatening situations. Personal non-vehicular transportation and transit outside of urban areas are unrealistic in this low-density. Urban areas have more diverse land uses and are more conducive to a broader range of emissions-lowering alternatives like transit, bikes, pedestrian walkways, and active transportation.

Access to transportation is not just about freight and commerce; it is also about people.[15] Transportation equity is a key concern and in this rural setting access and mobility must be considered. Nine Tribal governments within South Dakota rely on roads to connect to critical services such as retail and wholesale centers, health care, schools, agricultural supply chains, grocery shopping, and other activities that sustain communities and enhance the quality of life. Sioux Falls has the only two hospitals in South Dakota nationally ranked by the U.S. News and World Report, and the only three considered "high performing." Because critical services are unavailable in many communities, passenger cars and light trucks are the main connection to the locations where the services exist.

In a rural setting, dependence on regional economic centers cannot be overstated. Economic centers are dispersed across the state and are influenced by the denser settlement patterns in eastern South Dakota compared to sparsely populated western parts of the state. Figure 7 shows the taxable sales for the population centers generating over $150 million in taxable sales along critical corridors.

[15] https://www.kcur.org/2023-02-24/rural-transit

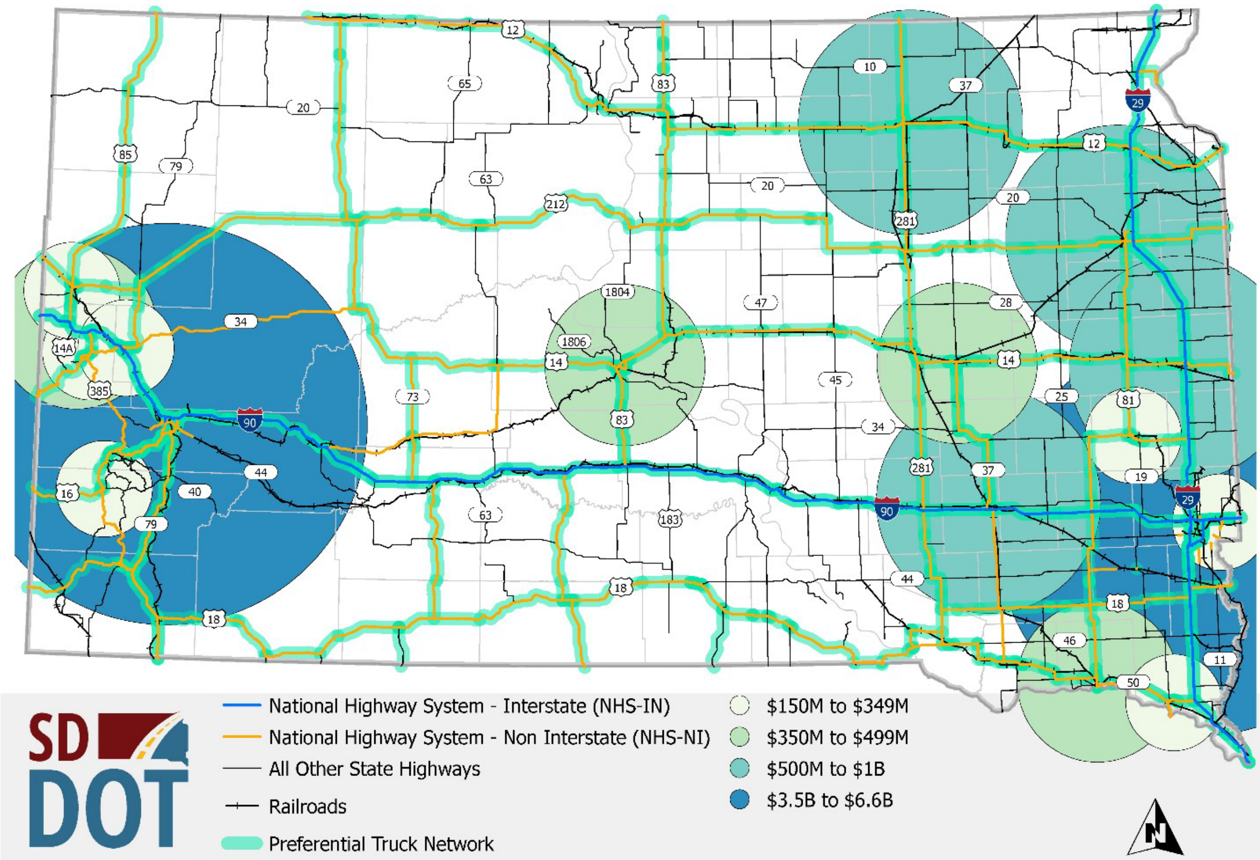

Figure 7: Taxable Sales
Source: South Dakota Department of Revenue

High-quality highway and freight rail assets connecting the surrounding areas to these commercial centers strengthen both the surrounding area and the regional center. This is accomplished by lowering transportation costs by improving access to each center's goods, materials, and professional, medical, and other services. The regional centers need the surrounding area to create an economy of scale large enough to economically sustain the services it provides. A center can provide more diverse and higher quality services because improved transportation expands its service area. Taxable sales are a measure of the strength of the dependency and a measure of the size of the regional center's service area.

The larger metropolitan areas in South Dakota have large taxable sales which are attributable not only to their large populations and strong economies but also to travelers and businesses from across the state purchasing the unique products and specialized services they offer. The economic activity along the Interstate 90, Interstate 29, and the expressway corridors depicts transportation's influence on the volume of sales and commerce. The size of a center's service area and the level of sales it generates partially depends on the population density of the area served. Lower density areas tend to have large service areas to create economies of scale sufficient to support specialized businesses and services.

Small towns provide fewer services. Travel distances from rural areas to these locations can be over 100 miles and more than an hour drive. Supporting strong, connected service centers is important to meet citizens' needs. A reliable transportation system between the service areas and citizens shortens the trips, affects vehicle miles traveled (VMT), and the level of emissions.

Rail Connects Exports to Distant Markets

South Dakota may rely on trains even more than other states. The president of the South Dakota Corn Growers Association says other states have more options.

"If you think about it, we're actually a very landlocked state," said Scott Stahl. "We don't have access to the Mississippi River or barges on the Missouri River that would allow for transportation other than the rail."

The rail line affects those on the receiving end too. "It's very critical to our partners in the ethanol industry. About half of the corn in South Dakota is used up by ethanol plants," said Stahl. "Our industry can continue to thrive and provide opportunities for our farmers across the state."

Other than Sioux Falls and Rapid City, only three cities—Aberdeen, Pierre, and Watertown—have commercial air service. To maintain reasonable driving distances to commercial service airports, the State Aviation Systems Plan strives to have at least 96 percent of the population with no more than a two-hour drive time. Even that is a long drive, particularly in bad weather.[16] Keeping the driving distance reasonable improves the quality of life, the opportunities for economic growth, increases safety, and it also helps control emissions.

[16] https://dot.sd.gov/transportation/aviation/aviation-systems-plan#listItemLink_1605

Chapter 3 Emissions and Context Are Connected

In 2019, South Dakota produced approximately 0.7 percent of the country's carbon emissions from all economic sectors by calculating emissions as a function of fuel consumption. South Dakota's transportation sector is very energy and emissions efficient relative to the size of its land area and its dispersed service centers. South Dakota ranked 45th in transportation-related carbon emissions produced, generating only 0.4 percent of the nation's transportation emissions.[17] Only the District of Columbia, Vermont, Rhode Island, Delaware, and New Hampshire produced less and were either smaller or more urban so their travel distances would be shorter. The sum of all their land area is less than 30 percent of South Dakota's. Distances between towns and services in these states depicts a very different context than South Dakota, where towns and services are much farther apart. Figure 8 gives an idea of the length of some of the trips from large farms and ranches in South Dakota compared to the smaller states. Figure 7 showed the locations with higher volumes of taxable sales where a wider variety of services are available.

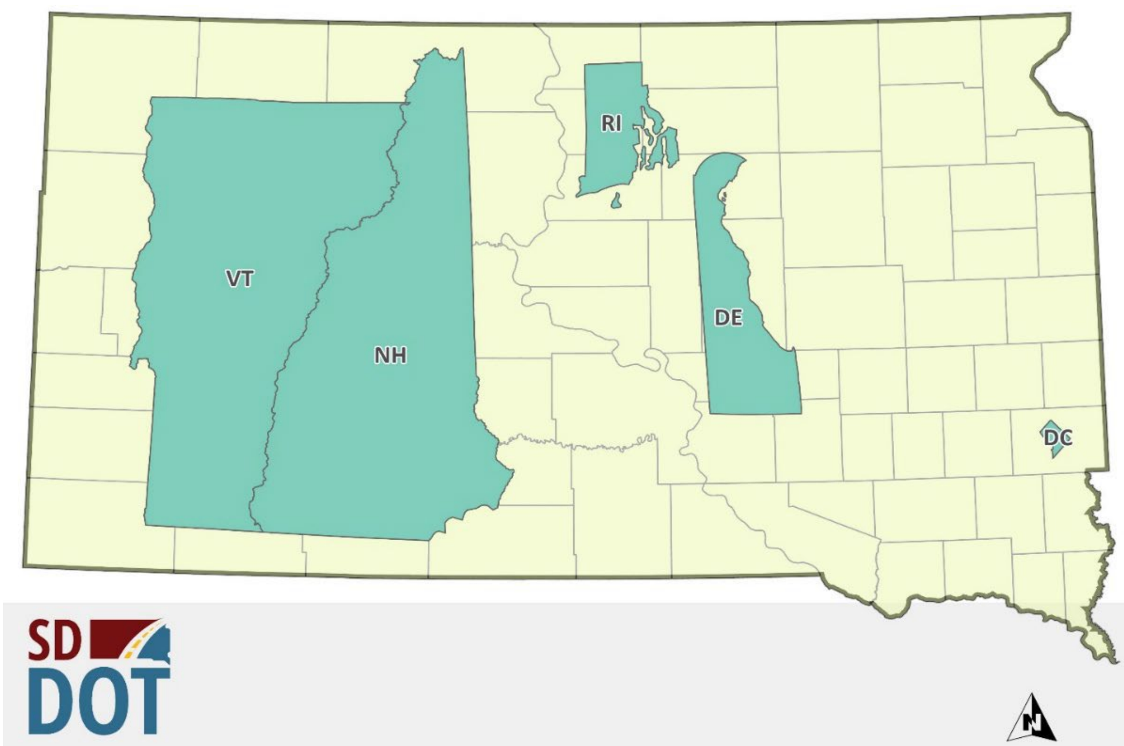

Figure 8: States and DC with Lower Emissions than South Dakota

[17] https://www.eia.gov/environment/emissions/state/

In 2019, South Dakota's transportation sector produced 6.8 million metric tons, or approximately 16 percent, of the state's total of 43.8 million metric tons of emissions. Transportation's percentage is a small compared to most states and the nation overall. Another positive is South Dakota agriculture and forestry were major emissions absorbers, removing 2.8 million metric tons from the atmosphere. SDDOT will continue the policies that have effectively limited transportation emissions. Nationally, approximately 33 percent of the carbon emissions are produced by transportation, twice the percentage of South Dakota's transportation emissions.[18] This highlights South Dakota's transportation, energy, and emissions efficiency even in its rural, low-density setting (Figure 9).

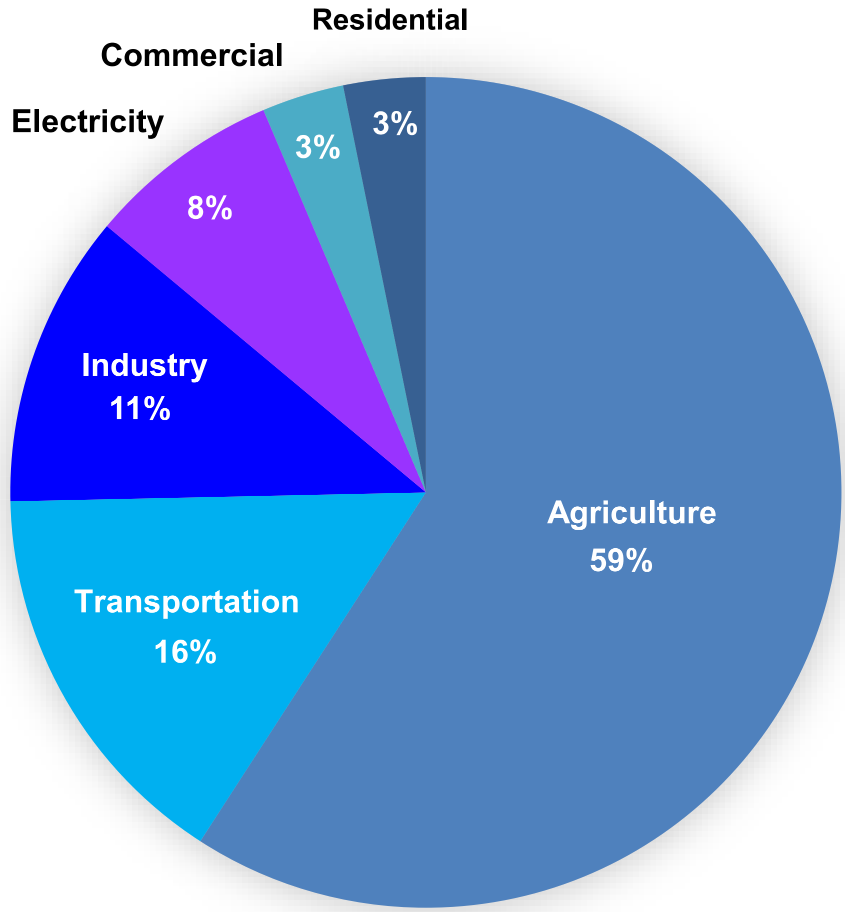

Figure 9: South Dakota 2019 Percent of Carbon Dioxide Emissions by Economic Sector
Source: https://usafacts.org/articles/where-carbon-emissions-come-from-in-each-state

Emissions growth in South Dakota's transportation sector has been slow over the last 20 years and has started to level off. In 1990, the transportation emitted 4.9 million metric tons and over the next three decades emissions grew to 6.8 million metric tons in 2019 (Figure 10). It grew about 40 percent over 30 years or about 1.1 percent per year.

[18] https://usafacts.org/articles/where-carbon-emissions-come-from-in-each-state/

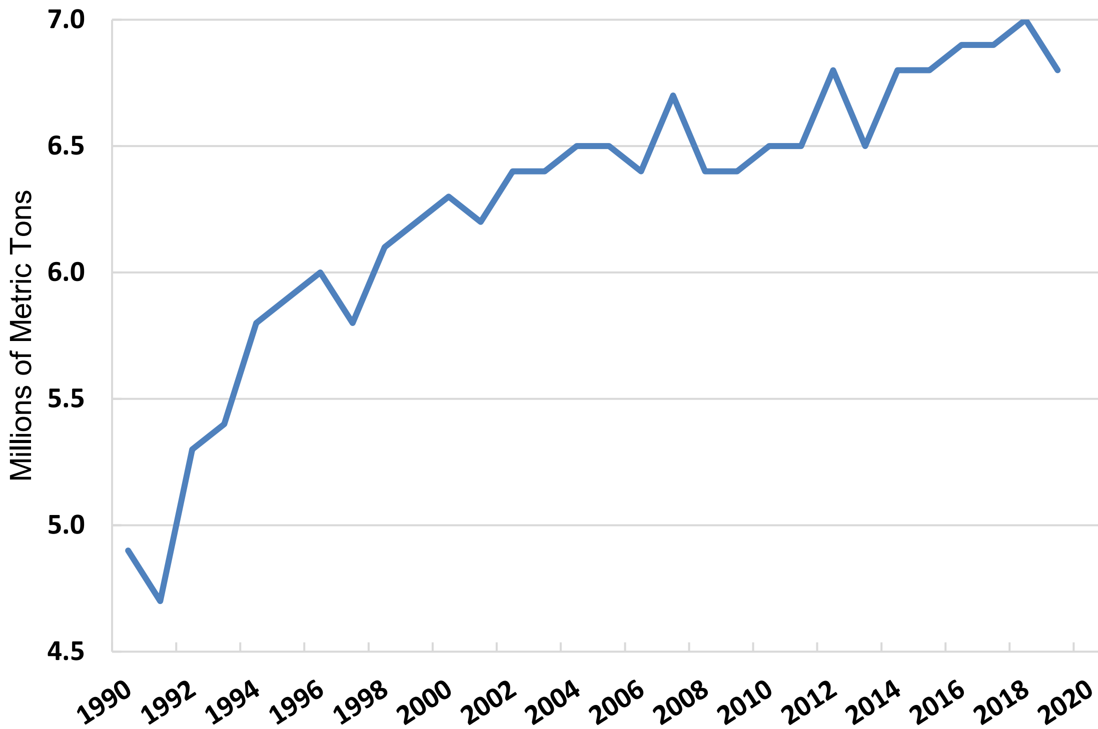

Figure 10: South Dakota Transportation Sector Carbon Emissions

Source: https://usafacts.org/articles/where-carbon-emissions-come-from-in-each-state

3.1 Sensitivity of Emissions to Context

Over the same period, VMT grew from 7.0 billion in 1990 to 9.9 billion in 2019, almost 42 percent or 1.4 percent per year (Figure 11). Emissions have been growing at a slower rate than VMT. Improved transportation facilities, vehicle fuel efficiency, and declining fuel consumption are likely contributors to this slower comparative rate.

In South Dakota there is a strong association between transportation emissions and VMT. The correlation coefficient, which shows the strength of the association between these two factors, is 0.83. If the correlation coefficient is 1.00, then emissions and VMT would be perfectly, positively correlated. Although correlation does not imply causation, it is apparent VMT and emissions are strongly connected.

South Dakota's distances and low population density make automobile travel more costly and demand inelastic. As previously mentioned, the National Highway System, other non-NHS state routes, local roads and streets have little or no highway congestion to slow traffic or indirectly encourage transit or other modes like bicycles and walking. Temperature extremes and distance also discourage it.

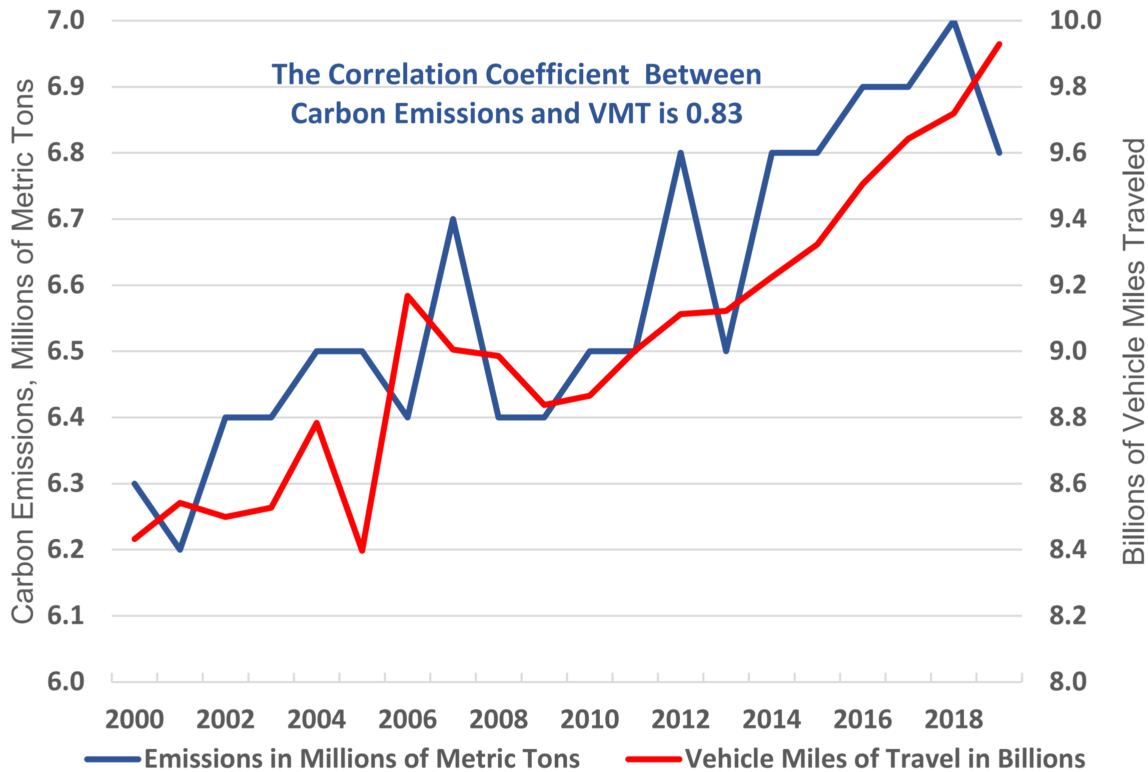

Figure 11: Carbon Emissions and VMT in South Dakota
Sources: https://www.fhwa.dot.gov/policyinformation/statistics/2020/pdf/vm3.pdf
https://usafacts.org/articles/where-carbon-emissions-come-from-in-each-state

Transit requires sufficient ridership to make it sustainable. Urbanists unfamiliar with South Dakota's setting might propose transit as a primary solution to reduce emissions. However, in many locations with South Dakota's low population density, the number of transit passengers per vehicle could be so low that it would be similar to a single occupant vehicle. Also, trip travel times needed to consolidate sufficient ridership to realize energy and economic efficiency would make the trip inconvenient, uncomfortable, and impractical. Transit is viable alternative in some areas but is not a universal solution in all locations and settings.

Figure 12: Young Transit Riders

Even in more urban settings, transit is not always an emissions solution. The Bureau of Transportation Statistics reported most passenger travel in the United States—commutes and long-distance travel—occurs on highways, accounting for nearly 5.6 trillion passenger miles in 2019 or almost 88 percent of total travel.[19]

Starting in 2020, the pandemic constrained travel. The travel reduction, the recovery, and the increasing fuel efficiency of the fleet are apparent in the gallons of fuel taxed in 2020 as shown in Figure 13. Gallons of fuel taxed is a reasonable short-term indicator of future VMT. Consequently, recent data may not depict normal travel patterns or the future context for South Dakota's strategy. Over the period analyzed, vehicle miles traveled peaked in 2019 and then declined. The gallons of fuel taxed in a strong, healthy economy probably will be higher than it was in 2019 and 2020 unless recent fuel price increases persist, and travel continues to be affected.

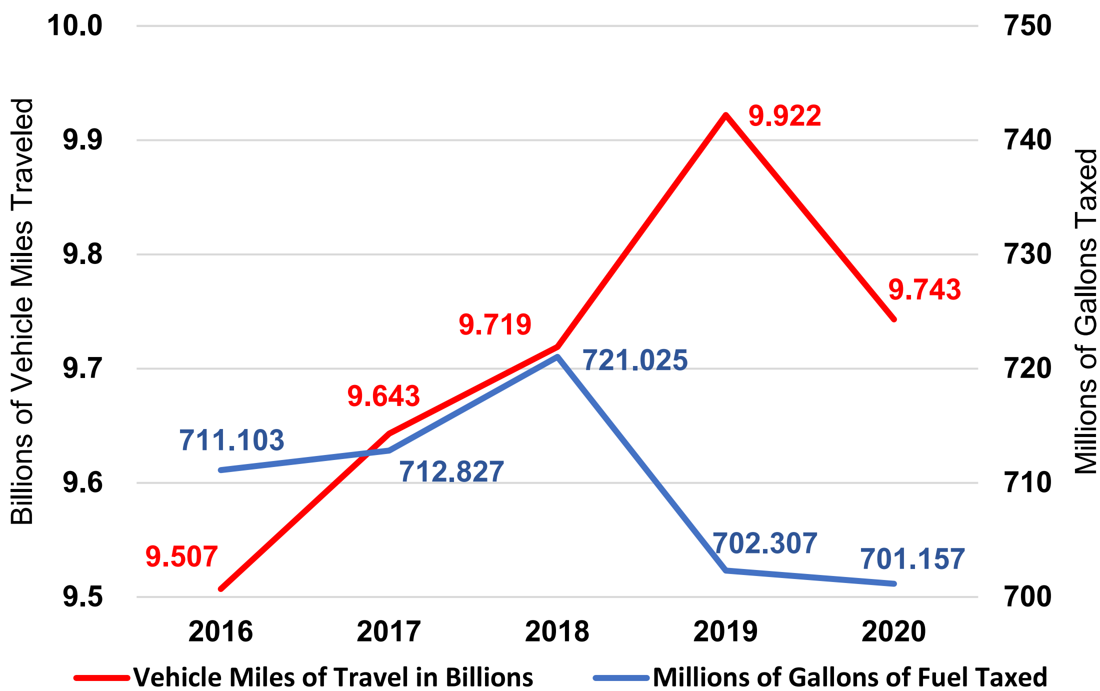

Figure 13: Comparison of SD Fuel Taxed and VMT

Source: FHWA Statistics, Tables VM-3 and MF-202.
https://www.fhwa.dot.gov/policyinformation/statistics/2020/vm3.cfm
https://www.fhwa.dot.gov/policyinformation/statistics/2020/mf202.cfm

The comparison of fuel taxed with VMT reveals a time lag between the time the fuel is taxed to restore depleted fuel inventories until it is consumed and reflected as VMT. Fuel consumption, partially reflected by the amount of fuel taxed, can be an indicator of expected transportation

[19] https://www.gao.gov/assets/gao-23-105967.pdf, Pages 4-5.

emissions in the transportation sector. After the impact of the pandemic has stabilized, the data should normalize and more clearly reveal highway users' inclination to travel.

3.2 Economic Health, Emissions, and the Supply Chain

Gross State Product (GSP) and VMT also are closely connected. The need for travel to support the economy is intuitively obvious but the data below support that intuition. Figure 14 shows the correlation coefficient is 0.88 between VMT and GSP. Obviously, there is a strong association between VMT and gross state product that confirms South Dakota's vehicle dependency. Economic effects and COVID impacts are also apparent in the data.

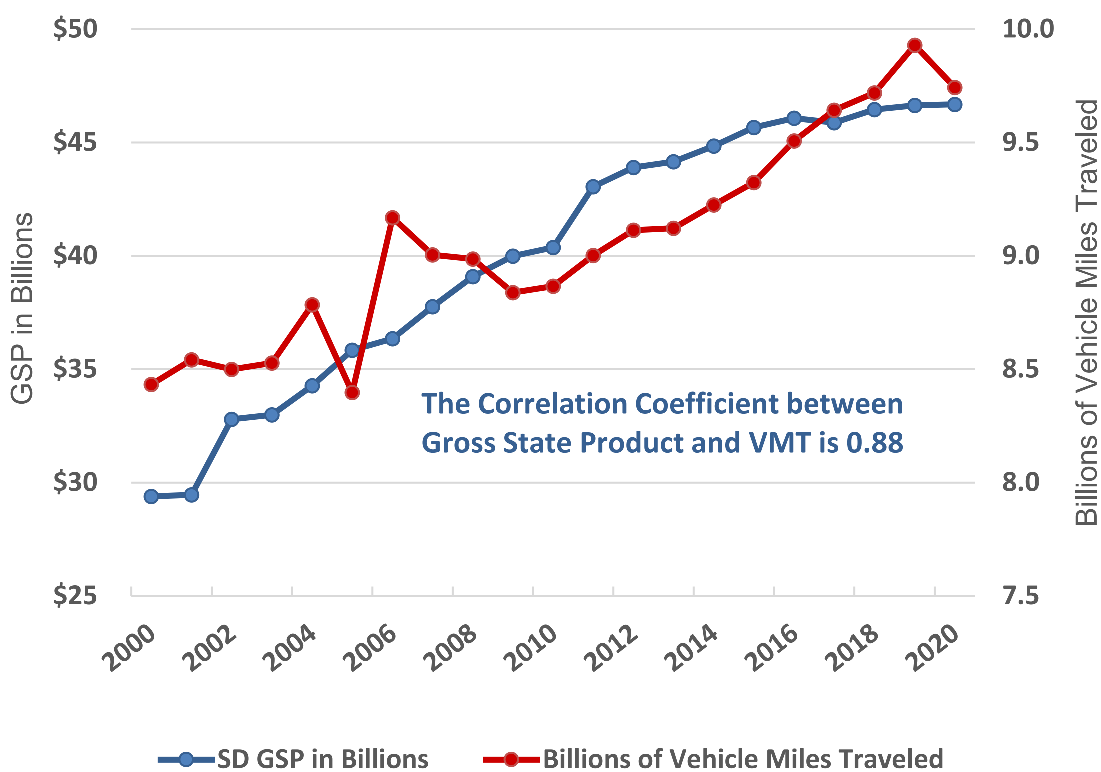

Figure 14: Comparison of GSP and VMT

Source: *https://www.fhwa.dot.gov/policyinformation/statistics/2020/pdf/vm3.pdf*
https://united-states.reaproject.org/data-tables/gsp-a900n/tools/460000/

In South Dakota's setting, the emissions strategy, methods, and activities must be carefully crafted to not reduce gross state product and economic activity. A sustained effort to limit emissions cannot be supported by a struggling economy. As stated earlier, there are few mobility options other than conventional vehicles in rural areas and VMT reductions there are not attainable. Aggressive action to limit VMT would almost assuredly produce undesirable economic outcomes because of the strong relationship between VMT and GSP.

South Dakota is not isolated from the national economy and the economies of other states. National policy and other states' actions affect our economy. The correlation coefficient between Gross National Product and National VMT is also a strong 0.83. The economic connections to other states bind the nation and the states together.

Further evidence of the strength of South Dakota's connection to the nation is shown by the parallel movement of the Freight Transportation Services Index (TSI) and Gross Domestic Product (GDP) and the link to economic recessions (Figure 15).[20] Collectively, the USDOT and all states need to be cognizant of the importance of maintaining transportation mobility and accessibility so a healthy national economy can positively affect other states and support a sustainable national carbon reduction strategy.

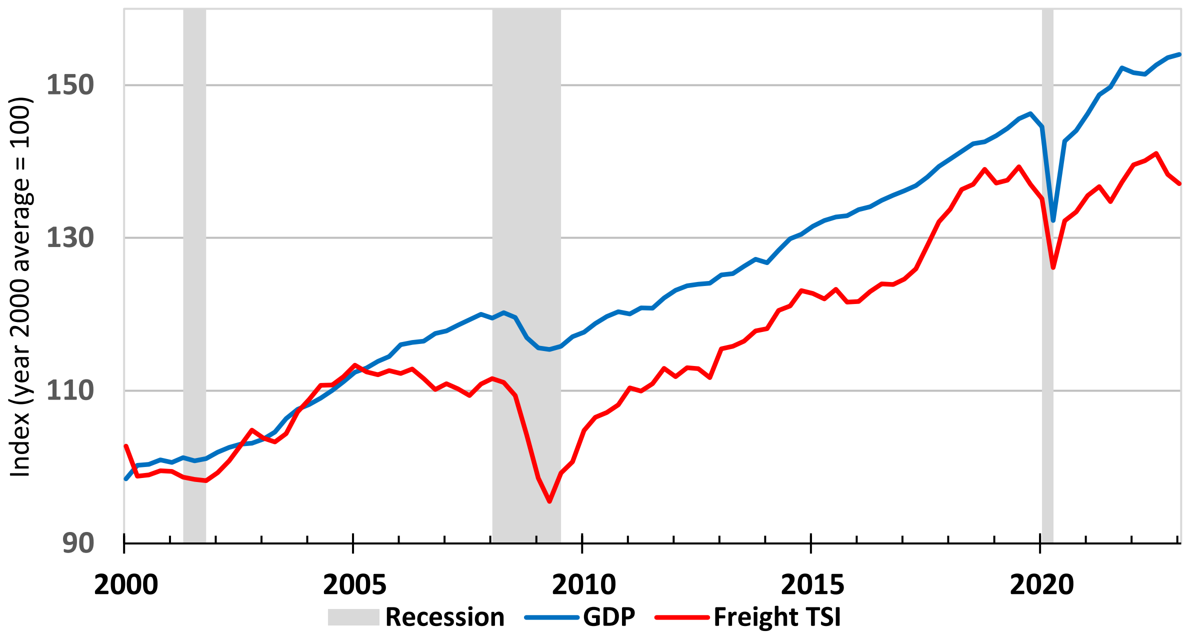

Figure 15: Real Quarterly GDP and Freight Transportation Service Index

Sources: GDP: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, table 1.1.6, available at https://apps.bea.gov/iTable/index_nipa.cfm. Freight TSI: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at https://data.bts.gov/Research-and-Statistics/Transportation-Services-Index-and-Seasonally-Adjus/bw6n-ddqk.

The strong link between national freight and GDP suggests negative effects on VMT could impact South Dakota if interstate freight were affected by national strategies or strategies of other states in ways that adversely impact South Dakota, particularly if those areas are closely tied economically to the state by freight and supply chains. Clearly, the national and state transportation systems, and our economies are all connected.

[20] https://www.bts.gov/newsroom/february-2023-freight-transportation-services-index-tsi

3.3 Emissions Are Connected to VMT

The United States has a much higher percentage of urban VMT than South Dakota, 69 percent compared to 30 percent, respectively, even using the urban definition of 5,000 population or more (Figure 16). Travelers in areas with an urbanized population of 50,000 or more are easier to entice to use modes other than automobiles than small town urban and rural travelers where the lack of modal choices and economies of scale for transit service discourage them.[21] Proximity, a sizeable number of users, and travel time matter in encouraging the use of modal alternatives.

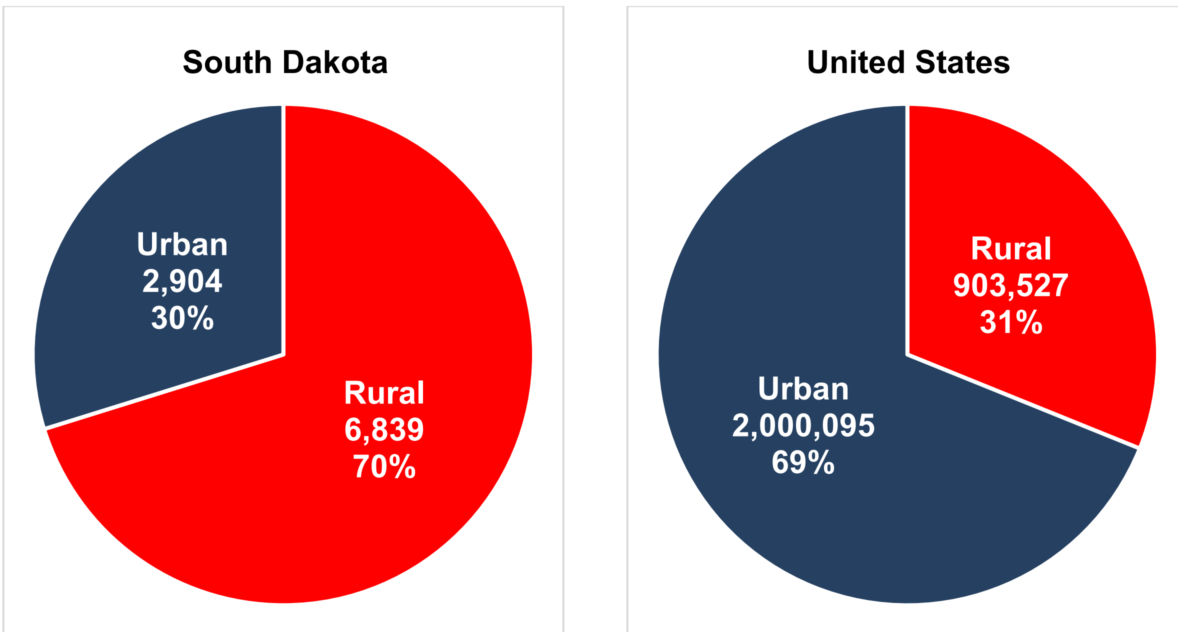

Figure 16: South Dakota and US Urban and Rural VMT Comparison 2020, Billions of Miles Traveled
Source: https://www.fhwa.dot.gov/policyinformation/statistics/2020/vm2.cfm

In rural areas, the need for efficient travel speeds to mitigate distance has a great impact on practical modal choices. For example, the pandemic related VMT decline between 2019 and 2020 was only 1.9 percent in South Dakota, but 2.8 percent nationally. The effect in South Dakota was less because of the state's stronger dependence on vehicles for mobility, access, and critical services. South Dakota's travel demand "elasticity" is low because there are fewer modal substitutes for vehicular travel than in less densely populated areas.

A recent Congressional Budget Office report substantiated rural areas depend more on their transportation system than their urban counterparts. The average annual U.S. rural household's VMT are approximately 50 percent higher than the average urban household.[22]

[21] Urban-Rural Glossary: https://www.fhwa.dot.gov/planning/glossary/
[22] Page 4, Emissions of Carbon Dioxide in the Transportation Sector, CBO, December 2022. https:/www.cbo.gov/publication/58861

The percentage of urban and rural VMT in the U.S. and South Dakota are almost exact opposites as the previous figure shows. Consequently, it will be easier to limit travel or redirect travel to other modes in the U.S. than it will be in South Dakota because limiting VMT in South Dakota would adversely affect equity and mobility. The state's three MPOs and the smaller urban areas like Aberdeen, Brookings, Huron, Pierre, Watertown, Brookings, and Yankton can offer more travel options than the rural areas but the small number of users imposes limitations. Congress wisely emphasized that strategies, methods, and activities be "appropriate" to the context.

3.3.1 Emissions and Gross State Product Are Connected

An important consideration in developing a carbon reduction strategy is the strength of the connection between emissions and South Dakota GSP as shown in Figure 17. The correlation coefficient is 0.84 and that confirms emissions are closely tied to state GSP. Consequently, SDDOT will ensure the state economy stays strong and healthy as it executes a sustainable emissions strategy.

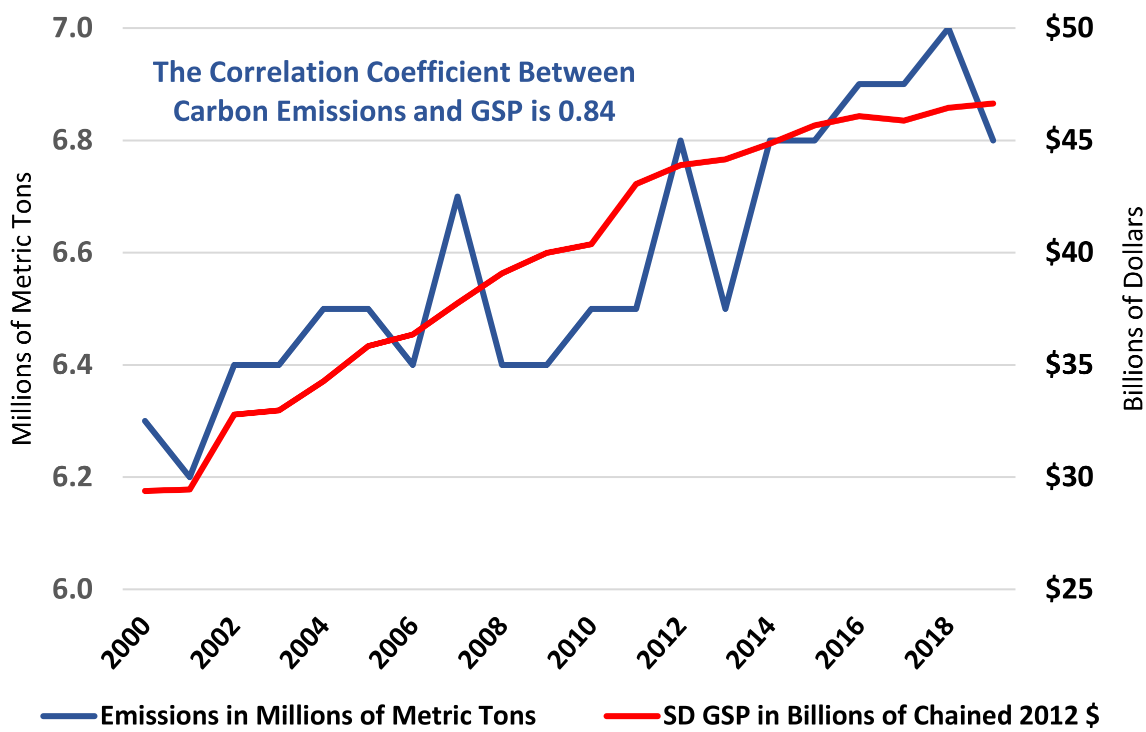

Figure 17: Relationship of Carbon Emissions to GSP
Sources: https://usafacts.org/articles/where-carbon-emissions-come-from-in-each-state/
https://united-states.reaproject.org/data-tables/gsp-a900n/tools/460000/

Nationally VMT is increasing but transportation emissions are relatively flat with a correlation coefficient of .03. Also, national Gross Domestic Product (GDP) and emissions are less connected with a correlation coefficient of -0.22, but the correlation between national GDP and national VMT is strong at 0.83. Consequently, efforts to affect national VMT may be possible, but such a policy may have minimal effect on transportation emissions. If national VMT reduction is being considered as a policy, context sensitive effects on different states and the connections need to be understood because of the potential adverse impacts on their economies. This is an important issue worthy of research.

Limiting emissions from transportation has been difficult to achieve for three main reasons, according to a 2022 study by the bipartisan Congressional Budget Office:

> "First, the demand for transportation services is not very sensitive to the price of such services. Demand for transportation is built into the places that people live, work, and socialize and the places that businesses produce and sell their goods. Those locations can change, but such change typically happens slowly.
>
> Second, the transportation sector is overwhelmingly dependent on a single fossil fuel, petroleum. Although the price of petroleum is higher than that of other fossil fuels per unit of energy (in part because of the cost of refining it into usable fuels), few cost-effective alternatives are currently available. In fact, the price of embedded CO_2 (what final users pay for energy per metric ton of CO_2 released) in the transportation sector is more than twice the price in the other sectors.
>
> Third, people tend to own vehicles for a long time, delaying the effects of improvements in the fuel efficiency of new vehicles."[23]

Electric utilities have indicated in the short term and under normal operating conditions, the South Dakota electrical grid can support the expected equipment and charging infrastructure along the four EV Ready Interstate Corridors.[24] In rural parts the state EV use is more difficult due to the long distances traveled, severe climate, and limited access to EV services and commercial charging stations. SDDOT wants to work with the private sector to "right size" the system in response to demand. The existing electrical grid, travel inelasticity, established land use patterns, and long-term vehicle ownership make limiting emissions in transportation difficult. Low-density settlement with fewer transportation alternatives amplifies the impacts and limits practical choices.

3.4 South Dakota Is an Important Link in the State and National Supply Chain

The Freight Analysis Framework estimated over 40 percent of the truck traffic in South Dakota was "through" traffic which is traffic having neither an origin nor a destination in South Dakota.

[23] Page 4, Emissions of Carbon Dioxide in the Transportation Sector, December 2022, https://www.cbo.gov/system/files/2022-12/58566-co2-emissions-transportation.pdf.

[24] https://dot.sd.gov/media/documents/EV/SDDOTEVPlan_final.pdf

Consequently, the impact of restraining through truck VMT could have devastating effects on national food security and supply chain strength although it would have positive effects on South Dakota's emissions. This is a carbon reduction strategy that will not be pursued.

Truck freight became more important in rural South Dakota after important rail lines were abandoned in the 1970s which the state subsequently purchased. As expected, South Dakota rail carries most of the international export and import tonnage because of the absence of barge access. Because of variable flows, the Missouri River does not serve barges to South Dakota even though one 15-barge tow can replace two 100-car trains or 870 semi-trailer trucks. Rail carries almost 81 percent of the international export tonnage and 60 percent of the import tonnage. Domestically, outbound trucks ship about 37 percent of the tonnage and inbound trucks transport about 41 percent of the tonnage. Within South Dakota, trucks account for about 89 percent of the tonnage.[25] South Dakota's top four trading partners by tonnage are Minnesota, Nebraska, North Dakota, and Washington. Cereal grains, animal feed, agricultural products, and energy account for most of the commodities shipped. These commodities are critically important to domestic and international food security. Figure 18 shows a summary of South Dakota's freight movement, tonnage, and value.

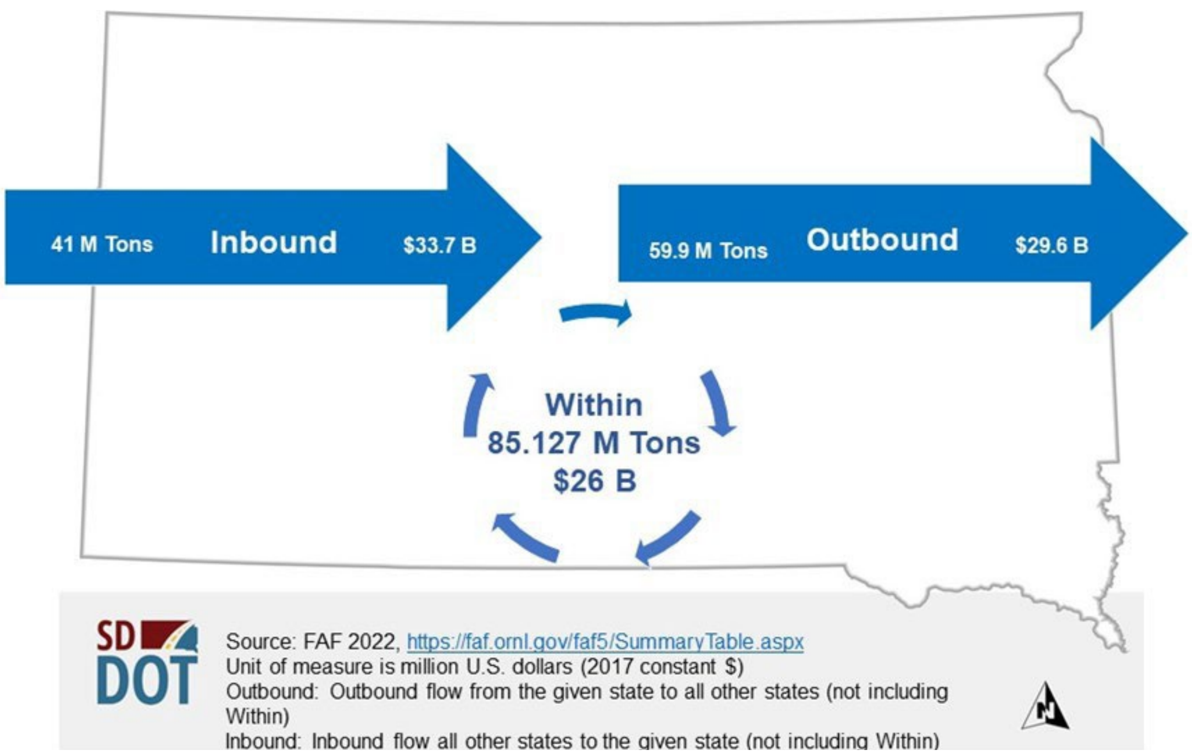

Figure 18: Destination of Freight Flows in 2022

[25] https://faf.ornl.gov/faf5/SummaryTable.aspx

3.5 Facilitating Freight Flow

Pass-through truck traffic generates wear and tear on South Dakota's highways and bridges and requires state funding to preserve them, but it provides limited benefits to the state. Through freight increases truck traffic and emissions. Yet, it provides tremendous benefits to the nation by strengthening freight supply chains and reducing the cost of delivered products. This illustrates the importance of South Dakota's highways to interstate commerce. The origins of the pass-through trucks and their destinations shown below are further evidence of that importance. Figure 19 shows the volume of trucks passing through South Dakota in 2017. I-90, I-29, and US212 to Montana carry the most pass-through trucks. The major origins and destinations are Minnesota, Nebraska, and North Dakota. Some of the traffic to North Dakota is international truck traffic along I-29 to the Pembina, ND international border crossing with Canada. Pembina is the nation's eighth busiest crossing with Canada.

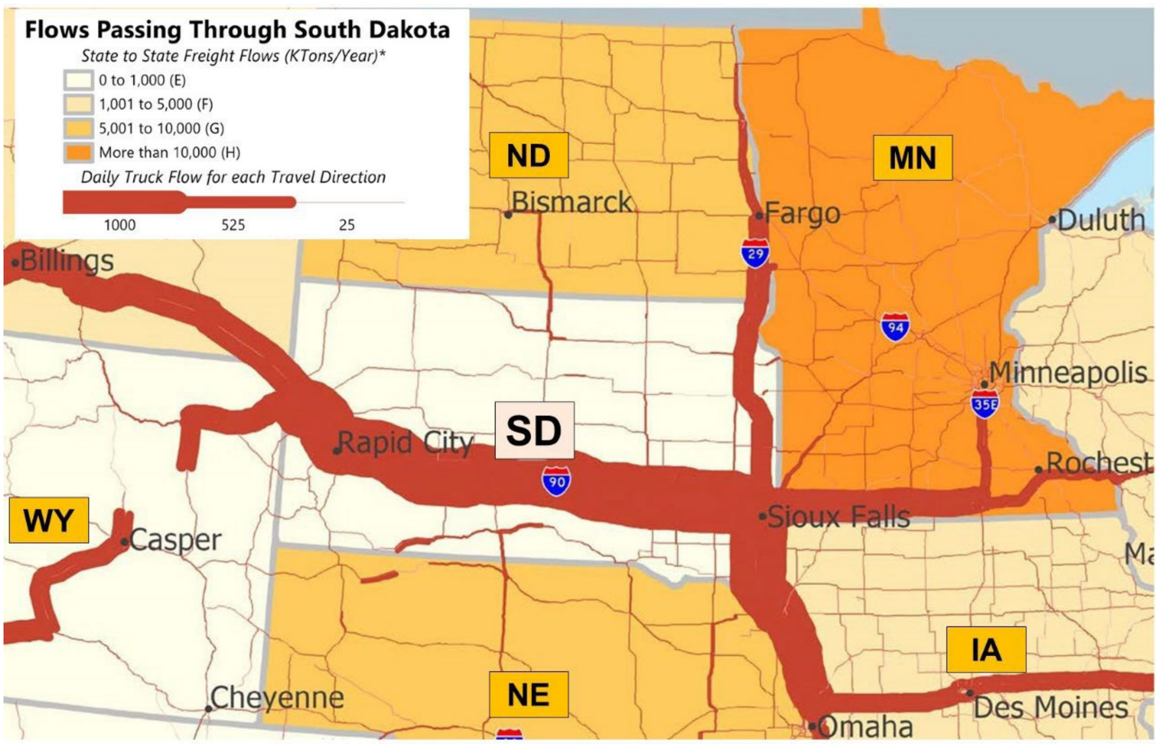

Figure 19: Freight Flows Through South Dakota
Source: Freight Analysis Framework

Strengthening supply chains also is important to support South Dakota's rural economy.[26] A December blizzard incident in 2022 when the Interstate system was closed for five days confirmed the importance of restoring mobility for truck freight to limit truck idling and fuel consumption as a useful strategy.[27] The economic impacts of truck freight are obvious to just-in-time delivery for private sector inventory control and cash management. Consequently,

[26] https://ops.fhwa.dot.gov/freight/freight_analysis/state_info/south_dakota/South%20Dakota_Thru_2017.pdf
[27] https://www.facebook.com/reel/685279902976876?s=single_unit

South Dakota will avoid approaches that discourage important international and interstate trade and commerce.

One important approach used in the SDDOT's strategy is to support agricultural commodity truck freight so it can be easily transferred to energy efficient intermodal railroad shuttle trains. Figure 20 shows trucks waiting on a local access road to unload at a rail-served soybean processing plant. This heavy use also occurs at harvest, though infrequently.

Figure 20: Trucks Line Up to Unload at a Soybean Processing Plant

The SDDOT has served and encouraged shuttle train facilities with transportation improvements since rail abandonment and consolidation began after the Milwaukee Road Rail Line filed for bankruptcy on December 19, 1977. As noted earlier, the state committed to preserve these national rail connections to the west coast and to other national rail carriers. With no other options, the state bought the Milwaukee line from Terry, Montana to Appleton, Minnesota, and several intrastate rail lines to protect rail service and to preserve connections to other rail freight providers. A key objective in choosing which rail lines to acquire was to serve the areas with the most significant agricultural production. Burlington Northern Santa Fe RR became the main operator on the state rail system and later purchased most of it from the state.

Shortening South Dakota truck trips by facilitating intermodal freight transfers to more energy efficient trains is an effective energy and economically efficient strategy, particularly for shipping agricultural commodities. Recently, the SDDOT rehabilitated the Mitchell to Rapid City Rail Line between Mitchell and Presho. Shippers responded by building three new or upgraded shuttle train grain handling facilities that shortened truck trips to rail transfer points. There are many energy-efficiency benefits to this approach according to the former Executive Director of the Transportation Policy Project and One-Rail and former Secretary of the Delaware Department of Transportation Ann Canby (Figure 21).[28] Development along that rail line

[28] https://www.onerail.org/mitchell-rapid-city-south-dakota/

continues to evolve and progress as a rail success story, responding to improved transportation efficiency and reduced transportation costs.

OneRail

America's future is riding on it.

Success Stories in Rail Investment

Mitchell-Rapid City South Dakota

Track conditions at milepost 388.9 in 2010 and 2012, before and after, the completion of the USDOT TIGER II Project.

The Mitchell-Rapid City (MRC) Railroad Reconstruction project from Mitchell to Presho, South Dakota, improves the existing freight line, which was in poor condition, leading to a suspension of freight service and an economic loss. SDDOT worked with the MRC Regional Railroad Authority to upgrade the state-owned rail line.

The rail line has received two USDOT TIGER grants, revitalizing the railroad, and successfully raised farmers' grain prices, lowered input costs, reduced trucks on the road and congestion for motorists, and helped farmers in the area lower transportation costs and increase shipping reliability.

The communities, railroads, and state of South Dakota supported the investment in rail infrastructure.

The first train to arrive at Liberty Grain Elevator after the MRC Railroad Reconstruction, November 2012.

FUNDING

Mitchell to Chamberlain
- $16 million TIGER II Grant Funds
- $13 million match from the Dakota Southern Railroad, MRC Regional Railroad Authority, the South Dakota Railroad Board, and local sources.

Chamberlain to Presho
- $12.7 million TIGER VI Grant Funds
- $26 million match from Rails to the Future, Governor's Future Funds, State Grant, and Dakota Southern.

PARTNERS

- U.S. Department of Transportation,
- South Dakota Department of Transportation, Dakota Southern Railroad,
- Mitchell-Rapid City Regional Railroad Authority

RESULTS

Jobs & Economic Impact
- Liberty Grain created a $32 million handling facility near Kimball. As a result of the facility there are 20 full-time employees.
- Liberty Grain handled 18 million bushels of grain and loaded about 4,000 rail cars in 2017.
- Two industrial rail parks were built near Kimball.
- The South Dakota Wheat Growers built a $4 million agronomy facility near Kimball and a $40 million agronomy and grain handling facility near Kennebec.
- Dakota Mill & Grain is constructing a new $20 million grain facility east of Presho. The facility will have 3.15 million bushel grain capacity.
- The railroad has moved over 6,800 cars of goods in 2016 and 8,500 cars in 2017.
- Lower transportation costs and improved price competition among elevators allow central South Dakota farmers to retain more profit per bushel which stimulates the area's economy

ENVIRONMENTAL BENEFITS

The improved rail service and new grain elevators reduce truck miles for farmers shipping crops, lowers shipping risk and increases reliability, reduces congestion for motorists and saves farmers time and money, especially during harvest.

DAKOTA SOUTHERN RAILROAD

Figure 21: Rehabilitated Mitchell to Rapid City Freight Rail
Source: https://www.onerail.org/mitchell-rapid-city-south-dakota/

Reducing truck haul distances by transferring to rail is effective in reducing truck emissions because rail is more energy efficient. Rail can move one ton of freight 500 miles on a gallon of fuel. A truck would require about 3.75 gallons to move a ton the same distance.[29] On average, railroads are three to four times more fuel-efficient than trucks. Moving freight by rail instead of truck lowers emissions up to 75 percent, on average. Nationally, railroads account for about 40 percent of long-distance freight movement but produce only about 1.9 percent of emissions. That illustrates great energy and emissions efficiency. Rail freight cannot substitute for truck freight in all circumstances, however.

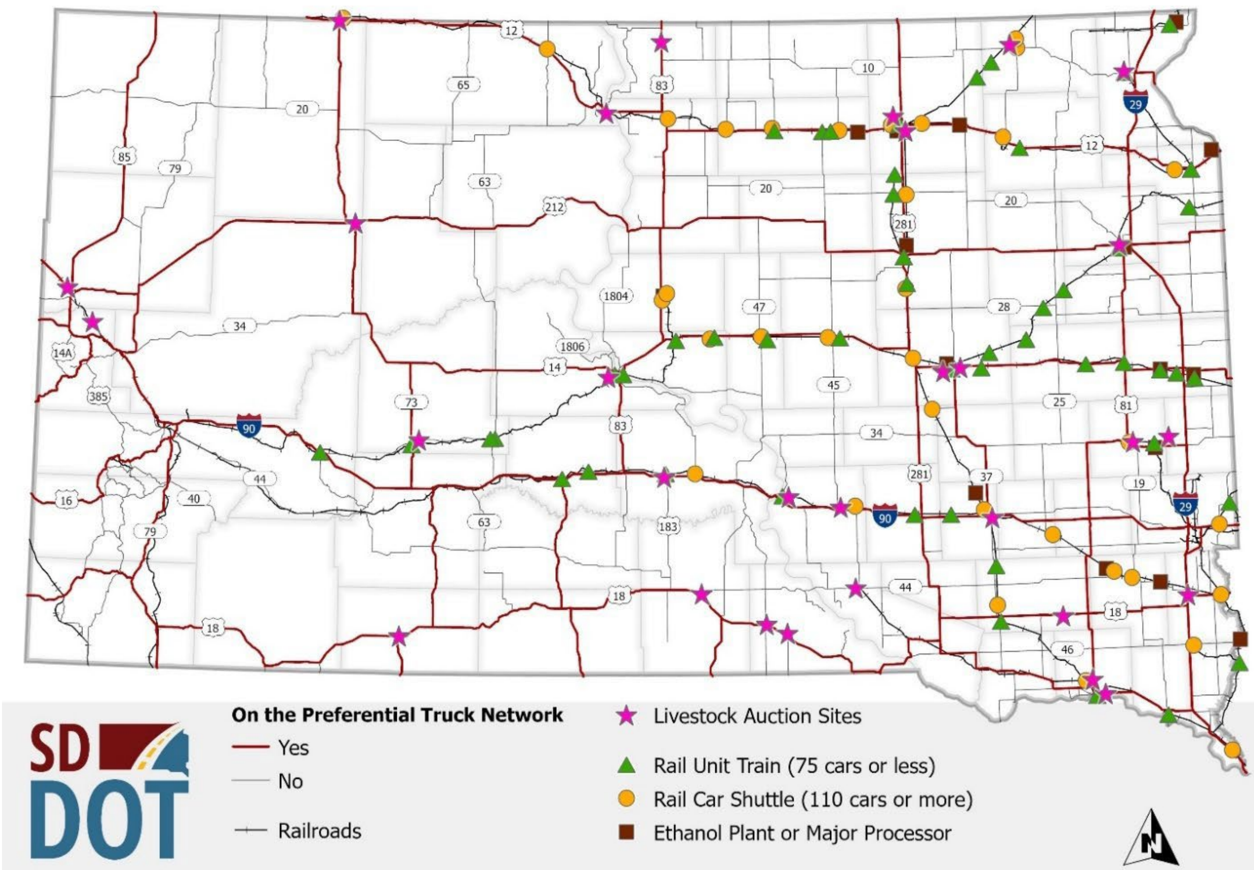

Figure 22: Intermodal Freight Facilities

As the state partners to enhance intermodal balance, the use of tax increment financing, loans, and value capture have recently encouraged the development of rail shuttle facilities at Yankton and Presho.[30,31] The widely dispersed locations of some of those key grain handling and processing facilities are shown in Figure 22**.**

The growth in the number of shuttle train facilities parallels the increasing agricultural yields per acre because of improved genetics and farming practices. For example, corn yields per acre

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[29] https://www.imiproducts.com/blog/calculate-fuel-efficiency-gains/
[30] https://www.fhwa.dot.gov/ipd/pdfs/value_capture/case_studies/yankton_sd_napa_junction_rail_industrial_park.pdf
[31] https://www.fhwa.dot.gov/ipd/project_profiles/sd_dakota_mill_grain_highway_14_access.aspx

have grown by over 50 percent in the last 20 years. State commodity movements for corn, wheat, soybeans, sunflowers, and milo generate on average the equivalent of over one million 18-wheel truck trips per year. Figure 23 shows estimated county commodity movements by trucks based on average annual production levels relative to the locations of agricultural processing and shuttle train facilities. It also shows how the state aligned its rail preservation efforts to complement the areas of greatest agricultural production. Truck numbers were estimated based on an 18-wheel configuration loaded at 80,000 pounds using county annual crop production over multiple years. The figure also illustrates the transition from farming to rangeland and ranching from eastern to western South Dakota.

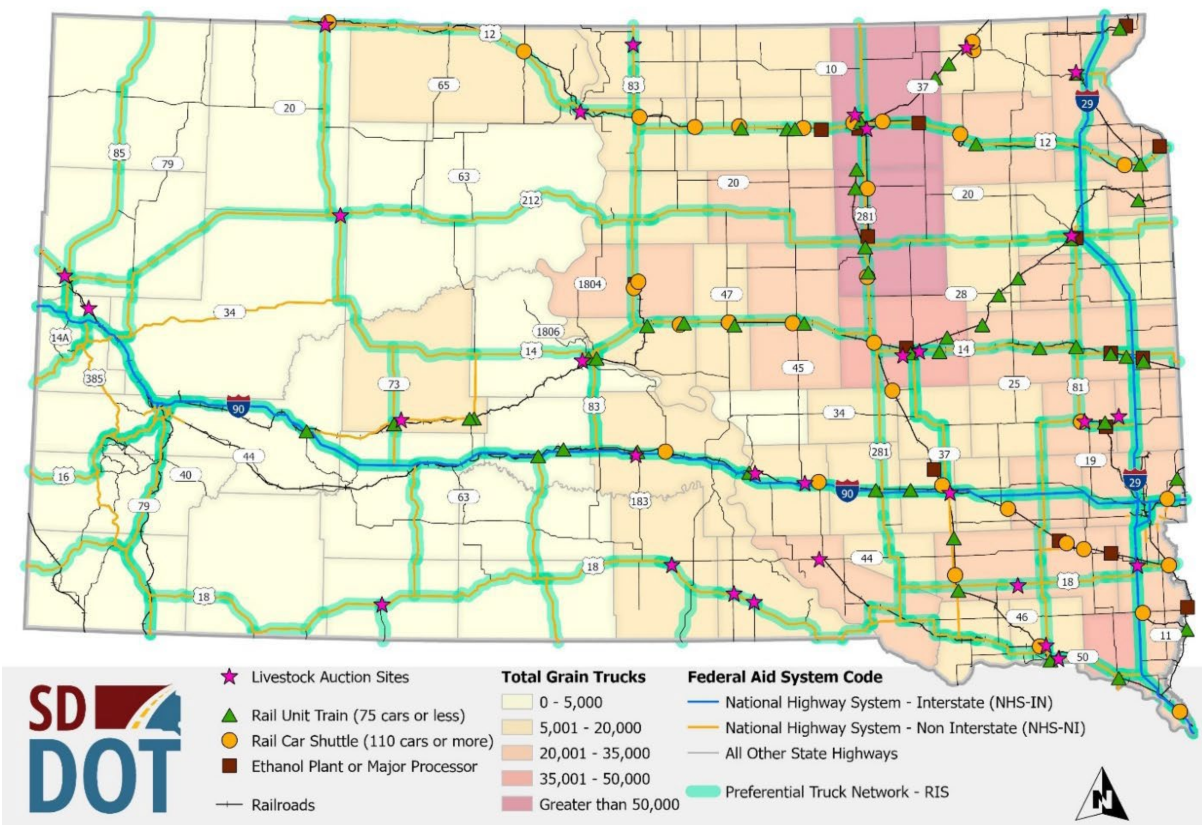

Figure 23: Estimate of Commodity Movement by Trucks

The counties with heavy crop production are apparent. The figure assumes the truck movement occurs only once, but movements may occur several times from the field to the farm storage bin, and finally to market.[32] Using the FHWA's Freight Analysis Framework, there could be about 1.5 million agricultural truck movements if all the commodity shipments used fully loaded 18-wheel trucks.[33] This is a fifty percent increase over the rough estimate shown using only agricultural production tonnage to estimate truck volumes. These movements are important for national food security. In agriculture both planting and harvest are time-critical, with weather

[32] https://farmdocdaily.illinois.edu/2020/11/changes-in-us-grain-storage-capacity.html
[33] https://dot.sd.gov/media/documents/2022draft_PublicAll.pdf

driving the timing of both planting and harvesting. Rain, hail, or early snowfall before harvest can destroy a year's work.

The transition from elevator grain storage to on-farm grain storage is changing South Dakota's grain movement dynamics. Producers want more control over their prices and storing grain in large grain bins on the farm is one method of asserting control by timing sales when prices are favorable. This also affects the timing of commodity movements. Table 2 depicts the changes in "On Farm" and "Off Farm" storage for major crops.

Table 2: Stored Major Grain Stocks in South Dakota

	Total Bushels in Millions	Percent Change from 2022
Corn	409	7
On Farm	255	19
Off Farm	154	-7
Soybeans	74	-4
On Farm	28	0
Off Farm	46	-7
Wheat	36.6	13
On Farm	16.5	74
Off Farm	20.1	-12
Oats	3.7	79
On Farm	2.75	72
Off Farm	0.95	102

Source: https://www.nass.usda.gov/Statistics_by_State/South_Dakota/Publications/Crop_Releases/Grain_Stocks/2023/SD-gsk2303.pdf

If prices are favorable to producers, commodities can be trucked from farm storage anytime a shuttle train is being assembled (Figure 24). The farmers' choices of crops that are planted respond to anticipated market prices and to weather which can fluctuate substantially from year to year.

Grain movements are concentrated at harvest. Truck movement from farm storage to shuttle trains can be even more concentrated as shuttle trains of 110 rail cars are being loaded at the large grain elevators. Off-farm movement can be affected by a major international grain deal at one of the coastal ports using large bulk cargo vessels. The South Dakota truck-rail movements adjust to international grain markets, commodity prices, and the capacity and availability of on farm storage. Along with these complex marketing strategies, the energy and emissions efficiency of shuttle trains compared to truck-only shipping are critically important.

Figure 24: On-Farm Grain Storage and Grain-Moving Augers
Photo Courtesy of Ben Orsbon

3.6 Value-Added Agribusiness Lowers Energy Consumption and Emissions

Value-added processing of agricultural products near the location where they are produced is also energy and emissions efficient. South Dakota is distant from national and international markets, so keeping production and transportation costs low is necessary to remain economically competitive. Adding value locally while reducing the weight or volume of products to be shipped helps control production costs. This is especially true for bulky items like grain and other agricultural commodities because transportation costs are a large percentage of final production cost.

Figure 25: Gevo Groundbreaking

Beyond improving shuttle train access the SDDOT also participates in constructing turning lanes and other safety improvements at grain loading and agricultural processing facilities (Figure 25). The Gevo facility is a $1 billion plant and the largest economic investment in South Dakota history. It is a world-class sustainable fuel production facility located in Lake Preston built on the Rapid City, Pierre, and Eastern rail line.[34] Such facilities support regional markets, reduce truck trip lengths, and are strongly supported by local producers and the SDDOT.

Integrated value-added agribusiness shortens the distance to the location where value is added and reduces transportation costs as a percentage of total production costs. For example, Valero Renewables built a 140-million-gallon per year ethanol plant near Aurora, in Brookings County. It processes 49 million bushels of corn annually and produces 368,000 tons of dried distillers

[34] Source: https://gevo.com/news/gevo-breaks-ground-on-net-zero-a-construction/

grain a year.[35] Ethanol has much higher value than corn—33 cents per pound compared to 11 cents per pound, respectively in May 2023—three times the value per pound.

A few hundred yards down the road from Valero is the Novita Nutrition plant that turns Valero's distillers grain, a byproduct, into dairy and poultry feed that nourishes up to 600,000 dairy cows every day using NovaMeal. Novita also creates a NovaOil, a vegetable oil providing energy for poultry diets.[36] Both Valero and Novita are located adjacent to the Rapid City, Pierre, and Eastern rail line because of its transportation efficiency.

High performance dairy cows produce 100 pounds of milk every day and this requires the consumption of about 55 pounds of dry matter, plus water. Dairy farms located near Brookings, Elkton, and Lake Norden take advantage of the nearby dairy feed. Volga is close by and has a soybean processing plant, also a feed source. The proximity of dried distillers grain, soybean meal, and corn silage support dairy operators by lowering transportation and production costs.

Expanding dairy farms stimulated the Bel Brands Cheese Company to open a $140 million, 170,000-square-foot plant in Brookings that produces 22 million pounds of Mini Babybel cheese rounds each year (Figure 26). The plant requires milk from about 15,000 cows.[37] The plant uses about 500,000 pounds of milk to produce 70,000 pounds of cheese or 1.5 million Babybels. This reduces the weight shipped to distant markets by a factor of seven and volume even more. Other cheese plants have also located in Milbank and Lake Norden to take advantage of growing dairy operations.

Figure 26: Bel Brands Cheese Plant
Photo Courtesy of Ben Orsbon

[35] https://www.valero.com/about/locations/aurora-plant
[36] https://www.brookingsregister.com/article/novita-plant-open-for-business
[37] https://www.foodprocessing-technology.com/projects/bel-brands-cheese-manufacturing-plant-brookings-south-dakota/

Value-added agricultural processors need efficient transportation to increase their profitability, create jobs, support the regional economy, and keep production costs low. SDDOT supports the regional economy with an efficient highway network and supplements highways with rail freight improvements in the public interest. Facilitating value-added agribusiness is a smart emissions reduction strategy by lowering the weight and volume of products shipped while increasing the value of products per unit weight or volume.

Farmers rarely receive a large percentage of the final price of the products they help produce. According to the National Farmers Union, farmers get just 3 percent of the final price of hamburger buns and only 32 percent of the final price of pound of ground beef. [38] Cattle have much higher value per pound than grain. On August 15, 2023, corn was valued at $4.62 a bushel or 8.3 cents a pound, and feeder cattle were $2.46 a pound.[39] Thus, cattle production can contribute to an economical and emissions-efficient transportation strategy.

Cattle outnumber people in South Dakota by about five to one at 3.85 million, and there are approximately 1.2 million hogs and 255,000 sheep. The proximity of ethanol facilities to livestock production shortens truck trips because dry distillers grain, a byproduct of ethanol production, is a major source of feed for livestock. Figure 27 conservatively estimates the number of 18-wheel cattle truck movements.

The estimate is low because the calculation considers that cattle are only moved once, but they may move many times from pasture to pasture and from feedlot to market. Supporting transportation-efficient agriculture supports a sustainable emissions strategy because everyone benefits, and bulky and weighty byproducts are not transported as far, saving energy, and reducing emissions while putting more profit in producers' pockets.

Supporting national and intrastate commerce, agricultural production, freight movement requires access to ethanol, gasoline, and diesel fuel to power freight trains, heavy trucks, light duty trucks, transit, and other passenger vehicles. Access to pipeline fuel terminals is necessary for that to occur. SDDOT does not control the location of pipelines or pipeline terminals, but they are critically important to support agriculture, tourism, equity, and mobility. These terminals are widely dispersed across the state as shown in Figure 28.

[38] https://nfu.org/farmers-share/

[39] https://markets.businessinsider.com/commodities/corn-price

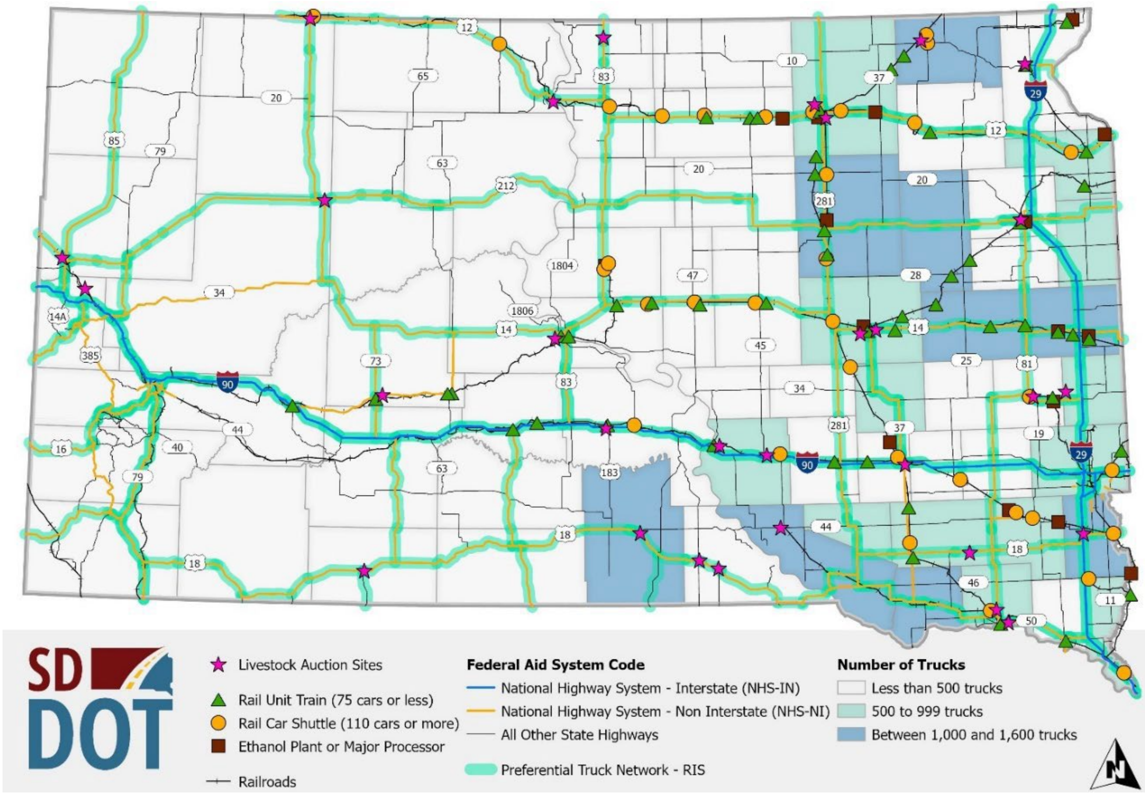

Figure 27: Estimate of Cattle Movement by Truck

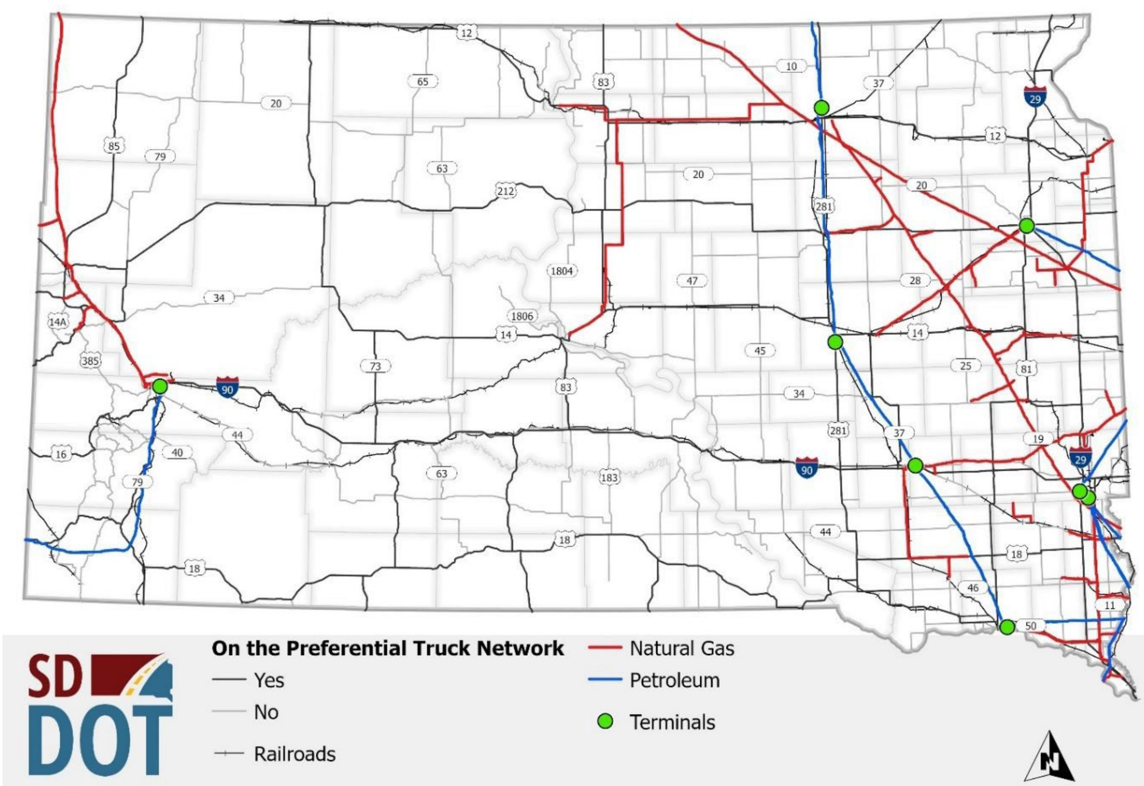

Figure 28: Pipelines with Truck Intermodal Terminals

3.7 Tourism Travel

Much of the rural VMT in South Dakota is generated by interstate commerce and tourism to national and state parks and scenic byways in South Dakota, Wyoming, and Montana. Tourism in western South Dakota to Mt. Rushmore National Monument, Badlands National Park, Wind Cave National Park, Jewel Cave National Park, the Minuteman Missile Silo, Custer State Park, the Black Hills National Forest, and the rails-to-trails Mickelson Trail bike path across the north-south expanse of the Black Hills National Forest are critical to the state's economy. They generated more than seven million visits in 2021, which is more than eight times the state's population. The Sturgis Motorcycle Rally also enhances the economy. The South Dakota Department of Tourism notes 13.5 million visitors at various state attractions in South Dakota spent $4.4 billion in 2021, accounting for nearly seven percent of the total GSP.[40]

South Dakota has six automobile-dependent scenic byways (Table 3).

Table 3: South Dakota Scenic Byways

Native American Scenic Byway (National)	Skyline Drive Scenic Byway
Peter Norbeck Scenic Byway (National)	Spearfish Canyon Scenic Byway
Badlands Loop Scenic Byway	Wildlife Loop Road Scenic Byway

Figure 29: Native American Scenic Byway on Lower Brule Reservation
Photo Courtesy of Ben Orsbon

Major national parks in adjacent states accessed by South Dakota highways include Yellowstone, Grand Teton, and Glacier. They collectively generate 11.8 million visits. Montana and Wyoming also have many scenic byways. Montana has nine with one All-American Road and four National Byways, and Wyoming has 21 with two All-American Roads. Combined, the

[40] Source: https://sdvisit.com/sites/default/files/2022-01/Summary%20of%202021%20Economic%20Impact.pdf

three states host more than 25 million tourism visitors annually. Many tourists use I-90, I-29, and the Expressway System through South Dakota as an integral part of their journey.

Assisting passenger trips is critical to the tourism industry. South Dakota and other states benefit from this type of interstate commerce and reducing passenger trips to limit fuel consumption and emissions without alternatives would create severe economic hardships for the tourism industry. It would also have negative impacts nationally by reducing the appreciation of America’s diverse scenery and impeding the understanding of different regions, cultures, and lifestyles.

USDOT Secretary Pete Buttigieg said, “One of the most basic things you need in order to thrive is the ability to get to where you need to be.”[41] Moving people and products where they need to be requires an understanding of what is feasible, effective, and efficient. Efficient movement of people allows the economy to thrive, supporting a sustainable strategy to reduce emissions.

[41] Page 23, Pete Buttigieg Wants to Make Transit Accessible, Steve Wright. Planning, Volume 89, Number 1, Spring 2023.

Chapter 4 Statutory Requirements and Executive Guidance

The details of the Carbon Reduction Program (CRP) Implementation Guidance are limited except for the statutes and regulations cited. The guidance states it does not have the force and effect of law and is not meant to bind the states or the public in any way.[42] It conveys the existing requirements and states the strategy must be updated every four years.

The national purpose of the CRP is to reduce transportation emissions through the development of State strategy and by funding projects designed to reduce transportation emissions. The program lists several requirements in 23 U.S.C. 175(d)(2). The program shall:

(A) support efforts to reduce transportation emissions;

(B) identify projects and strategy to reduce transportation emissions, which may include projects and strategy for safe, reliable, and cost-effective options-

(i) to reduce traffic congestion by facilitating the use of alternatives to single-occupant vehicle trips, including public transportation facilities, pedestrian facilities, bicycle facilities, and shared or pooled vehicle trips within the State or an area served by the applicable metropolitan planning organization, if any;

(ii) to facilitate the use of vehicles or modes of travel that results in lower transportation emissions per person-mile traveled as compared to existing vehicles and modes; and

(iii) to facilitate approaches to the construction of transportation assets that result in lower transportation emissions as compared to existing approaches;

(C) support the reduction of transportation emissions of the State;

(D) **at the discretion of the State**, **quantify the total carbon emissions** from the production, transport, and use of materials used in the construction of transportation facilities within the State; and

(E) **be appropriate to the population density and context of the State**, including any metropolitan planning organization designated within the State.[43] [44]

SDDOT's Carbon Reduction Strategy meets all the requirements of 23 U.S.C. 175(d)(2) by identifying projects and strategies to limit emissions. A critical aspect of addressing these

[42] Page 1, https://www.fhwa.dot.gov/environment/sustainability/energy/policy/crp_guidance.pdf.
[43] 23 U.S.C 175(d)(2).
[44] https://www.fhwa.dot.gov/environment/sustainability/energy/policy/crp_guidance.pdf

requirements is Congress's direction that the program be appropriate to the population density and context of the State because a program that is appropriate, economically efficient, and practical will shape its implementation. Following this Congressional directive will avoid creating economic and lifestyle hardships and restrictions on the freedom of travel.

Another critical aspect is that quantification of emissions by the State is at the State's discretion. South Dakota chose not to quantify emissions for several reasons:

- lack of valid emissions models
- dependence of models on assumptions
- imprecision of resulting emissions estimates
- cost of modeling compared to its accuracy and benefits.

The lack of benefits of modeling in a rural context where conventional vehicle travel demand is inelastic was a major consideration in the decision. In a practical sense, South Dakota's population density and settlement patterns define the context that determines the viability, practicality, equity, and economic impact of emissions and limits alternatives. Transportation alternatives with potential to limit emissions are more numerous in areas with higher population density.

Practical options are limited in a large, low-density state where summer and winter weather can be severe, where commercial centers, towns, activity centers, and health care facilities are widely dispersed, where vehicular tourism and farming are major economic contributors, and where opportunities for non-vehicular travel and transit use are limited. Access to health care is also a critical concern.[45] A significant modal shift to transit in rural areas is unrealistic because of the low population density.

Figure 30: Ft. Pierre National Grasslands
Photo Courtesy of Ben Orsbon

[45] https://www.siouxfalls.business/keeping-health-care-accessible-in-rural-south-dakota/

The types of vehicles purchased, and the level of use determine the emissions generated on South Dakota highways. SDDOT does not make these decisions, citizens make them. These choices are outside the control of the SDDOT and can only be influenced in a limited way. In a very rural setting, constraining VMT or vehicular travel may be impossible and would have catastrophic consequences. By proposing a strategy appropriate for its population density and context, the SDDOT will avoid endangering agricultural production; health care access; food security; national, regional, state, and local supply chains; transportation equity; and the economic and physical health of large areas of this state and the nation.

SDDOT will emphasize energy efficient travel and freight shipment, encourage non-conventional and non-vehicular modal choices when it is practical and efficient, and select energy-efficient methods to construct, maintain, and operate its transportation system. Providing travelers with information to sustain mobility will also be an important strategy. SDDOT cannot do this alone. Other governments, MPOs, and urban areas will use other approaches where they are feasible, practical, and supported by the public. Preserving citizens' freedom to choose their preferred modes of travel is essential in South Dakota's context.

Chapter 5 Consultation, Coordination, and Public Involvement

This strategy was coordinated using SDDOT's adopted public involvement plan.[46] The coordination process was led by a Carbon Reduction Strategy Task Force of seventeen individuals with a broad range of expertise because of the knowledge needed to embed emissions reduction across the agency (Table 4).

Table 4: Expertise of the Carbon Reduction Task Force

Name	Specialty
Christina Bennett	Construction and Maintenance Manager
Travor Diegel	Pavement Design Engineer
Sarah Gilkerson	MPO Coordinator and Long-Range Planning
Steve Gramm	Planning Squad Engineering Manager
June Hansen	Civil Rights Compliance Specialist
Joanne Hight	Administration Program Manager
Mark Hoines	FHWA
Dave Huft	Intelligent Transportation Systems Program Manger
Jason Humphrey	Pierre Region Engineer
Jordon Kitts	Federal Funding Specialist
Mark Leiferman	Project Development Program Manager
Ben Orsbon	Advanced Professional
Jerry Ortbahn	Federal Funding Specialist
Brace Prouty	Scoping and Safety Squad Engineering Manager
Scott Rabern	Chief Road Design Engineer
Bradley Remmich	Aeronautics Transportation Specialist II
Andy Vandel	Research Engineering Manager

Others were also engaged to develop and refine the strategies. During coordination SDDOT's Carbon Reduction Strategy Task Force helped identify external stakeholders. The public involvement process used the appropriate processes and steps outlined in the Federal planning regulations.[47]

To take advantage of the interest created by the STIP/TIP Coordination meetings to increase the audience, the SDDOT "piggy-backed" the Carbon Reduction Strategy coordination in a combined STIP/TIP/CR Strategy process and engaged three MPOs, six planning districts, legislators, local governments, and the broader public.

[46] https://dot.sd.gov/media/documents/SDDOT-PublicInvolvementPlan2022-SignatureCopy.pdf
[47] https://www.ecfr.gov/current/title-23/chapter-I/subchapter-E/part-450/subpart-B/section-450.210

Nine Tribes in South Dakota provided input using the public involvement process outlined in the 2022 Public Involvement Plan (Table 5). The Carbon Reduction Strategy was shared with the Tribes in South Dakota and the concerns of affected tribal governments were considered.

Table 5: Tribes in South Dakota

Cheyenne River Crow Creek Flandreau Santee	Lower Brule Oglala Rosebud	Sisseton Wahpeton Standing Rock Yankton

Since the highway and bridge contracting community is an important extension of SDDOT, it was also consulted. The SDDOT wanted to ensure no important audience, particularly anyone in a potentially disadvantaged community, was overlooked. Figure 31 shows the dispersed locations of Tribes, MPOs, and counties. The map is meant as a general guide to where tribal lands are located but does not wholly represent tribal lands or reservations as they are today.

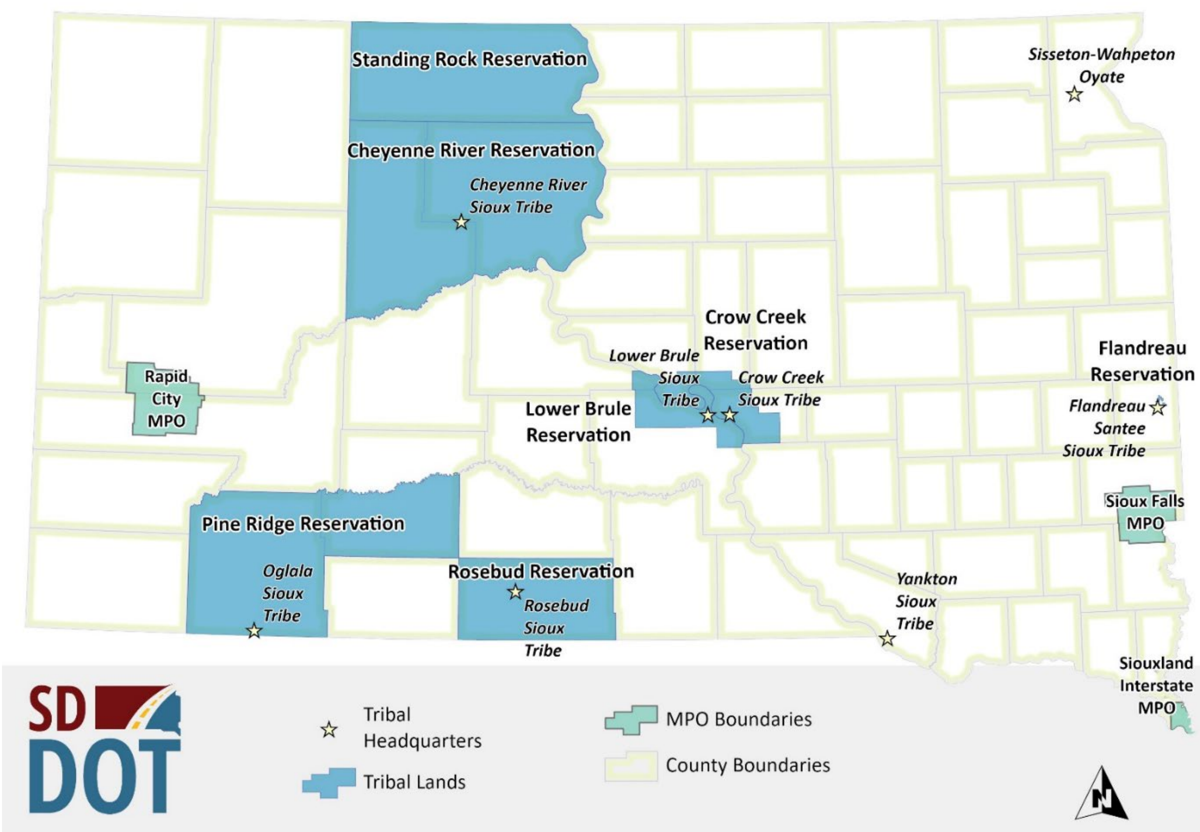

Figure 31: Tribes and Metropolitan Planning Organizations

The following approaches for programming CRP projects to improve travel efficiency, increase mobility, and limit energy consumption were discussed:

- identify projects that support limiting emissions
- provide alternatives to single occupancy vehicles (e.g., transit, bike/pedestrian, shared)
- increase options for walking, bicycling, and transit
- facilitate use of vehicles or travel modes with lower emissions per person-mile
- identify infrastructure vulnerable to weather-related incidents and pinpoint those locations to limit energy consumption during repair or replacement
- evaluate and rank critical priorities

SDDOT coordinated the CR Strategy with Sioux Falls and Rapid City Area MPO member agencies and used the informal STIP/TIP Coordination meetings to further coordinate the CR Strategy with the MPOs. Formal STIP/TIP/CR Strategy public meetings were held in Aberdeen, Ft. Pierre, Rapid City, and Sioux Falls. Also, the Tribes, MPOs, and the public were invited to participate in any or all four public STIP/TIP/CR Strategy coordination meetings through a virtual online Zoom meeting option and Facebook Live.

Notification of these meetings was extensive. The SDDOT advertised the meetings through the South Dakota Newspaper Association in 122 newspapers, both print and digital. Notices were sent to special organizations and people that have expressed interest in the past including all State legislators, City Mayors, County Commissions, County Highway Superintendents and Tribal Officials. Public access channels on local cable television systems were also invited to publicize these meetings. Notices were also posted to SDDOT's social media outlets, on SDDOT's website and public service announcements were submitted to the radio and television stations. A total of 129 people attended the meetings in-person and 2 virtually.

The Facebook Live events were viewed the night of, or post-event by 5,218 people. Comments were encouraged orally, submitted virtually, or in writing following the meetings. These meetings were recorded and were placed on the Department's website for viewing. All individuals were encouraged to review and listen to the meetings and view the presentations online at their convenience. Through the extensive public involvement process, SDDOT illustrates it seeks and values input to increase knowledge and awareness of the opportunities and challenges created by this strategy.

The SDDOT regularly engages MPOs, Tribal governments, and planning districts through formal and informal processes. When possible, SDDOT measures the media outlets used, the number of stakeholders engaged, organizations reached, and public officials present. SDDOT worked to engage all parties and interests.

Chapter 6 SDDOT's CRP Strategy

SDDOT's primary Carbon Reduction Program (CRP) strategy is to **allocate resources to improve energy efficiency**. The best way to limit emissions is through energy efficiency because energy consumption and emissions are directly related. Although SDDOT has not overtly emphasized it, it has always limited emissions because saving energy and economic efficiency are fundamental to good government and environmental stewardship.

Even though South Dakota is a rural state, many context-sensitive opportunities outlined in the IIJA can further integrate energy efficiency into SDDOT's practices. This chapter describes how SDDOT will increase energy efficiency as it manages the safety, condition, and performance of the state transportation system. Three considerations govern the practical reach of SDDOT's strategy:

- the factors SDDOT controls directly with its projects and funding.
- the factors SDDOT can influence through funding and coordination.
- the limits of SDDOT's influence over private sector market decisions, transportation users' behavior, and other governments' actions.

Using the legislative language in 23 U.S.C. 175 and the guidance provided by FHWA and the USDOT on April 21, 2022, SDDOT identified six broad methods—in addition to specific projects—to guide its CRP strategy:

- Embed Energy Efficiency into SDDOT Business Practices (Section 6.1)
- Reduce Highway Users' Energy Consumption (Section 6.2)
- Promote Freight Efficiency (Section 6.3)
- Encourage Non-Motorized and Multi-Occupant Travel (Section 6.4)
- Reduce Energy Impact of Infrastructure Projects (Section 6.5)
- Improve SDDOT Internal Energy Efficiency (Section 6.6)

The activities listed in each section describe how the overall strategy will be realized.

6.1 Embed Energy Efficiency within SDDOT Business Practices

Federal guidance encourages each State to integrate its strategy into its plans and business processes. SDDOT's plans, policies, and business processes inherently consider energy efficiency and emissions because of their strong connection to cost containment. By intentionally embedding its strategy in its plans, policies, and processes, SDDOT can firmly ingrain energy efficiency into its culture and practice.

Although the plans, policies, and processes will not be developed with CRP funds, they will generate many projects and activities eligible for CRP funding, based on 23 U.S.C.104(b)(7) and 175(c).

6.1.1 Strategy Maintenance

An important but potentially overlooked activity for any agency is to proactively maintain its carbon reduction strategy. While this document defines a sound, comprehensive strategy for limiting emissions, it must evolve by adjusting as conditions change. SDDOT will maintain this strategy consistent with federal guidance and the need for updates.

6.1.2 Planning

SDDOT develops and maintains numerous statewide, regional, corridor, and project plans and studies, including:

Table 6: SDDOT Plans and Studies Influencing Emissions

Strategic Highway Safety Plan Statewide Long-Range Plan Statewide Transportation Improvement Program (STIP) Transportation Asset Management Plan Freight Plan Rail Plan	Transit Plan Electric Vehicle Infrastructure Deployment Plan Aviation Systems Plan SDDOT Strategic Plan Interchange, Intersection, Corridor Studies, and the Decennial Interstate Corridor Study

In each of these plans, SDDOT addresses energy and emissions at a scale and scope appropriate to the subject. Many of the solutions and tactics that emerge from them align with components of this strategy, but SDDOT is receptive to new concepts that further promote energy efficiency. The plans will be adjusted as the setting changes to improve emissions reduction.

6.1.3 **Project** Programming

The USDOT apportioned $8.922 million to South Dakota to fund carbon reduction projects in FFY2022. Slight annual increases are expected during the remaining four years of the IIJA. SDDOT will invest this funding in eligible projects that improve energy efficiency while advancing mobility, system reliability, and sustainability of physical assets.

A broad list of activities is eligible for funding under the program. Funds apportioned to a State under section 23 U.S.C.104(b)(7) may be obligated for projects to support the reduction of transportation emissions, including:[48]

[48] 23 U.S.C. 175(c).

(A) a project described in section 149(b)(4) to establish or operate a traffic monitoring, management, and control facility or program, including advanced truck stop electrification systems;

(B) a public transportation project that is eligible for assistance under section 142;

(C) a project described in section 101(a)(29) (as in effect on the day before the date of enactment of the FAST Act (Public Law 114–94; 129 Stat. 1312)), including the construction, planning, and design of on-road and off-road trail facilities for pedestrians, bicyclists, and other nonmotorized forms of transportation;

(D) a project described in section 503(c)(4)(E) for advanced transportation and congestion management technologies;

(E) a project for the deployment of infrastructure-based intelligent transportation systems capital improvements and the installation of vehicle-to-infrastructure communications equipment, including retrofitting dedicated short-range communications (DSRC) technology deployed as part of an existing pilot program to cellular vehicle-to- everything (C–V2X) technology;

(F) a project to replace street lighting and traffic control devices with energy-efficient alternatives;

(G) the development of a carbon reduction strategy in accordance with subsection (d);

(H) a project or strategy that is designed to support congestion pricing, shifting transportation demand to nonpeak hours or other transportation modes, increasing vehicle occupancy rates, or otherwise reducing demand for roads, including electronic toll collection, and travel demand management strategy and programs;

(I) efforts to reduce the environmental and community impacts of freight movement;

(J) a project to support deployment of alternative fuel vehicles, including-

(i) the acquisition, installation, or operation of publicly accessible electric vehicle charging infrastructure or hydrogen, natural gas, or propane vehicle fueling infrastructure; and

(ii) the purchase or lease of zero-emission construction equipment and vehicles, including the acquisition, construction, or leasing of required supporting facilities.

SDDOT will allocate CRP funding to activities clearly eligible under federal guidance. SDDOT will use other federal and state funding sources for activities that will help limit emissions but are not clearly eligible for CRP funding. If SDDOT wants to use CRP funding for other activities, it will formally contact FHWA.

SDDOT identifies practical urban and rural CRP projects in its Statewide Transportation Improvement Program (STIP),[49] which is approved annually by the South Dakota Transportation Commission. Each CRP project is identified by a "CR" prefix in the project number listed in the STIP.

6.1.4 Design

After a project's scope is defined in consideration of energy efficiency, SDDOT designers will develop plans and specifications that support its efficiency goals. Every aspect of the design—whether relating to roadway geometry, signing, lighting, paving, grading, materials, access management, and traffic control—will be evaluated as an opportunity for energy efficiency within the context and constraints specific to the project. As energy-efficient design concepts and details are developed, SDDOT will incorporate them into its design manuals so they can be applied to future projects as well.

6.1.5 **Project** Scoping and Value Engineering (VE) during the Design Phase

In addition to highway safety, infrastructure condition, and capacity, SDDOT will consider energy efficiency as projects are developed and designed.

Scoping strategies that can improve energy efficiency include:

- ensuring that project scope addresses pertinent condition, capacity, and safety needs to avoid the need for subsequent construction and energy consumption.
- geometric design improvements to improve traffic flow and reduce delay.
- operational improvements through application of intelligent transportation systems and transportation systems management and operations.
- safety improvements that reduce the likelihood of traffic incidents that cause non-recurring congestion and require energy-intensive emergency response.
- features that improve infrastructure longevity to limit life-cycle energy demand.
- features that reduce the need for ongoing maintenance efforts.

[49] 2024 – 2027 Statewide Transportation Improvement Program, SDDOT, https://dot.sd.gov/media/SDDOT%202024-2027%20SDDOT%20STIP%20Book%20Final.pdf

The value engineering process, as identified under 23 CFR Part 627, can be used to increase energy efficiency by considering traffic flow, detour times and distance, construction wait times, and project reliability and resilience.

6.1.6 Value Engineering during the Construction Phase

Value engineering enables a contractor to suggest project value improvements which may be time or cost-saving design modifications and construction changes after a contract is awarded. In compliance with 23 U.S.C 175(c)(G) and (d), SDDOT will continue to encourage contractors to consider energy-saving and energy consumption as a component of requests. Changes accepted by SDDOT will generate energy savings not only for the immediate project but also for similar future projects. Energy savings will reduce emissions.

6.1.7 Government Coordination and Grant Administration

Other transportation agencies can also consider energy efficiency and emissions in their planning processes. Federal guidance emphasizes coordination with South Dakota's three Metropolitan Planning Organizations at Sioux Falls, Rapid City, and Sioux City, South Dakota which is within the tristate Siouxland Interstate Metropolitan Planning Council MPO boundaries. CRP-funded projects will be coordinated using the public involvement processes of the MPOs and SDDOT. Public transit agencies share a role in energy efficiency, as transit is most viable in these areas.

Rural areas also receive special consideration in the federal guidance. South Dakota's nine tribal governments are remote and widely dispersed and often contain Disadvantaged Community Census Tracts and Areas of Persistent Poverty. They and many other small towns, rural communities, farms, and ranches rely solely on roads for access to essential services.

Figure 32: Badlands National Park on the Pine Ridge Reservation
Photo Courtesy of Ben Orsbon

6.2 Reduce Highway Users' Energy Consumption

Because the greatest share of transportation-related energy consumption is by highway users, reducing their energy demand can have the greatest impact on overall energy efficiency and limiting emissions.

6.2.1 Access Management

Enhancing roadway access management reduces emissions. Improving the design, location, and limiting the number and extent of roadway access points promotes safety, reduces traffic conflicts and traffic delay, and smooths traffic flow. Improved traffic flow saves energy and reduces emissions. The SDDOT will continue to use access management to improve safety, facilitate traffic and freight movement, and sustain strong, resilient supply chains with a renewed focus on energy efficiency and reducing emissions.

6.2.2 Traveler Information

Traveler information helps highway users plan and complete safe, energy-efficient trips. Accurate traveler information supports informed traveler decisions during severe weather and other situations, enabling travelers to select the best routes for their trips or to adjust plans if their trips may be unsafe, delayed, or disrupted.

Figure 33: Rapid City Truck Stop Filled as Blizzard Closes I-90
Video Courtesy of https://www.facebook.com/reel/685279902976876

SDDOT will work with its traveler information providers to enhance the accessibility, clarity, timeliness, and accuracy of information related to road and weather conditions, work zones, traffic incidents, emergencies, and special events. SDDOT will investigate the feasibility of providing information on roads under the jurisdiction of Tribes, local governments, and federal agencies. In addition, the SDDOT will collaborate with third-party providers to establish in-vehicle information feeds. As technology becomes available, connected vehicle technologies will be deployed on key corridors.

6.2.3 Active Traffic Management

According to the Federal Highway Administration, active traffic management (ATM) is the ability to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions.[50] Traffic congestion has a direct impact on the energy efficiency, fuel consumption, and emissions of vehicles. Although South Dakota experiences a limited amount of recurring traffic congestion, non-recurring situations due to severe weather, work zones, traffic incidents, and special events present opportunities for greater energy efficiency and limiting emissions (Figure 34).

SDDOT will acquire and operate active traffic management system software and roadside ITS devices like cameras, dynamic message signs, automated closure gates, and queue detection equipment to dynamically monitor and manage traffic and coordinate incident response.

Figure 34: Sturgis Motorcycle Rally is a Busy Time
Photo Courtesy of South Dakota Department of Tourism

Regulatory variable speed limits, which reduce disruption and delay to winter travel, will be established on segments of the Interstate highway system. In suitable urban settings, adaptive traffic signals will be deployed.

6.2.4 Traffic Incident Management

According to the Federal Highway Administration, traffic incident management (TIM) is a planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents so traffic flow can be restored as safely and quickly as possible.[51] SDDOT will continue to collaborate with MPOs and other state and local agencies to sponsor incident responder training and establish traffic incident management teams and plans. Quicker, more effective response will reduce the duration and impact of traffic incidents; improve the safety of motorists, crash victims, and emergency responders; reduce secondary crashes; restore smooth traffic flow; and minimize delay, congestion, and energy consumption.

[50] https://ops.fhwa.dot.gov/atdm/approaches/atm.htm
[51] https://ops.fhwa.dot.gov/tim/

6.2.5 Electric Vehicles

One barrier to large scale electrification is the lack of charging infrastructure. Because SDDOT does not own or operate electrical power infrastructure, it must influence power generation and grid characteristics within the limits of its authority. As consumer demand grows, utilities must establish a dispersed modern power grid with greater peak charging capacity to support long distance travel.

SDDOT expects to receive approximately $29 million in Federal funding from years 2022 through 2026 to support its NEVI Plan[52]. SDDOT estimates at least 13 additional Direct Current Fast Charging stations are needed to achieve EV Corridor Ready status on South Dakota's four Alternative Fuel Corridors: I-29, I-90, I-229, and I-190. Installations may begin in the coming years. After the Interstate build-out, other locations will be deployed depending on funding availability and private sector interest. Low numbers of EVs will make broad, rapid deployment of charging stations difficult. SDDOT plans to encourage charging stations appropriately based on the local setting, demand, and need.

SDDOT's NEVI plan describes how it could support the deployment of charging infrastructure. SDDOT anticipates awarding federal NEVI funds through a competitive process to private sector entities that will provide the required 20 percent match.

6.2.6 Alternative Fuels

South Dakota is a significant producer of ethanol, a practical fuel additive to petroleum-based fuels. Other fuels such as plant-based oils, hydrogen, and compressed natural gas (CNG) are also being considered as supplements or replacements for petroleum-based fuels. As alternative fuels become available, SDDOT will consider them for its fleet and for public transit providers. Some public transit agencies have recently received grants to purchase alternative fuel vehicles. SDDOT will also work to support the transition to electricity and alternative fuels by establishing an equitable framework for road use charges. SDDOT will respond to consumers' choices of vehicles and fuels within its limits of funding and authority.

6.3 Promote Freight Efficiency

Because of South Dakota's geography and economy, its residents depend heavily on highway freight transport. Long distances between towns, rail facilities, and major state, regional, national, and international markets make truck and rail freight efficiency essential to controlling costs of commodities and products and to limiting fuel consumption and emissions (Figure 35).

[52] https://dot.sd.gov/media/documents/EV/SDDOTEVPlan_final.pdf

Figure 35: Three Combines Harvest Wheat East of Pierre
Photo Courtesy of Ben Orsbon

6.3.1 Commercial Vehicle Configurations

SDDOT has promoted energy efficiency by encouraging truck platooning and the use of longer combination vehicles.

In 2019, SDDOT was instrumental in the passage of SDCL 32-26-50, which allows the SD Transportation Commission to promulgate rules for truck platooning. By coordinating speeds and shortening spacing between trucks, platooning can save up to 5% of fuel for leading trucks and 10% for trailing trucks.

SDDOT worked with the US Senate to expand longer combination vehicle (LCV) routes in South Dakota beyond the Interstate System on other specially designated National Highway System routes.[53] LCV routes allow trucks with up to three trailers, a cargo length of 100 feet, and gross vehicle weight up to 129,000 pounds. The LCV Network uses many of the NHS and State Preferential Truck Network routes and links many of the commercial centers shown previously in Figure 7.

SDDOT will continue to support the use of large but safe vehicles to reduce the number of trips needed and limit total energy consumption and emissions.

[53] 49 USC 31111(e) and 23 CFR, Subchapter G, Part 658, Appendix C.

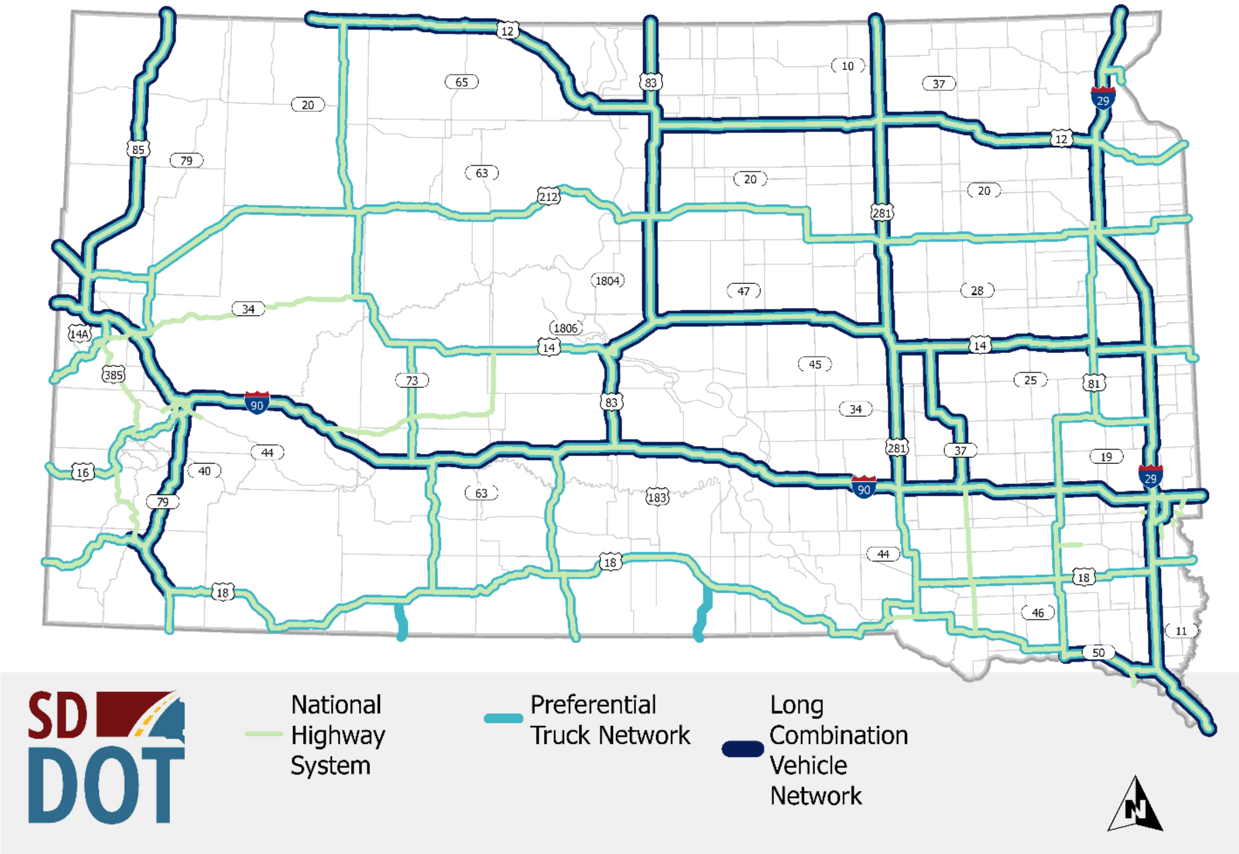

Figure 36: Longer Combination Vehicle Routes

6.3.2 Intermodal Freight Transfer

Transferring freight from trucks to rail reduces energy consumption and transportation costs while adding to producers' profitability. Rail transportation is most economical and energy efficient if truck freight can be consolidated over an agricultural production area large enough to economically support the use of long trains (Figure 37).

Figure 37: Valero Ethanol Facility
Photo Courtesy of Ben Orsbon

SDDOT's State Rail Plan identifies future projects to further facilitate energy efficient rail shipping. SDDOT will continue to support improvements to freight rail projects, short lines, rail upgrades and highway access to shuttle train facilities through use of:

- the Consolidated Rail Infrastructure and Safety Improvements (CRISI) program
- the Special Transportation Circumstance (STC) program
- other state and federal funding
- tax increment financing where appropriate

A recent example of an improvement to enhance freight transfer is the approval of a $24.7 million CRISI grant for the Sisseton Milbank Railroad Modernization project to replace 37 miles of the Sisseton Milbank Railroad, including the rehabilitation of one bridge. This railroad offers interchange connections to BNSF, CN, CP, and UP within the Twin Cities, as well as access to Mississippi River barge services. These connections reduce energy consumption and emissions.

6.3.3 Electronic Systems

SDDOT will continue to deploy and operate technology that promotes safe and uninterrupted commercial vehicle movement to facilitate commerce, save fuel, and limit emissions.

South Dakota's automated permitting system directs commercial vehicles to routes that can safely accommodate them, avoiding restrictions, delays, and impassible roadway segments. SDDOT will pursue system enhancements to accurately map route restrictions and provide turn-by-turn directions to operators.

SDDOT will expand deployment of electronic screening systems at its ports of entry and weigh stations. The systems identify moving commercial vehicles and verify their credentials, weight, height, and the condition of tires and brakes. Allowing safe vehicles to bypass the ports of entry saves both energy and time, while removing unsafe vehicles from the traffic stream prevents traffic crashes and incidents, also saving time and energy.

Finally, SDDOT is exploring technology to inform truck operators as they approach work zones to reduce the likelihood of entering an impassible work zone or experiencing a crash. The technology will increase safety while preventing delay, congestion, and rerouting that unnecessarily expend energy.

6.3.4 Truck Parking and Idling Reduction

To comply with motor carrier safety regulations, truck drivers must rest every 10 hours. SDDOT will continue its regular assessments of truck parking needs and availability, especially on Interstate highways. Providing adequate truck parking spaces at Interstate rest areas will reduce the time and fuel truck operators expend finding safe parking.

In collaboration with other states along the I-90 and I-94 corridors, SDDOT will investigate the feasibility of a truck parking information system to detect available parking and notify operators. Timely and reliable information can avoid wasteful fuel consumption while searching for safe parking locations.

After they are parked, many trucks must idle their main engine to provide heating, cooling, and auxiliary power. Truck Stop Electrification (TSE) and Electrified Parking Spaces (EPS) can provide power without engine idling, saving fuel and limiting emissions. SDDOT does not plan to install TSE and EPS at its Interstate rest areas, but private facilities may consider them if market incentives are created.

6.4 Encourage Non-Motorized and Multi-Occupant Travel

Another way SDDOT can limit fuel consumption and emissions is to promote travel alternatives that may be more energy efficient than highway travel.

6.4.1 Active Transportation

SDDOT will manage its Transportation Alternatives (TA) program to save fuel and limit emissions by encouraging modes that do not require petroleum fuel consumption. By reducing the number of roadway users, the program also reduces travel delay and fuel consumption for others.

The program allocates more than $8 million of federal transportation funds to enhance intermodal transportation and initiate smaller-scale, non-motorized transportation projects such as pedestrian and bicycle facilities and paths, recreational trails, safe routes to school projects, community improvements such as historic preservation and vegetation management, and environmental mitigation related to stormwater and habitat connectivity. The program builds Americans with Disability Act (ADA) compliant infrastructure to connect housing to essential services, often for disadvantaged people.

Figure 38: Walk to School Day

The program awards projects annually for construction by the third year. SDDOT will encourage grant applications that emphasize energy efficiency and limiting emissions while addressing local concerns for safe and accessible transportation.

6.4.2 Transit

SDDOT will continue to manage and promote urban and rural transit operations throughout the state. The SDDOT's Air, Rail, and Transit Program administers federal funding received from the Federal Transit Administration as well as state transit funds.

Although transit can be more energy efficient than personal vehicles, SDDOT will encourage even greater energy efficiency by promoting federal funding acquisition and operation of energy-efficient transit vehicles and through efficient routing and dispatching by transit providers.

6.4.3 Park and Ride

Park and ride facilities can provide safe, convenient locations for carpooling groups to consolidate multiple vehicle trips into single vehicle trips with multiple passengers. Improving the convenience and availability of park and ride facilities can attract transit ridership and enhance energy and time savings compared to single occupancy vehicles.

As SDDOT administers the Federal nonmetropolitan transit funding programs, it will review practical locations where carpooling and park and ride strategies can be integrated into transit plans and projects. Surveys of transit providers could assess the interest, practicality, and effort required to connect park and ride facilities to commercial and employment locations using transit.

6.5 Energy Impact of Infrastructure Projects

Because building, repairing, and rehabilitating transportation infrastructure represents SDDOT's largest financial investment and its most directly influenced energy-intensive activity, it provides a substantial opportunity for energy and emissions efficiency.

6.5.1 Life Cycle Analysis

SDDOT employs life cycle cost analysis to identify the most cost-effective investments attainable with available funding. SDDOT will extend its analysis to assess energy consumption over the complete life cycle of facilities. The assessment will evaluate facility design, material and construction specifications, rehabilitation selection, and material recycling to improve project sustainability and service life.

Life cycle analysis may favor investments in designs and materials with long life expectancy because they would reduce the frequency of energy-consuming repair, rehabilitation, or replacement. Analysis may similarly favor investments that promote durability and resilience. For example, drainage improvements may reduce the likelihood of flooding that could require energy-intensive repairs which impact users travel time, distance, and energy consumption.

6.5.2 Energy-Efficient Pavements

SDDOT's 8,000 roadway-mile network of highway pavements is its most valuable asset in terms of both money and energy. The construction and operation of pavements can be made more efficient by several means.

SDDOT will continue to incentivize construction of smooth pavements, which save energy and operating costs for the vehicles that travel them. Although smooth pavements provide minor improvements in vehicle fuel efficiency, the cumulative savings realized over millions of vehicle miles traveled is huge.

Selection of pavement type and materials is also important. SDDOT will optimize mix designs for cement type and cement content to reduce energy demand. National efforts will be monitored for opportunities to further reduce emissions.

Finally, recycling pavements offers an excellent opportunity to reduce energy demand. SDDOT will continue its practice of recycling asphalt concrete pavements and portland cement concrete pavements into the subgrade and surfacing layers. Additional efforts will be made to expand on current recycling techniques to provide energy-efficient pavements.

6.5.3 Energy-Efficient Lighting

Light emitting diode (LED) lighting is 40 to 60 percent more energy efficient than traditional lighting technologies. LED luminaires provide more light with lower energy consumption, emit less heat, and enjoy a longer lifespan with lower maintenance and operating costs. SDDOT will specify LED lighting on its construction projects and progressively convert existing lighting systems to LED to reduce energy consumption. For future construction projects, SDDOT may consider other energy efficient lighting technology as it becomes available.

6.5.4 Work Zone Traffic Control

SDDOT will optimize the length and duration of lane closures to minimize disruption to the traveling public, reduce congestion and delay in work zones, and limit fuel consumption and emissions. To discourage unnecessary lane closures, SDDOT will include lane rental or similar provisions in paving projects for applicable projects which are in the best interest of the SDDOT or the traveling public. Lane closures for pavement rehabilitation will be reviewed when work is suspended except for necessities like concrete curing. Likewise, SDDOT will limit the length and duration of lane closures for Interstate highway work based on the type of work being done when concerns related to lane reduction could cause congestion and travel delay.

Where detours are needed, SDDOT will select short, direct detour routes that minimize travel distance and delay while maintaining an adequate corridor for travelers. Traffic control will be designed to limit the time users are idling and waiting on flaggers or pilot cars.

6.5.5 Earthwork

SDDOT will work to establish earthwork balance points to limit haul distances and reduce the amount of fuel expended by construction equipment. In rural locations, grades can typically be designed with balance points of one-half mile or less (desired) or one mile (maximum).

6.6 SDDOT Internal Energy Efficiency

The strategies described in this section aim to make SDDOT's internal activities more energy efficient.

6.6.1 Remote Work

At the onset of COVID-19 in early 2020, SDDOT invested in computer hardware and software to enable many of its workers to work remotely and meet virtually. Although non-essential offices reopened shortly afterwards, many workers continue to work remotely at least part of their time. SDDOT will continue to allow remote work schedules, which save travel time, vehicle expense, and fuel consumption.

6.7 Electric Vehicles and Equipment

Fully electric, plug-in electric hybrid, and hybrid electric vehicles consume less energy and produce fewer emissions than conventional vehicles and generate no tailpipe emissions while running only on electricity. SDDOT will evaluate the availability, cost, benefits, and suitability of energy-efficient vehicles and heavy equipment to South Dakota's climate, distances, and work demands. Some heavy truck options are available now, but their power capacity is not yet sufficient to travel long distances and power onboard hydraulic equipment, especially during long hours of snowplowing. Hybrid and electric passenger and utility vehicles, which have received more development, may be incorporated into the SDDOT's fleet more quickly.

SDDOT will also consider electric versions of light equipment such as air compressors, weed trimmers, and small mowers. Although energy savings may be modest, significant savings may be realized on a statewide, multi-year basis.

6.7.1 Buildings & Facilities

SDDOT owns and operates office buildings, maintenance shops, rest areas, and other facilities that consume energy. SDDOT will identify cost-effective opportunities to install more efficient lighting and heating systems when facilities are built, replaced, or remodeled.

6.7.2 Winter Maintenance

Winter maintenance, which is one of SDDOT's most important maintenance functions, is also one of the most energy intensive. Performing winter maintenance as efficiently as possible can save significant amounts of fuel and emissions, while ensuring roads are treated effectively and quickly.

SDDOT will continue development, deployment, and use of its winter Maintenance Decision Support System, which uses location-specific knowledge of roadway characteristics, current and forecast weather, and feasible maintenance treatments to identify treatment strategies that use material, equipment, labor, and fuel most efficiently.

SDDOT will analyze its snowplow routes to maximize the number of miles treated compared to the total miles driven. By reducing deadheading, the revised route assignments are expected to reduce total miles driven and fuel consumed by more than twenty percent while maintaining or even improving level of service. SDDOT will also reevaluate the locations of auxiliary materials storage to limit haul distances and reduce the number of return trips to central shops needed to replenish deicing chemicals.

Figure 39: SDDOT Plowing Sun Dogs on Christmas Eve
Photo Courtesy of Luke Neville, Lead Highway Maintenance Worker in Philip

An innovation well suited to multi-lane highways is the use of towplows, which can plow two lanes at once, reducing the number of passes needed to remove snow and ice from the roadway. SDDOT will expand their use where road and traffic conditions allow.

SDDOT will evaluate liquid deicing chemicals to identify the materials most effective in each of its maintenance areas. Using the most effective materials will reduce the need for repeat treatments that add to energy consumption and emissions.

6.7.3 Roadside Maintenance

SDDOT's primary roadside maintenance activity is mowing ditches to maintain line of sight and prevent accumulation of snow on roadways. SDDOT will explore methods to make roadside maintenance more energy efficient, possibly by reducing frequency or using more efficient equipment. This work may require several years to complete, and the likelihood of success is unknown.

6.8 Summary

SDDOT's main CRP strategy is to **allocate resources to improve energy efficiency**. SDDOT has worked to reduce emissions for many years because saving energy and economic efficiency are fundamental aspects of good government and environmental stewardship. Aligning and integrating transportation projects, plans, polices, processes, design, construction, operations, and maintenance will protect safety, mobility, accessibility, equity, and economic and job growth and implement the strategy. Although South Dakota's rural context discourages options like passenger rail or metro transit, SDDOT enjoys many opportunities to integrate energy efficiency more fully into its business practices.

Chapter 7 Conclusion

The SDDOT Carbon Reduction Strategy meets all the requirements of 23 U.S.C. 175(d)(2).[54] It also supports USDOT's Strategic Plan goals.[55] It is a conscious investment in good government because it supports economic efficiency and environmental stewardship as well. Nationally, only five much smaller and more urban states produced less transportation-related carbon emissions than South Dakota.[56] The sum of all their land area is less than 30 percent of South Dakota's so their travel distances are much shorter. Even with a large land area, a dispersed population, and long travel distances South Dakota's transportation emissions are low.

South Dakota meets all the National Ambient Air Quality Standards (NAAQS) for ozone, carbon monoxide, and/or particulate matter and has no nonattainment or maintenance areas. Obviously, South Dakota's transportation sector is very energy and emissions efficient relative to the wide area it serves and the importance of its transportation system to national connectivity and international trade. South Dakota's strategy builds on private sector decisions and market momentum. Nurturing a harmonious and coordinated strategy will limit emissions while supporting safety, resilience, mobility, and a strong economy.

The SDDOT's main strategy to "**Allocate Resources to Improve Energy Efficiency**" makes sense in South Dakota's unique context. Congress thoughtfully required the program be appropriate to the population density and context of the State. [57]Congress understood a "context sensitive" approach strengthens the CRP strategy's effectiveness. Within South Dakota's rural and urban context, three considerations shape SDDOT's strategy:

- factors SDDOT controls with its projects and funding
- factors SDDOT can influence through funding and other means
- the limits and extent of SDDOT control and influence over the behavior of transportation users and other governments' actions.

SDDOT influences the transportation projects and transportation services it funds. Through its projects, processes, policies, and planning, the SDDOT can shape others' emissions production in limited ways. SDDOT's ability to influence and shape transportation emissions is limited because of population densities. Modal viability and distances to activity centers, commercial and economic centers, and services affect the strategies SDDOT can use. Because of this, a key

[54] https://uscode.house.gov/view.xhtml?req=(title:23%20section:175%20edition:prelim)%20OR%20(granuleid:USC-prelim-title23-section175)&f=treesort&edition=prelim&num=0&jumpTo=true
[55] https://www.transportation.gov/sites/dot.gov/files/2022-04/US_DOT_FY2022-26_Strategic_Plan.pdf
[56] https://www.eia.gov/environment/emissions/state/
[57] https://www.fhwa.dot.gov/environment/sustainability/energy/policy/crp_guidance.pdf

to implementing an effective strategy is encouraging energy efficiency by SDDOT customers, contractors, and SDDOT staff across its broad spectrum of services, projects, and activities. Strategies must balance limiting emissions with safety; preserving, sustaining, and enhancing mobility; and transportation system reliability and continuity to avoid adverse economic consequences. Limiting conventional travel choices would lead to transportation inequality and mobility insecurity for Tribes and other citizens, particularly rural residents (Figure 40).

Figure 40: Forest City Bridge Connecting to the Cheyenne River Reservation
Photo Courtesy of Ben Orsbon

The SDDOT will use a sustainable approach while avoiding impractical and inappropriate alternatives that are counterproductive and inefficient in a rural, low-density setting. Limiting emissions must also preserve mobility. Protecting and strengthening the economy and the freedom to travel in rural and urban areas are critical aspects of South Dakota's strategy. The synergy of aligning, connecting, and balancing Carbon Reduction projects, transportation plans, polices, processes, operations, and construction to work together harmoniously will accomplish the strategy by magnifying the interaction and outcome. It will also provide people "the ability to get to where they need to be," as USDOT Secretary Pete Buttigieg said.[58]

SDDOT's strategy is safe, energy efficient, limits emissions, and supports mobility and accessibility as an example of good government and environmental stewardship. The SDDOT will pursue the strategy and activities proposed in this document to limit energy consumption and emissions while it fulfills its central mission "to efficiently provide a safe and effective public transportation system" for the state and the nation.

[58] Page 23, Pete Buttigieg Wants to Make Transit Accessible, Steve Wright. Planning, Volume 89, Number 1, Spring 2023.


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