

APPENDIX 1 TRENDS AND SCENARIOS

TABLE OF CONTENTS

- 1. Planning for Uncertainty 3
 - Approach 3
 - Findings 4
 - Next Steps for Scenario Planning 4
- 2. Future Trends and Disruptors 5
 - People and Places 5
 - Economy and Business 5
 - Technology 6
 - Environment 7
 - Policy and Funding 7
 - Transportation 8
- 3. Transportation Connection: Alternative Futures 10
 - Alternatives 10
 - Rural Renaissance 10
 - Centers and Cities 11
 - Smart and Connected 12
 - Ghost Towns 13
 - Survey Results 14
 - Rural Renaissance 14
 - Centers and Cities 18
 - Smart and Connected 21
 - Ghost Towns 24
- 4. North Dakota Trends and Conditions 27
 - Access to Services 27
 - Key Transportation Issues 27
 - Drivers of Change in North Dakota 27
 - Future Uncertainties and Disruptors 28
 - Agricultural Trends 30

Key Transportation Issues30

Drivers of Change in North Dakota.....30

Future Market Uncertainties and Disruptors30

Bicycle and Pedestrian33

Key Transportation Issues33

Drivers of Change in North Dakota.....33

Future Uncertainties and Disruptors.....33

Energy36

Key Transportation Issues36

Future Market Uncertainties and Disruptors36

Drivers of Change in North Dakota.....36

Infrastructure.....39

Key Transportation Issues39

Future Market Uncertainties and Disruptors39

Drivers of Change in North Dakota.....39

Population.....42

Drivers of Change in North Dakota.....42

Future Demographic Uncertainties and Disruptors.....42

Key Transportation Issues42

Technology45

Key Transportation Issues45

Drivers of Change in North Dakota.....45

Future Uncertainties and Disruptors.....45

Transit48

Key Transportation Issues48

Drivers of Change in North Dakota.....48

Future Uncertainties and Disruptors.....48

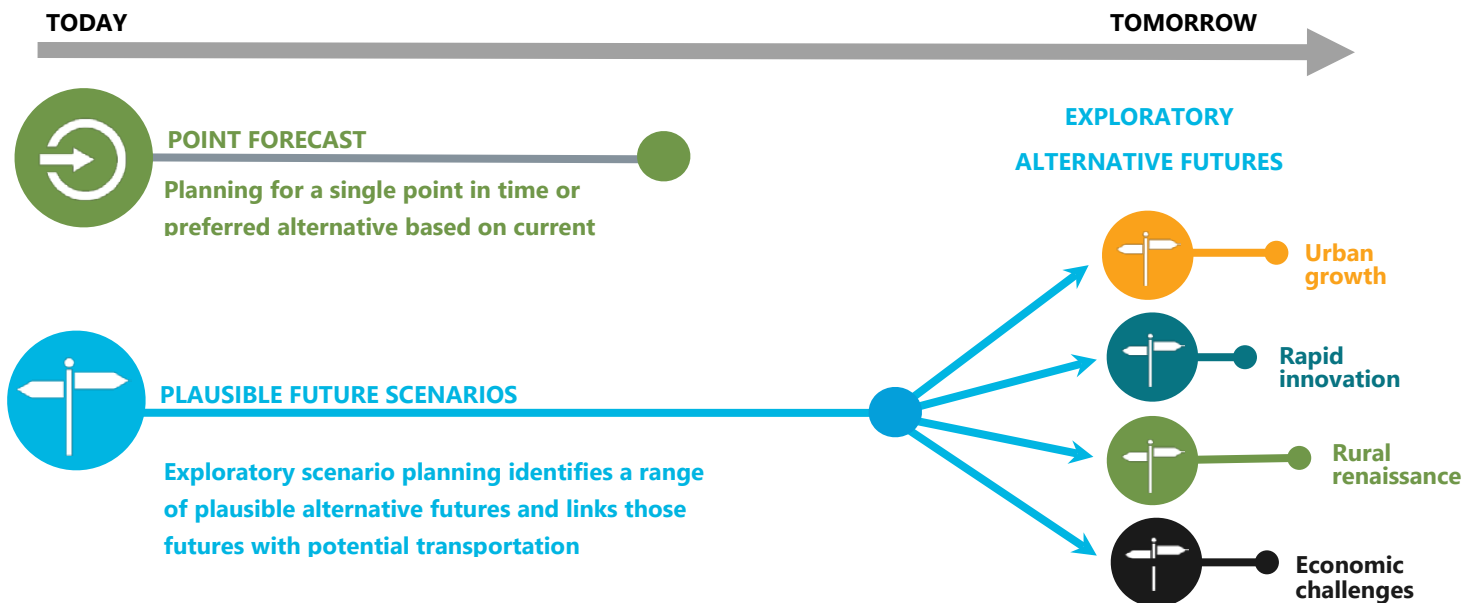
1. PLANNING FOR UNCERTAINTY

APPROACH

In considering how North Dakota might change in the future, North Dakota Department of Transportation (NDDOT) embarked on an illustrative and informative approach to scenario planning that reflected on several key questions:

- What are some of the major trends and disruptors coming to North Dakota?
- What major uncertainties or risks are out there?
- What will be the most significant drivers of change in the next 5, 15, 25 years?

The graphic below illustrates how scenario planning differs from a point forecast approach. A point forecast attempts to discern precisely what the future will hold based on current conditions, an exploratory scenario planning approach considers several plausible futures. In this case, each plausible future is also linked with potential transportation outcomes. Transportation Connection research and outreach activities identified four plausible futures – urban growth, rapid innovation, rural renaissance, and economic challenges – each of which are explored in more detail in Section 3 of this document.



A scenario planning process enables NDDOT to consider how changes in these trends and disruptors could result in a range of possible outcomes on the transportation network. Understanding the spectrum of different outcomes allows NDDOT to design a plan that is flexible and responsive to the future’s uncertainties. As different trends emerge in different parts of the state, the Department can adjust its policy and programming to deliver the transportation solutions that most effectively address the needs and priorities associated with the trends.

FINDINGS

As part of the Scenario Planning exercise, NDDOT incorporated surveys for Department staff and external stakeholders, including the public, on the four scenarios to obtain feedback on the probability of each scenario occurring and the impact that the scenario would have on transportation needs and priorities if the scenario were to occur. In each survey, respondents were asked to consider:

- How their own travel patterns and needs would change under the scenario
- How North Dakota’s transportation priorities would change under the scenario
- What changes they would want to see occur in the transportation system and what actions they would want to see NDDOT take in response to the scenario

Common findings across all four scenarios include:

- Demand for more travel options for local travel
- Recognition that long-distance travel will remain critical for rural areas
- Greater demand for online shopping and local freight deliveries
- Ongoing need for safety and security for all users
- Expectation that funding challenges for transportation increase

Common actions identified for NDDOT to take across all four scenarios include:

- Make cost-effective investments and maintain existing infrastructure
- Provide support for local infrastructure maintenance
- Prioritize safety for all users in all communities
- Support new technologies

“As long as people live in an area, the infrastructure needs to be safe and adequate.”

“Keep up with vehicle technology and needs input from roads and bridges to increase safety and decrease hazards and travel time.”

“More active transportation because of the shorter distance traveled”

The figure to the right shows a sample of pull quotes from Scenario Planning survey comments.

NEXT STEPS FOR SCENARIO PLANNING

NDDOT used the findings of the Scenario Planning exercise to develop strategies in Transportation Connection that respond to the needs and priorities that stakeholders identified. Moving forward, the Department will use these findings to guide future planning efforts, including the Statewide Transportation Improvement Program, the State Rail Plan, the State Freight Plan, and the Statewide Active and Public Transportation Plan.

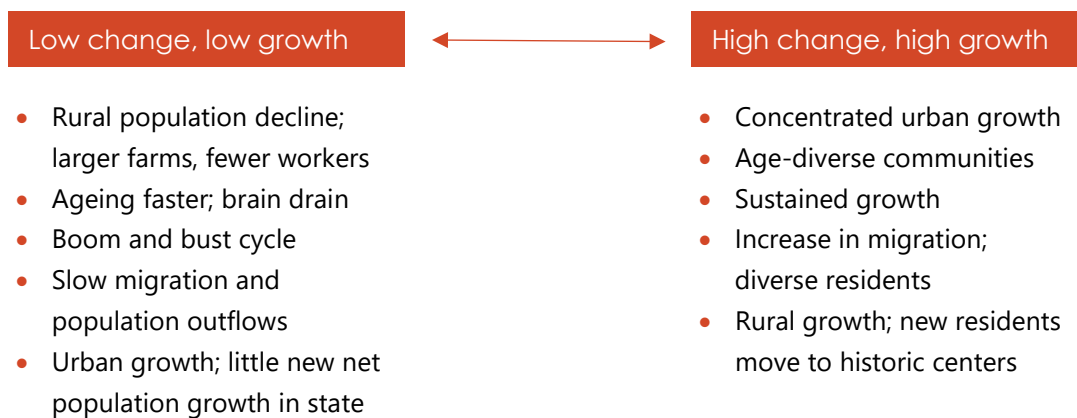
The Scenario Planning activities will enable the Department to analyze data related to the movement of people and goods throughout North Dakota, identify emerging patterns, and align them with the priorities and needs of the scenarios. As new disruptors emerge and their impacts are seen in the transportation data, NDDOT will be able to design and deliver transportation solutions respond to the identified opportunities and challenges.

2. FUTURE TRENDS AND DISRUPTORS

Key drivers of change include population, economy, development, technology, environment, policy, and risk. This section explores various plausible futures in North Dakota in each of those categories, describing outcomes at each pole of a spectrum of innovation and change. One end of this spectrum is characterized by slow growth and moderate to no deviation from the current trends in North Dakota. The other end of this spectrum describes a situation of strong growth and significant change from the conditions we see today.

PEOPLE AND PLACES

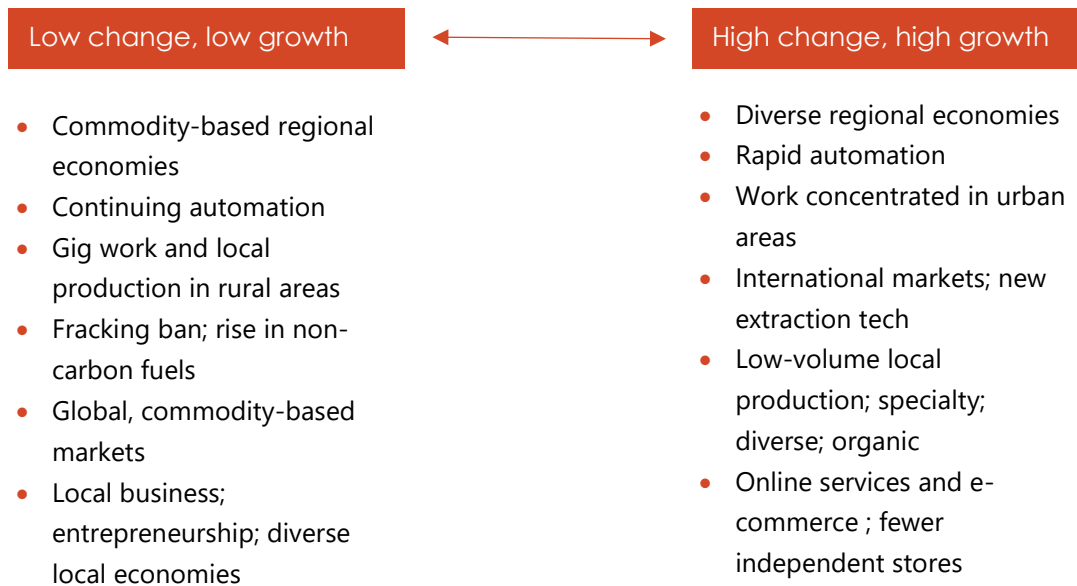
- **Urban Development** | At one end of the spectrum, North Dakota could see continued population decline in rural communities and the presence larger farms that employ relatively fewer workers. The other end is characterized by growth that is concentrated in cities and centers.
- **Older and Younger Residents** | North Dakota’s population could continue to grow older and see a Gen Z brain drain as young people leave rural areas for urban ones. In a high-change future, communities may become increasingly age-diverse.
- **Western North Dakota Growth** | North Dakota could fall into a cycle of boom and bust communities or see sustained and consistent community and economic growth.
- **Migration and Immigration** | A low-change future is characterized by slowed migration and population outflows, while a strong growth, high-change future is characterized by increased migration and diverse residents.
- **Rural Revitalization** | At one extreme, growth is concentrated in urban areas and there is little net new population growth statewide. At another, there is growth in rural communities as new residents move to smaller, historic centers.



ECONOMY AND BUSINESS

- **Industry Diversification** | North Dakota could continue its transition into commodity-based regional economies or see diversified regional industries.
- **Automation of Production** | While the automation of technological industries could proceed at its current rate, the country could also see rapid automation in production industries.

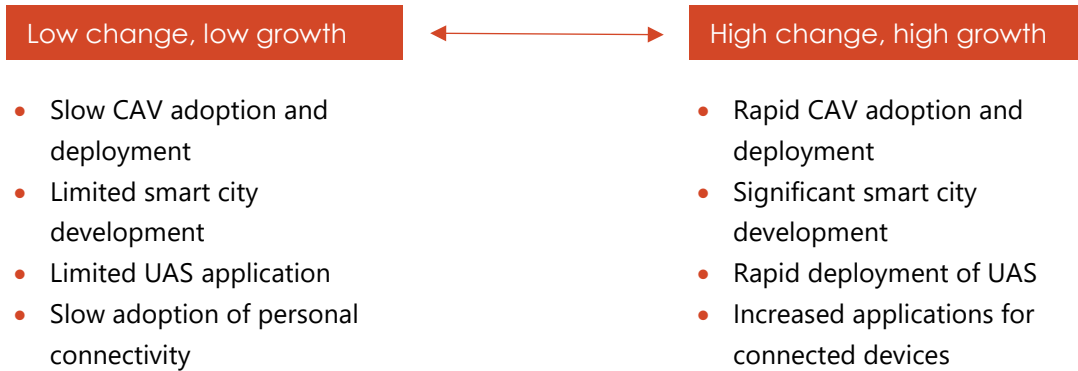
- **Employment Patterns** | Local production and gig/remote work rural opportunities could prove to be the main source of employment in North Dakota. In contrast, a high growth future is characterized by more employment opportunities created in urban centers.
- **Energy Production** | A fracking ban would likely lead to a significant drop in exploration and an uptick in the non-carbon-based fuels of the future. Personal energy production could become the dominant model, along with distributive generation. On the other end of the spectrum, an expansion in production and international markets might be accompanied by new extraction technologies and advances.
- **Agricultural Production** | With a shift to high-production, large-scale global markets, North Dakota could see a singular, commodity-based agricultural production model. In a high-change future, agriculture could shift to low-volume, specialty, and small producers, leading to local, organic, and diversified markets.
- **Retail and Consumer Behavior** | At one end of the spectrum, retail and consumer behavior might be characterized by local business, entrepreneurship, and a mix of retail and consumer services, leading to sustainable and diverse local economies. In a high-change future, North Dakota could see accelerating e-commerce, online services, fewer independent stores, and more distribution needs. This would likely result in less community-based spending.



TECHNOLOGY

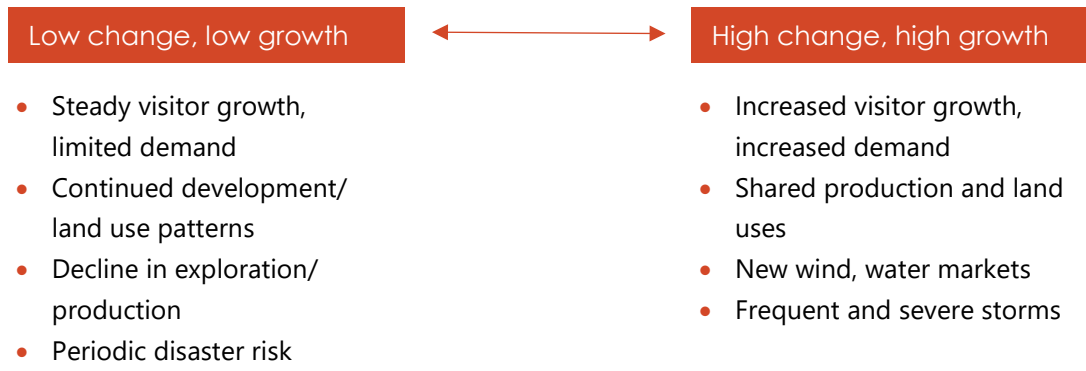
- **Connected and Autonomous Vehicles** | In a low-change future, there continues to be slow market adoption of CAVs and limited deployment. A high-change future is characterized by rapid adoption of these vehicle technologies.
- **Smart Cities and Infrastructure** | On one end of the spectrum, North Dakota could see limited development of connected systems. An alternate future is characterized by the development of comprehensive smart networks.

- **UAS Applications and Markets** | There could continue to be limited application and slow deployment of UAS applications. Alternatively, a high-change future could see rapid deployment of UAS across markets.
- **Data and Information Sharing** | Futures in this area envision either low adoption of personal connectivity or increased applications for connected devices.



ENVIRONMENT

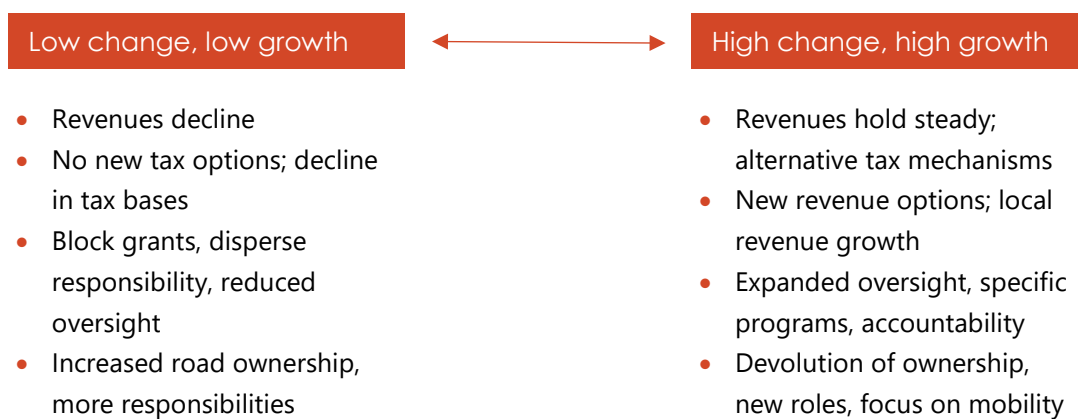
- **Recreation and Tourism** | In a low-change future, steady visitor growth yields limited recreational demand. In a future with significant increase in visitor volume, there is also a significant increase in public access demand.
- **Shared Land Use** | North Dakota could see continued development and land use patterns or a shift to increased shared production and land uses.
- **Natural Resource Markets** | On one end of the spectrum, there may be a decline in historical exploration and production. Alternatively, North Dakota could see a significant increase in new wind and water markets.
- **Natural Hazard Risks** | Natural hazards could continue to pose only periodic threats, while a high-change future could see more frequent and severe storm events.



POLICY AND FUNDING

- **Funding Sources** | Revenues and purchasing power could continue to decline. On the other hand, alternative tax mechanisms (e.g., a VMT fee) could help hold revenues steady.

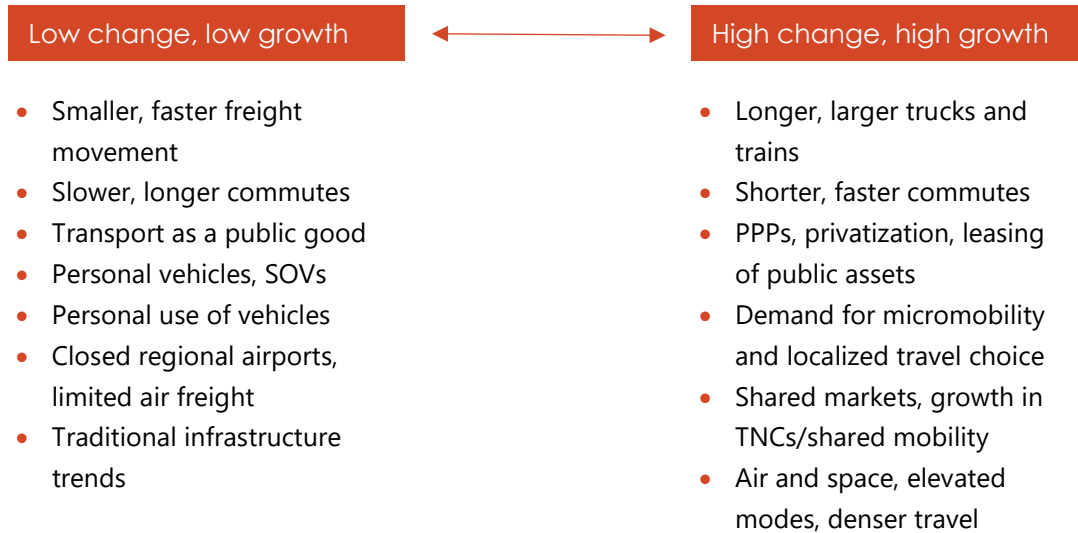
- **State and Local Funding** | With no new transportation funding options, a low-change future could see a decline in sales/severance tax bases. If additional revenue options were to become available, municipalities in North Dakota could introduce new programs and experience local revenue growth.
- **Federal Involvement** | At one end of the spectrum, North Dakota could see continued devolution of responsibilities, the presence of block grant programs more general in nature, and reduced Federal oversight. At the other, the state could see expansion of Federal oversight, specific grant programs, and increased accountability.
- **NDDOT Roles** | NDDOT could continue to take increased ownership of roads and the expansion of maintenance responsibilities. In a high-change future, the agency could see the devolution of ownership, take on new roles, and shift its focus to facilitating mobility.



TRANSPORTATION

- **Freight and Goods Movement** | Freight and goods could continue their trend towards smaller, faster, more frequent movements. Conversely, this sector could see a shift towards longer, larger, and heavier trucks and trains.
- **Commute Patterns** | A low-change future is characterized by commuters experiencing slower and longer travel patterns and durations, while the opposite scenario would see shorter, faster and different commute choices.
- **Public and Private Transport Roles** | While public and private transportation could continue to be seen as public goods, a high-change future is characterized by the proliferation of PPPs, privatization of transportation services, and the leasing of public assets and infrastructure.
- **Micromobility and Active Transport** | In a low-change future, North Dakotans might continue to rely on personal vehicles, single-occupancy vehicles, and surface transportation for their mobility needs. In a different future, they could encounter significantly increased demand for micromobility and more localized travel choices.
- **Shared Mobility and Economy** | New vehicles and equipment could continue to be used for personal use. An alternative future could encompass shared markets and equipment, drones/CAVs, and greater growth in TNCs and other forms of shared mobility.

- **Air Travel and Freight** | At one end of the spectrum, air travel might continue to trend towards closure of regional airports, no public use of UAS spaces, and limited air freight. A high-change future might be characterized by changes such as UAS, personalized air transport, shared or auto drones, in-state hop options, and new international markets for air freight.
- **Infrastructure and ROW** | While traditional trends in this area could continue, an alternate future might envision air and space, elevated, maximized and shared use infrastructure, elevated modes, denser travel, and new right-of-way management and maintenance.



3. TRANSPORTATION CONNECTION: ALTERNATIVE FUTURES

Transportation Connection explores several possible futures and the significant change they could bring to North Dakota – where people live, what they do, how they get around, and what people can expect from their transportation system. The following scenarios explore how people might travel, work, shop, and communicate in the North Dakota of the future, highlighting what has changed and what has remained the same.

These scenarios do not suggest that any of these futures will occur or that one is preferred over another; rather, they describe big-picture possibilities and ask “what if?” in order to generate flexible thinking.

ALTERNATIVES

RURAL RENAISSANCE

What if our rural areas become communities of choice in the future?

“Imagine you just moved into your new smart house with open space and fields all around. You check your greenhouse before getting on a call with customers on the other side of the globe, while your spouse is out in an outbuilding 3D printing drone components for a manufacturing company based in North Dakota.”

In this future, sustained economic growth and technological advances across the state provide opportunities for remote work and local and specialty agricultural production. North Dakota's small towns and rural areas become communities of choice, attracting new residents and building sustainable, vibrant local centers. Investments in broadband yield returns with all communities, industries, and infrastructure increasingly connected. Recreation and tourism transform into drivers of local economies. Resiliency planning largely mitigates natural hazard risk, encouraging new development.

This future is built around several key features:

- Rural communities become drivers of new population growth
- Gig work and home-based advanced manufacturing take off
- Local energy and agricultural production
- All industries are connected, smart, and efficient
- Local economies diversify and small town centers expand
- Recreation and tourism increase

- Mitigation reduces natural hazard risks



CENTERS AND CITIES

What if our cities grow quickly and become the centers of the state?

“Imagine you and your family are living in a new high rise with your job just a few blocks away. You moved into the city recently because this is where all the opportunities are. No one travels very far anymore as your shopping, schools, workplaces, and even entertainment are all streamed or delivered right to you.”

In this alternative, all new job growth is concentrated in existing urban cities and centers as North Dakota's economy becomes entirely services oriented. Migration into urban places and community centers drives growth into just several hubs around the state and rural communities experience accelerated declines. Connected devices, micromobility, and smart infrastructure make it easier, safer, and more convenient to move around urban areas with car-light lifestyles. Urban growth spurs need for resiliency and mitigation planning. Increased traffic and emissions in urban areas facilitates EV adoption and expansion of alternative energy markets.

This future is built around several key features:

- Mass migration to cities occurs and all new growth is concentrated in urban areas
- Economy diversifies into professional and technical services
- Energy and agricultural remain important, but their share of economic growth slows
- Energy production becomes more distributed and diversified
- Connected devices and smart infrastructure make it easier, safer, and more convenient to travel

- Urban growth spurs need for natural hazard mitigation around centers



SMART AND CONNECTED

What if innovations accelerate and we live in a tech-driven future?

“Imagine yourself with instant connectivity where everything around you has sensors, data streams, and is connected to everything else. Your work is mostly online and you can live anywhere and visit everywhere. It's easy to hail an autonomous drone and zip across the town or the state in a matter of minutes.”

In this alternative, accelerated innovation in all sectors, starting with agriculture and energy, leads to growth in tech centers around the state. Growth brings new opportunities and new industries to North Dakota. New residents and new job opportunities drives rapid population increases and creates diverse communities with new mobility needs. Rapid advances lead to entirely new uses of airspace and ground transport as drones and shuttles become commonplace. Data and connectivity expand dramatically to connect North Dakota to the world. Shared land use, new natural resource markets, distributed energy grids, and new infrastructure demand expands development pressure and heightens natural hazard mitigation needs.

This future is built around several key features:

- New residents move in and spur growth in diverse communities around the state
- Technology and innovation spurs job opportunities in new industries

- Online work and remote jobs grow significantly
- Energy and agricultural industries rapidly automate and become tech-driven
- Big data and smart infrastructure connect North Dakota to the world
- New technology is rapidly adopted
- Natural hazard risks and shared land uses increase as the state is rapidly developed



GHOST TOWNS

What if North Dakota's economy collapses and quality of life changes dramatically?

“Imagine yourself looking for a job half a world away. There isn't much left to do anymore after the energy industry collapsed and frequent storms made agricultural unprofitable. Your friends and family have already moved away after repeated floods, market uncertainties, and with so few jobs still available in the state.”

In this alternative, prolonged depression in energy and agricultural commodity markets leads to job losses and the collapse of local industries across the state. North Dakota ages more quickly as younger generations move away to look for work and communities are unable to make quality of life investments. With limited business investment, North Dakota falls behind in adopting new industry, transportation, and communications technologies. Increasingly severe and frequent storm events decimate vulnerable communities and infrastructure.

This future is built around several key features:

- Population declines across the state as residents move away
- Communities age more quickly as younger residents seek job opportunities elsewhere

- Energy and agricultural industries decline due to policy changes and international trade disruption
- Limited business investment slows the adoption of new technology and innovations
- Increasingly severe and frequent storm events decimate infrastructure



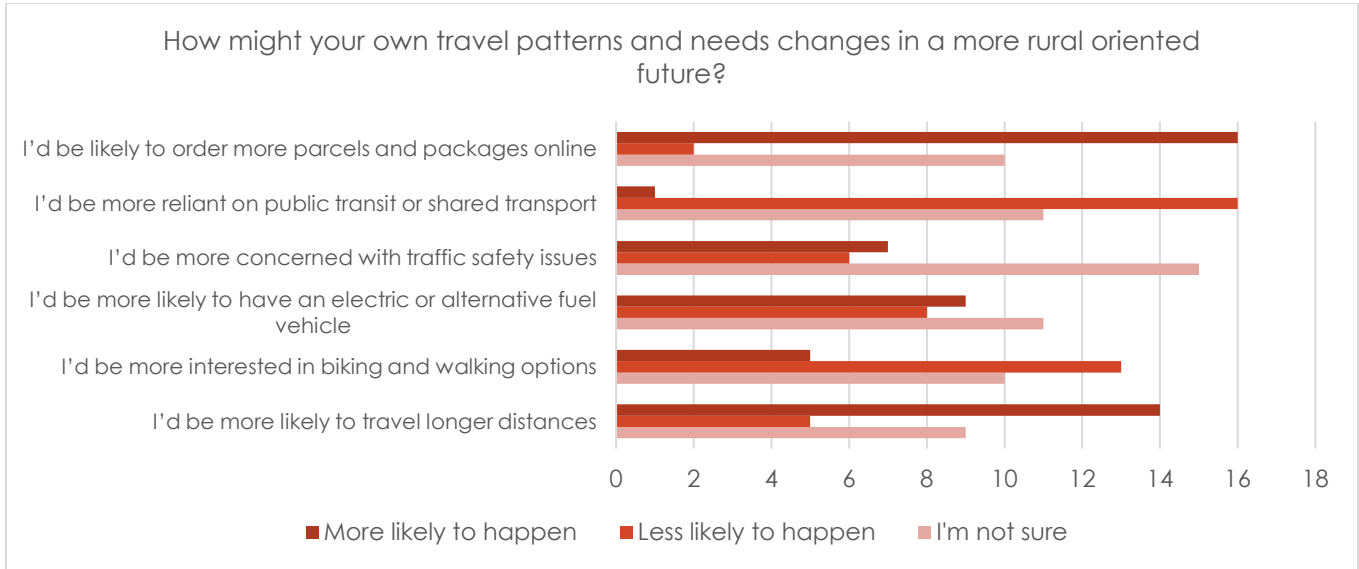
SURVEY RESULTS

This section summarizes survey results for each of the scenarios.

RURAL RENAISSANCE

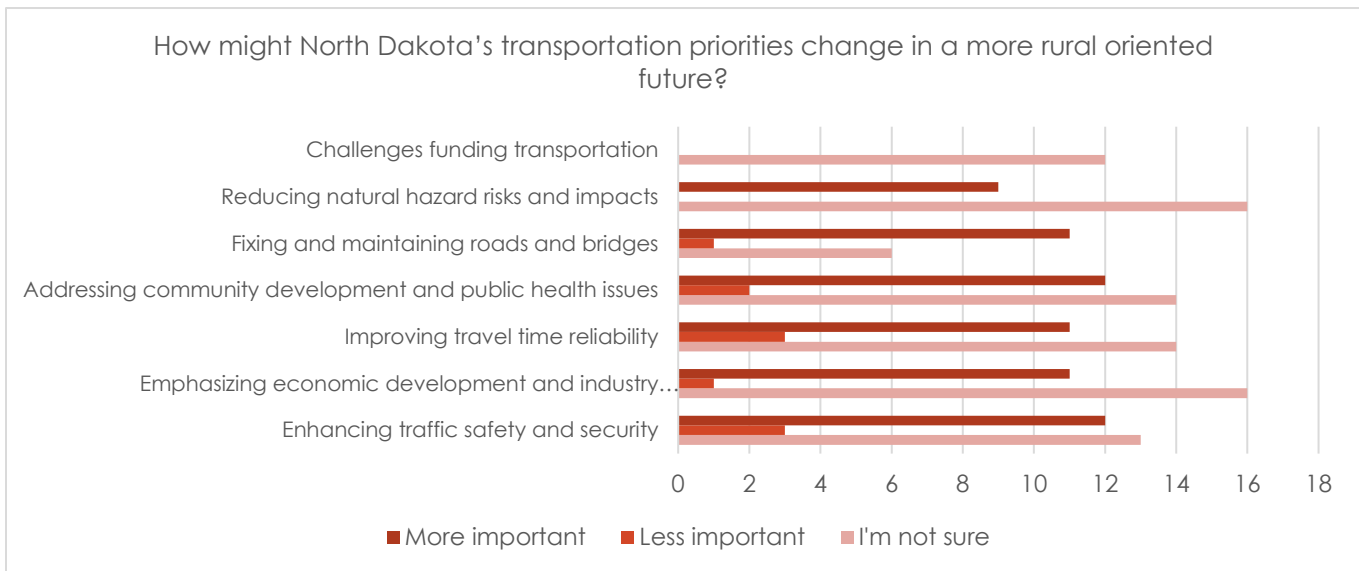
How might your own travel patterns and needs change in a more rural oriented future?

28 RESPONSES



How might North Dakota's transportation priorities change in a more rural oriented future?

28 RESPONSES



If this scenario came to pass, how would that change the way you travel?

26 RESPONSES

- Travel could be less miles per year if home delivery is ramped up with drones and allowing more work from home scenarios.
- I would likely travel less. I currently live in a rural setting, and under this scenario more diverse services would return to rural small towns.
- About the only way our travel would change is that it would be easier to car pool kids to events.
- Move to another state.
- It wouldn't.
- Would own at least one less vehicle as both spouses work from home. Would be traveling greater distances in all likelihood.
- Buy locally instead of driving an hour for fresh food.
- More public transportation.
- Very little as I currently live in a rural community and travel on rural roads to get to work/daily activities.
- It may have multiple impacts on mobility. I would likely be more reliant on e-commerce options getting packages delivered to home and would need to expect greater reliability and predictability of the transportation system. Personal mobility may experience growth in traveling longer distances to larger population centers and events for intercity/inter-destination travel but may reduce personal mobility within a community as biking and walking become much more attractive and desirable options. Additionally, if more services are obtained from an e-commerce prospective less travel may be required to obtain goods.
- It may make me look into alternative fuel vehicles or more long-term cost effective fuel types vs a standard internal combustion engine.
- More driving.
- I mostly travel to get TO rural areas for recreational purposes that are lacking in the city (safe places to bike ride, wild places to walk/hike, scenery). So I'd love to live in the country. But if everyone did that then the characteristics that make the wild country wild would be lost. And there's no future in dispersed living anyway. Probably better would be dense urban areas (as much as I loathe them) surrounded by wild country and ample public lands with a clearly delineated boundary between the two. In an energy-constrained future (likely) we're going to have to live close together. It's simply more efficient. So we'd better invest in making our urban cores tolerable/pleasant and leave some wild country on the perimeters. Presently in ND we're heading to a sprawling hellscape that is the worst of both worlds (see the area north of Mandan towards Harmon Lake as an example). That being said, when you speak of a rural renaissance, perhaps you mean a rejuvenation of small towns. With remote work a possibility many would LOVE to move to small towns. In 500 to 1,000 years, assuming we haven't used the nukes near Minot, small town living is likely to be the norm.
- It's too early to tell; but, with future driving technology, I hope that it would not only help the public (population, in general), but also for deaf and hard-of-hearing and have more technology features for both worlds.

- Would travel more unfortunately meaning wasting more resources.
- I already live in a rural New Salem and drive 35 minutes into the City of Mandan to work. During COVID I worked from home. I almost didn't drive at all when I worked from home with COVID. If more folks are living in rural areas and working from home in the gig economy they also would probably travel even less than they do today. What would be of concern is increased discretionary trips/traffic on rural roads (that one might today expect to be empty except for agricultural vehicles and the isolated truck or two). But more people might be walking or biking on rural roads - increasing safety conflicts. There would need to be more planning for safety. The only solutions that come immediately to mind are signage or on hard-surfaced rural routes, very wide shoulders that can double as bike or pedestrian lanes. Outright trails would be really nice, but probably cost prohibitive across wide swaths of the rural landscape.

In this future scenario, what should the DOT do? What kind of changes to the transportation system would help?

17 RESPONSES

- Safer bridges, more truck weight enforcement using WIMS, allow Fed. money to be swamped by local governments for State money. The State can keep the Fed. money, too much red tape for locals to deal with.
- Continue to maintain our road system. Expect more trucks and shipping vehicles moving products rather than passenger vehicles moving people.
- Make sure roads are better maintained.
- Wider roads and bridges. Heavier trucks and longer trailers.
- Robust infrastructure.
- Heavier load restrictions.
- Upkeep of long distance highways.
- Promote more gravel road preservation concepts for small local government road authorities and provide funding to build new bridges using innovative design concepts to save money and reduce down time.
- Maintenance of roads at the local level.
- Light rail.
- Make sure that snow removal practices are top of the line.
- I think safety will become critical. DOT should continue to make rural safety a key component of the transportation system. The DOT should also continue to invest in small towns under 5,000 population, especially if there is a commercial district nearby a State managed roadway. The DOT could provide an alternative funding source for communities looking to rejuvenate these commercial areas helping them stay competitive, safe, and reliable.
- Provide more active transportation infrastructure.
- I just don't see 330 million people dispersing into the countryside. It would be the least efficient way to arrange society. But to small towns, sure. Whether we congregate in cities or we repopulate small towns, e-bikes can handle most local travel while rail and freeways could handle interstate/town transportation. Having lived in walkable small towns I've parked my car for months and enjoyed a great quality of life that you just don't get in places like Bismarck, where places like State Street preclude

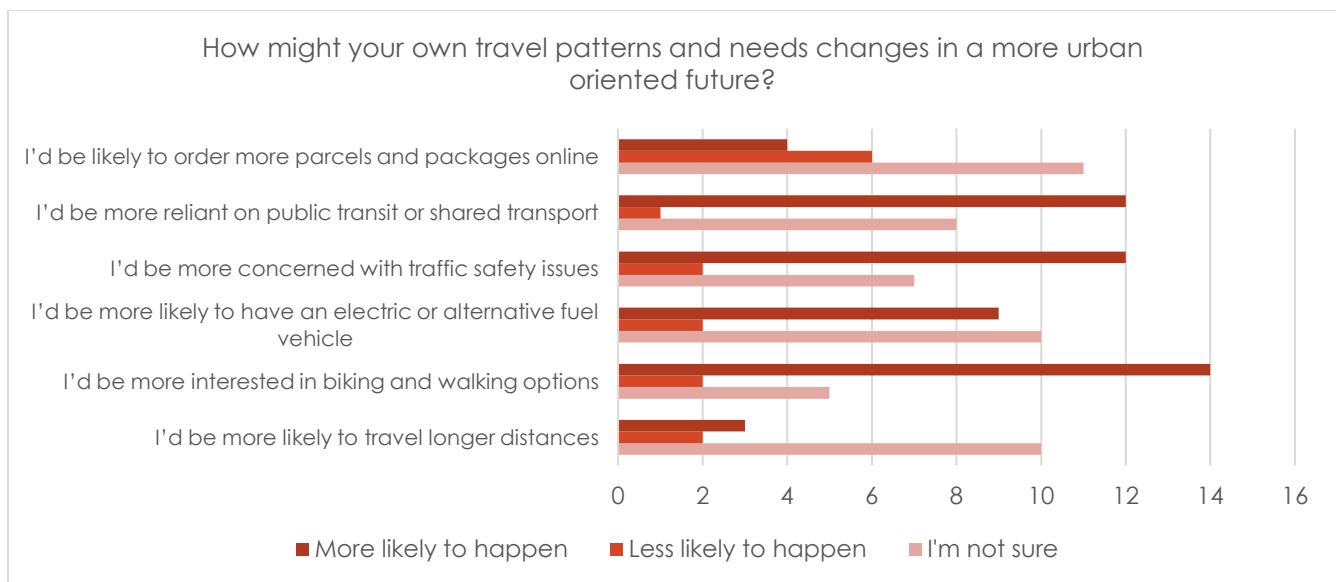
pedestrian and bicycle travel. In fact life in Bismarck was probably at its best during the early stages of the pandemic, when everyone put away the car and everyone set off on foot for evening walks and rides.

- I don't know at this time... only time will at a distant-future.
- Work with local to limit this rural focus.
- There is not a ton the DOT can do in this scenario. It will be imperative for local jurisdictions to make plans and policies to cluster rural development so that road improvements can be directed to those areas. Possibly DOT could provide planning grants. Also, as mentioned in last question, extend the shoulder(s) of hard-surfaced rural routes for bike/ped traffic, at such time as those rural routes are due for a resurfacing.

CENTERS AND CITIES

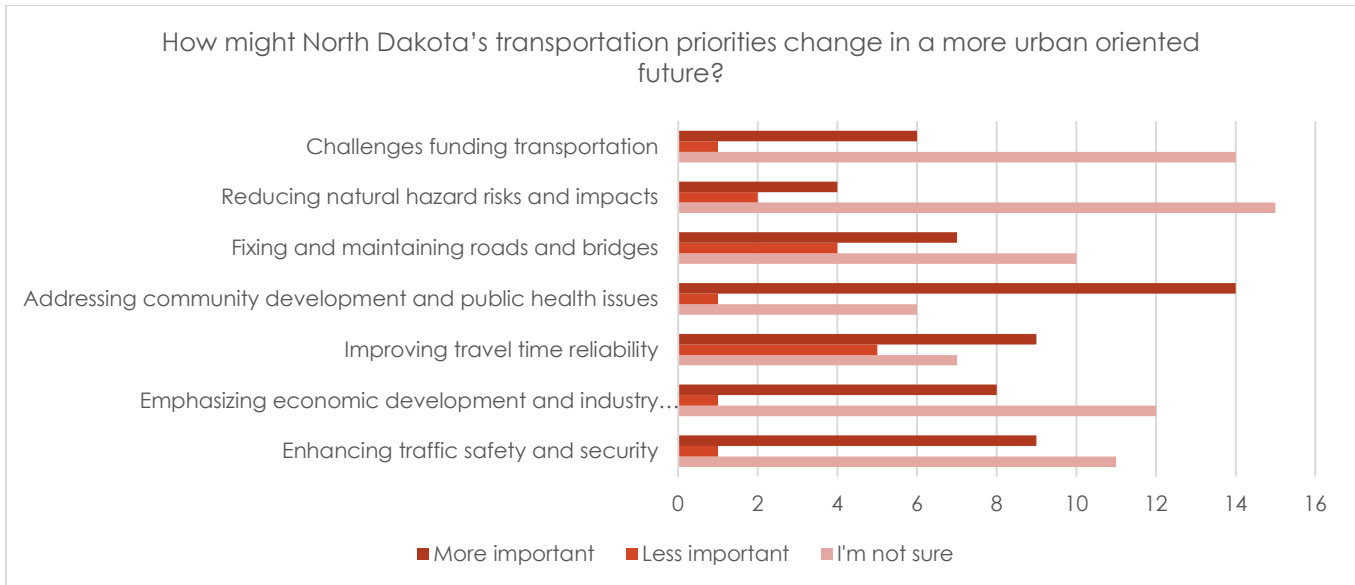
How might your own travel patterns and needs changes in a more urban oriented future?

21 RESPONSES



How might North Dakota's transportation priorities change in a more urban oriented future?

21 RESPONSES



If this scenario came to pass, how would that change the way you travel?

13 RESPONSES

- Travel would be only short around the neighborhood trips most likely on foot or public transportation. Vacation would be the only long trips taken.
- I would have to travel farther distances for everything.
- It wouldn't change my travel patterns.
- With more people and more traffic, I would want to travel less due to higher risk of crashes and urban burnout.
- I would not move to the urban center and this would limit the resources sent to rural areas. Answers would be different. We don't bike to work. You can't make us all move to town.
- Live closer to work (or work from home), live where essentials are within walking distance, look for neighborhood amenities - all would create less local travel. More time spent long-distance traveling for leisure.
- I would likely try to walk to work or use public transportation to eliminate the need to sit in traffic.
- Public transportation, Transportation Network Companies (Uber, Lyft), biking, and walking would become the preferred modes of travel for intercity trips. The household may even be able to reduce the number of motorized vehicles it owns trending toward a car free or car light lifestyle. Mobility options would be greater for all users of the system as opposed to the Rural Renaissance. The Rural Renaissance would seem to limit mobility options for intracity travel for goods and services to those who could afford it or have the ability to drive on their own. Fewer total personal miles traveled would likely result. The Cities and Centers model may allow for more shared forms of mobility.
- It might make walking, biking, or riding transit a more viable choice depending upon congestion.
- More active transportation because of the shorter distance traveled.

- Assuming dense cities and little sprawl, I'd likely venture to the edge of the city frequently for outdoor recreational pursuits. Sort of like Portland, Oregon has a line and on the other side of that line is the Columbia River Gorge Scenic Area, the city's playground. But within the city on a day-to-day basis I'd walk or ride my e-bike. I'd still want to travel on weekends to campgrounds and recreational areas farther from town, which would require a train/shuttle or my own car.
- Would travel via different modes than single occupied vehicle.
- My commute to work would drastically reduce. I would likely walk or take transit to work instead of driving.

In this future scenario, what should the DOT do? What kind of changes to the transportation system would help?

13 RESPONSES

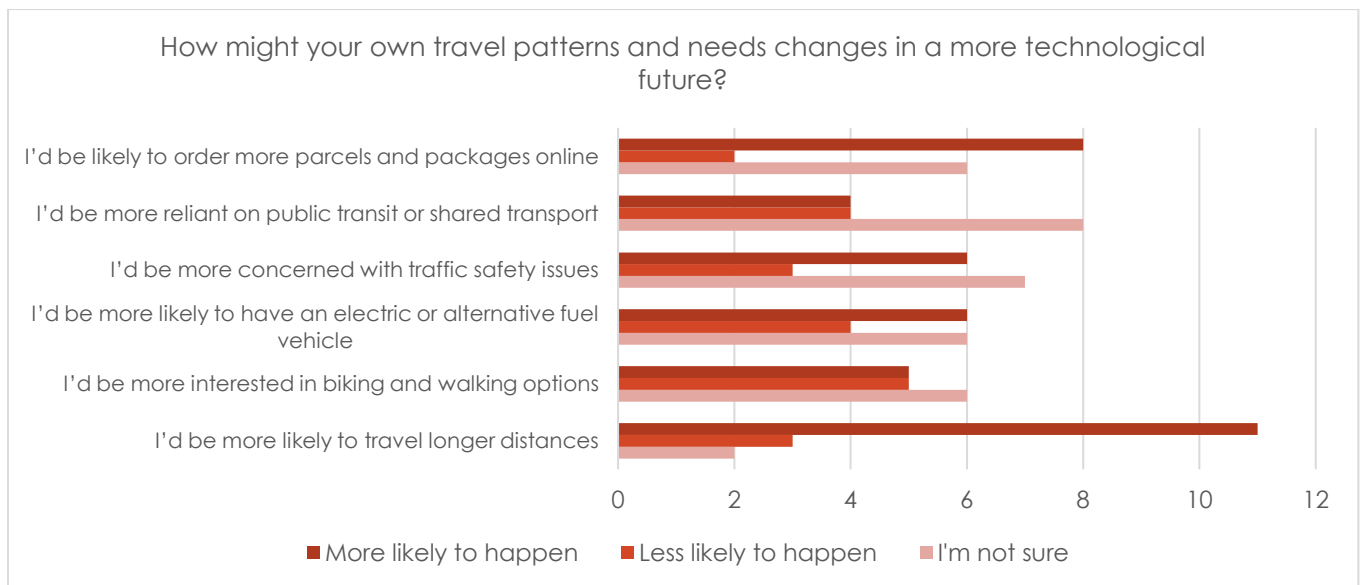
- Elevated and covered sidewalk to encourage walking the short distances and to separate pedestrians from traffic.
- Good roads and improve traffic flow when you start getting closer to the city centers.
- Making growing cities more efficient by building bypasses and through roads so people have the ability to get from one end of town to another without having to go through residential all the time.
- Maintain efficient traffic signal operations. Use of enforcement on speeding violators may need to increase to reduce crashes and insurance costs.
- Bike rentals, electric cars shared ridership, walking paths, neighborhood stores.
- Make urban roads more pedestrian friendly, slow traffic down, do landscaping with all transportation projects, support mass transit.
- Public transportation would need to be funded more.
- As with all scenarios prioritizing limited funds and other resources could support each one of these scenarios. In this case providing additional funding to public transportation and active forms of transportation in city center locations.
- More alternative modes of transportation. Less emphasis on speed and more emphasis on safety and I suppose reliability.
- More active transportation infrastructure.
- Get cars out of the urban cores. Full stop. They ruin quality of life. They're good for travel between small towns or cities, but poor choices for within cities.
- Support cities and communities achieve this.
- This scenario is VERY unlikely to play out in ND even by 2045 in my opinion. In order to have funding to institute functional mass transit, you have to have a huge amount of development pressure, which ND simply doesn't have. However, if ND DOT is looking to plan for this scenario, they would need to start setting aside right of way corridors in central cities while land is still "cheap." The location for these corridors would have to go hand in hand with long-range planning efforts in the large cities to direct commercial and multi-family development along these corridors. And there would probably have to be state-level legislation requiring large cities to adhere to their long-range plans. Local politics often forces electeds to cave to developers and constituents who don't look into the future beyond the end of their

noses. Plans are only effective if elected leaders make the decision, application by application, to adhere to them. In addition, the market pressure for semi-rural residences is so strong in ND. Even if the state imposed strict urban growth boundaries on large cities, often the surrounding counties (unless a state-level restriction is placed on them as well) will let sprawling growth happen just outside the city boundary. Most ND counties have little to no planning expertise to draw on and don't see the fiscal or land use disaster that this creates. It is very much "chicken and egg." But basically, in order for people to choose to live in a dense city environment, either the amenities have to be available (neighborhood grocery stores and retail) within walking distance or the transit system has to be already present and reliable.

SMART AND CONNECTED

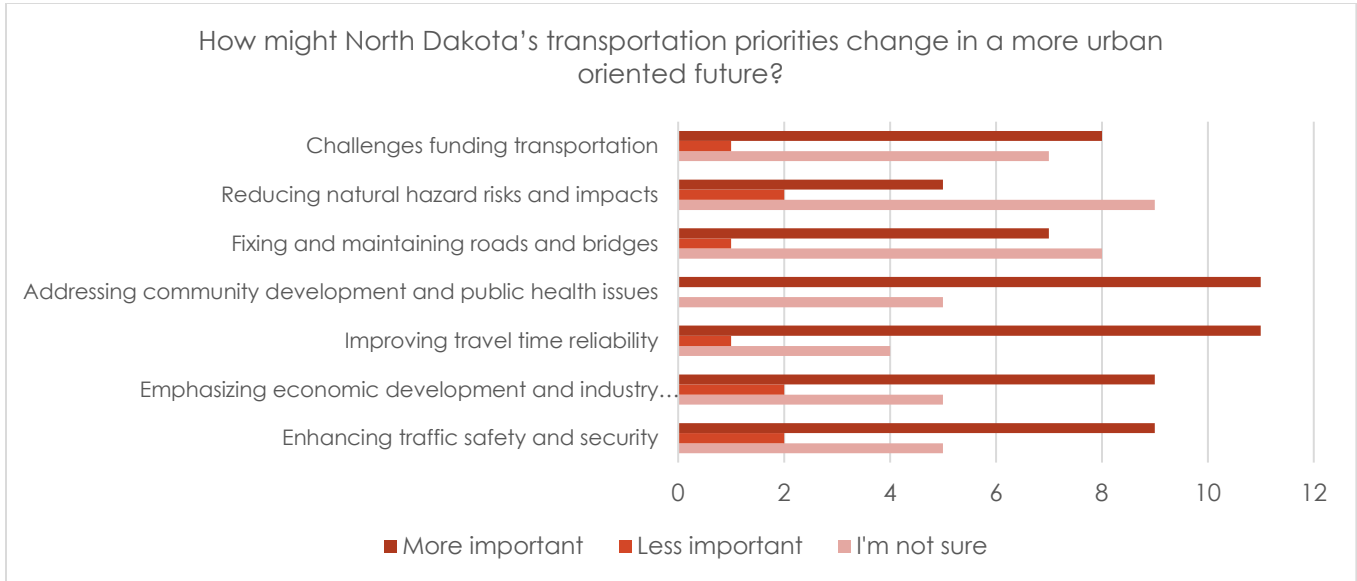
How might your own travel patterns and needs changes in a more technological future?

16 RESPONSES



How might North Dakota's transportation priorities change in a more technological future?

16 RESPONSES



If this scenario came to pass, how would that change the way you travel?

10 RESPONSES

- Maybe more hands free or guided driving from this technology. Fog line and centerline striping will need to be very visible.
- If travel was extremely easy and fast, we would travel far more for entertainment and business.
- I would probably be traveling more
- My travel patterns wouldn't change.
- Higher technology can provide a higher level of safety provided that it is in tune with other vehicles and the infrastructure.
- Since most newer vehicles now have built in navigation systems, it's nice when traveling to other states that provide real time information through these systems, i.e. Colorado. It would be nice to travel through ND and not have to rely on "pre-trip" information all the time and get it in real time through my vehicles. In ND, the pre-trip information rarely changes week to week. Would be nice to know that when the road you were on this morning was okay to travel on, and then in the afternoon on your way home, you find they have changed traffic patterns, i.e. lane closure, delays; would be nice to have this in real time in vehicle.
- This option could greatly improve transportation choice for all individuals regardless of age, income, or physical ability to travel. From an operational perspective there may be less involvement from an investment perspective as the connected system of vehicles would begin to optimize themselves. This alternative would likely greatly reduce the need to own your own personal forms of motorized transport so could free up individual capital to procure more goods and/or services. In this alternative users have more choice to travel in a way they prefer or that is most convenient or that is most affordable. There could be greater interest in biking and walking as preferred modes of transportation given safety enhancements of autonomous vehicles traveling around the system. Care will need to be paid for NDDOT

and local agencies to preserve the quality of street life continuing to allow pedestrians, cyclists, public transportation, and other modes to continue to interact as they do now. Segregating uses may have unintended consequences leading to sterile non interesting street life and vitality.

- It would make traveling less of a necessity. Wouldn't necessarily have to travel for work or to shop and most trips would be for recreation or to visit family, faith, etc.
- More time for relational travel.
- Would travel more as it becomes easier with automated vehicles for all; travel as a means to do something since everything is automated.

In this future scenario, what should the DOT do? What kind of changes to the transportation system would help?

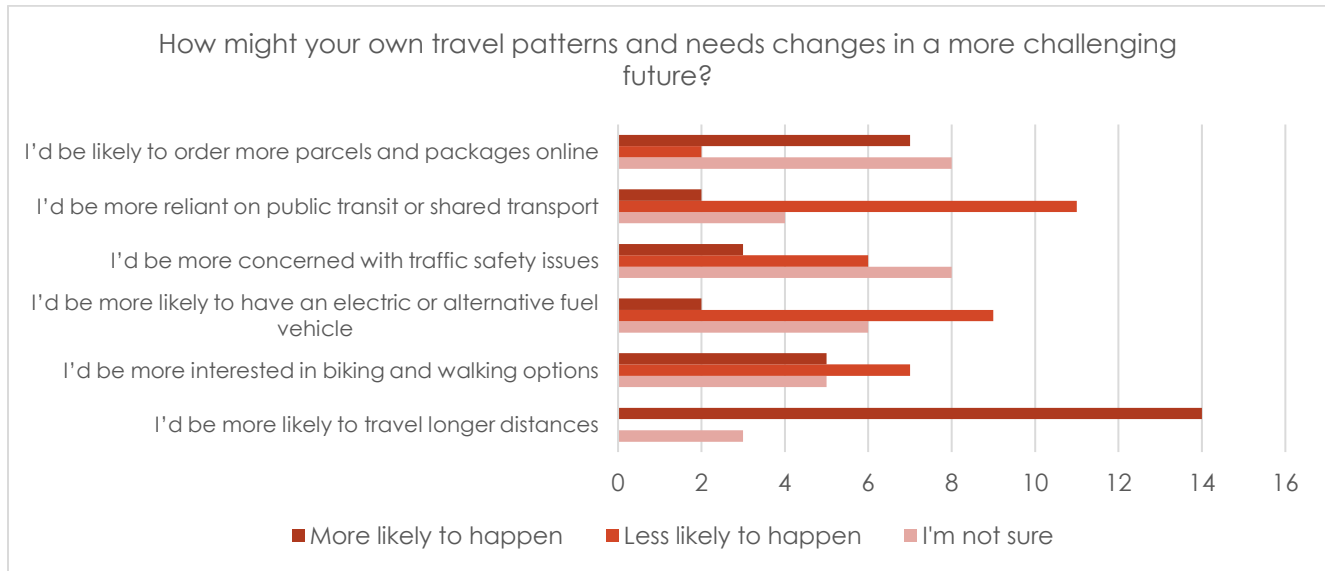
9 RESPONSES

- Traffic flow would likely increase, so high volume roads with excellent safety features would be a necessity.
- Stations to service the newer vehicles and top of the line roads and maintenance.
- Same as Cities and Centers. More efficient throughput in growing cities will allow more efficient delivery of goods and people across the city.
- Keep up with vehicle technology and needs input from roads and bridges to increase safety and decrease hazards and travel time.
- Look at technology when it comes to travel information. What ND has now, doesn't change when technology changes, especially vehicle technology. Why rely on pre-trip information when it can be done in real time. My vehicles which are 4-8 years old can get real time information on built in navigation systems while traveling in other states. Why doesn't ND keep up? It isn't safe having to use you cell phone to get info, especially since it isn't up to date (real-time).
- Continue to invest in public transportation and other active forms of transportation. Additionally, ensuring systemwide predictability and reliability will be imperative.
- More CAV technology. Safety will become so critical with the new technologies and the NDDOT will need to stay ahead of it.
- More active transportation infrastructure for the expanded leisure time.
- Use smart technologies for safety/security/reliability focus.

GHOST TOWNS

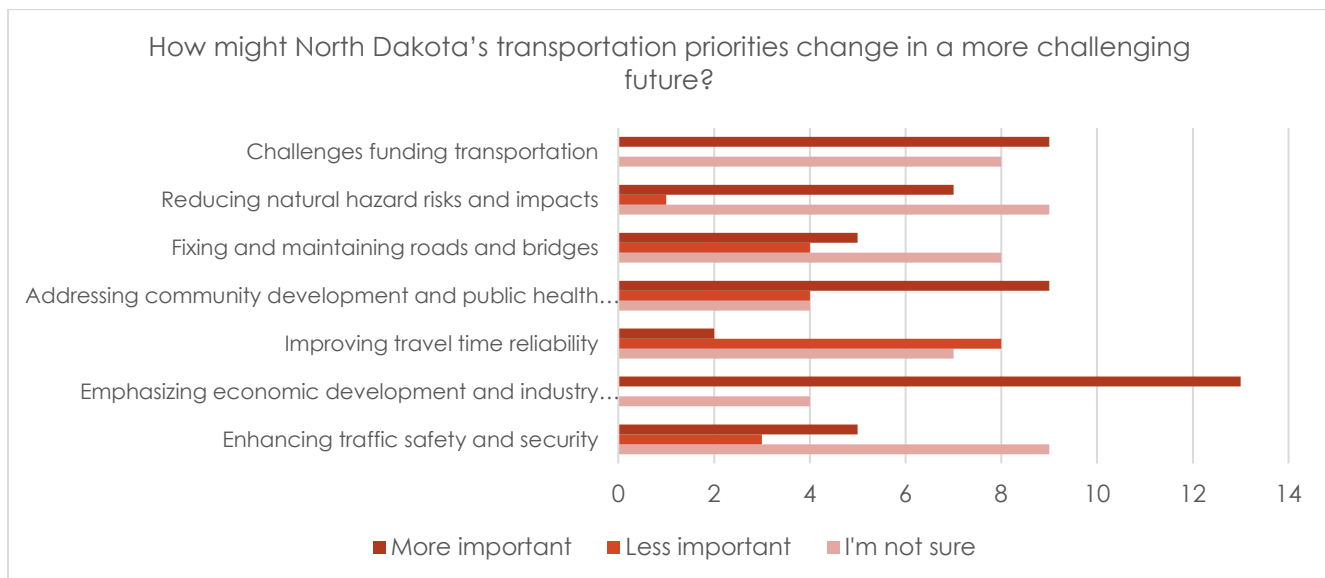
How might your own travel patterns and needs changes in a more challenging future?

17 RESPONSES



How might North Dakota's transportation priorities change in a more challenging future?

17 RESPONSES



If this scenario came to pass, how would that change the way you travel?

10 RESPONSES

- Longer travel for health care and shopping would be necessary, but would likely be less frequent.
- It wouldn't change my travel patterns.
- As long as people live in an area, the infrastructure needs to be safe and adequate.
- I would work remotely from a rural home. I would not use an electric vehicle because I would have to travel too far for basic services. All the resources will go to the cities and rural roads will deteriorate until they are unusable.
- I would likely travel a lot less and probably only travel in ND to come visit.
- It may impact status of employment. If I was without a job I may need to travel longer distances to seek employment and additionally may be without means to travel so would need to rely on more affordable forms of transportation such as public transportation, walking, and biking. It would be undetermined how much e-commerce would exist as many businesses may have left the state or local community requiring certain products to be procured online however with the loss of employment individuals may have less means to procure such items.
- It sounds like overall, I would be traveling much less.
- I probably wouldn't be able to afford travel in this scenario. Most people would stick close to home. Buying everyone a \$5,000 e-bike would be cheaper, probably, than maintaining tens of thousands of miles of paved roads.
- Ghost towns to some extent is ND's history - let some of it happen.
- Likely travel in general would be reduced because you'd have to live close (however possible) to your place of employment or sustenance. This would also be true if state population plummeted. If ag production was all but obliterated there would be less need to fund rural routes. This might actually create a scenario where more funding is available to serve the few areas of economic activity left. But if ag production stops in ND we can be pretty assured the world is about to end. So again, I wouldn't put too much stock in this scenario. The ghost town scenario is really just the other half of the cities and centers scenario. Population concentrates into centers and rural population disappears or declines further than it is today.

In this future scenario, what should the DOT do? What kind of changes to the transportation system would help?

9 RESPONSES

- Under this scenario roads designed for less traffic (i.e. 2-lane) would be fine, but they would need to be very robust and able to remain passable with minimum maintenance.
- DOT would need to ensure the long distance roads and bridges were well maintained.
- Not sure...
- In this scenario there better be once weekly bus routes from each ghost town to the city with the services. Volunteer drivers help but predictable reliable service is needed.
- Focus on preventative maintenance since funding will likely be down and try to stimulate the economy.

- Enhancing forms of affordable transportation such as public transportation, walking, and biking. It would also be helpful to collectively work together with other state agencies and local units of government to collectively establish a plan including economic enhancement to stabilize and grow the economy moving forward. All agencies economic futures will likely require transportation as a key component so working collectively with all relevant agencies to be striving for a common desired future will be critical.
- DOT would need to prioritize funding more efficiently to get people to the few available jobs. Alternative modes of transportation or a robust transit system would help connect people to jobs. Obviously planning for natural disasters would be very important too.
- Let some ghost towns happen.
- Again, cut your losses and focus transportation funding on the few centers of economic activity left. Try to make those locations as viable and inviting as possible.

4. NORTH DAKOTA TRENDS AND CONDITIONS

ACCESS TO SERVICES

Access to services is critical to health, wellness, and happiness. Services may include medical facilities, pharmacies, grocery stores, social services, libraries, and recreation activities. Access can be a two-fold problem: the distance people must travel to services and the barriers people face in traveling to services. In urban areas, people usually contend with barriers in traveling. This includes roadways with high speeds, lack of sidewalks, infrequent transit, lack of parking, and lack of a direct path because of an interstate or natural boundary. For rural residents, they have to contend with both parts of the access issue. They may travel long distances to access services and the as the length of the trip increases so do the chances that they will face barriers.



KEY TRANSPORTATION ISSUES

- Food security is a lack of access to enough food for an active, healthy life. There are three counties, Sioux, Benson, and Rolette, where 15 percent of residents are food insecure. Overall, only 7 percent of North Dakota residents are food insecure, well below the national average of 12 percent.ⁱ These statistics highlight the disparities in access based on geography.
- Disabilities can affect a person's ability to get around. Some physical disabilities prevent people from driving, which is a direct and significant impact. Other disabilities may limit employment opportunities. Nearly 20 percent of people living in poverty have at least one disability.ⁱⁱ
- North Dakota drivers rank third in the nation for annual Vehicle Miles Traveled (VMT). Only drivers in Iowa and Alabama drive more. The average North Dakota driver covers more than 17,000 miles per year.ⁱⁱⁱ This means higher travel costs for drivers and more wear-and-tear for roads.

DRIVERS OF CHANGE IN NORTH DAKOTA

- Nearly 20 percent of grocery stores in North Dakota's rural areas have closed in the past six years.^{iv} Over the same time, adult obesity rates have increased by 5 percent to 33 percent.^v Although this is below the national rate of 40 percent, North Dakota is one of nine states to reach this level.^{vi} As obesity rates climb and grocery stores close, rural residents will continue to have issues accessing fresh, healthy food.
- All public schools have a minimum of 100GB internet connectivity and more than 94 percent of households have access to high-speed internet.^{vii} This level of connectivity allows residents across the state to work and learn from home. Two benefits of this development are a reduction in trips and congestion; and improved access to employment and educational opportunities.

- Between 2010 and 2025, the number of adults ages 65 and older is expected to increase from 12 percent of North Dakota’s population to 18 percent.^{viii} Addressing the issue of access will require more intensive programs targeted to address the mobility needs of the elderly.

FUTURE UNCERTAINTIES AND DISRUPTORS

- If urbanized areas continue to grow and rural areas see their populations flatten or decrease, services and amenities may continue to close, decreasing quality of life for rural residents.
- With COVID-19, employers have been forced to implement work from home policies. With this experience, some employers may decide to utilize this work option in the long-term, potentially expanding employment options for people in rural or small urban areas.

Rural Amenities

As people concentrate in metropolitan areas, amenities like grocery stores and health care facilities might follow. With these reductions, rural residents may experience increased isolation and decreases in quality of life. To combat a reduction in services in rural areas, businesses may need to rethink their operations. An example is a pilot program run by the Association of Rural Electric Cooperatives. The program assists rural grocers with collectively purchasing food. The goal is help rural grocers secure lower prices that they can pass along to their consumers, helping them stay competitive with larger stores.^{ix} Telemedicine services may also counteract the urbanization of health care facilities, allowing people to speak with doctors and receive health care guidance from anywhere. However, lower costs may not counteract the loss of consumers in a region, and the closure of grocery stores and other amenities may accelerate. This could increase travel for consumers while putting them at greater health risk

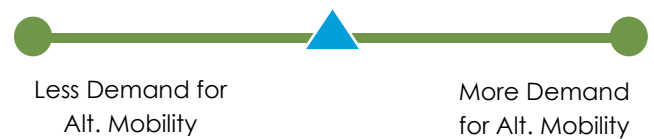
Access Impacts:



Travel Options for People with Mobility Challenges

North Dakota is a large state with several urban areas, but the majority of the state’s geography is rural. This has led to people driving long distances to access services such as medical facilities, pharmacies, grocery stores, social services, libraries, and organized recreation activities. However, many people have difficulties driving due to mobility challenges, such as a physical or cognitive disability. These challenges are common among the elderly, who are expected to represent 18 percent of North Dakota’s population by 2025.^x People with mobility challenges must rely on alternative travel means, such as public transit or human service transportation, in order to access these amenities. Such services are often expensive to provide and rely on federal and state subsidies. Long travel distances exacerbate the challenge.

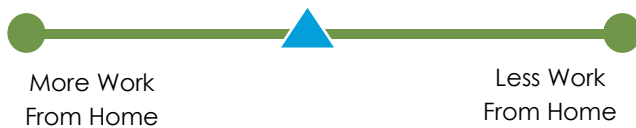
Access Impacts:



Telecommuting

Broadband coverage and COVID-19 have created an atmosphere where some North Dakota residents can choose where to work and live independent of each other. Many employers were forced to enact work from home policies in response to COVID-19. Through this process, some employees and employers have learned that working from home is a mutually beneficial policy. Both Facebook and Twitter have announced work from home policies that allow employees to work from home permanently. This means the tech giants could start employing people across the nation in locations much less expensive than San Francisco. These work from home policies may greatly expand employment opportunities in North Dakota.

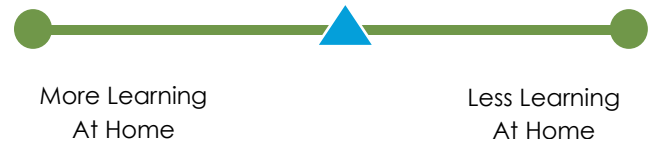
Access Impacts:



Learning & Workforce Development at Home

Broadband coverage may expand education opportunities for students and working professionals. Students in K-12 may continue to attend traditional schools, but they may also access additional classes and courses not offered at their local school. The ND Department of Public Instruction has recently piloted an online preschool program for rural students. The program focuses on literacy activities for students and online guidance for parents. Professionals seeking additional certifications and training may access courses online instead of traveling to a centralized training facility. These opportunities will improve access in remote areas and may reduce regular travel for work- and education-related trips.

Access Impacts:



i Feeding America. "Food Insecurity in North Dakota, 2018." <<http://map.feedingamerica.org/county/2018/overall/north-dakota>>

ii North Dakota Compass. "Health Trends." Jun 2019. <https://www.ndcompass.org/trends/Health_Trends_June_12_2019.pdf>

iii National Household Travel Survey, 2017.

iv KFYR. "New initiative to help rural grocery stores." 20 Dec. 2019. <<https://www.kfyrtv.com/content/news/New-initiative-to-help-rural-grocery-stores-566395781.html>>

v ND Compass. "Health trends." <https://www.ndcompass.org/trends/Health_Trends_June_12_2019.pdf>

vi United States Centers for Disease Control and Prevention. Overweight & Obesity.

vii Dakota Carrier Network. "DCN delivers one-gigabit internet access to North Dakota K-12 schools." 21 Aug 2019. <<https://dakotacarrier.com/dcn-delivers-one-gigabit-internet-access-to-north-dakota-k-12-schools/>> Internet Access in North Dakota. <<https://broadbandnow.com/North-Dakota>>

viii North Dakota Department of Commerce Census Office. Population Projections of the State, Regions, and Counties 2016.

ix KFYR. "New initiative to help rural grocery stores." 20 Dec. 2019. <<https://www.kfyrtv.com/content/news/New-initiative-to-help-rural-grocery-stores-566395781.html>>

x ND Compass. "Aging Overview."

<https://www.ndcompass.org/aging/#:~:text=Between%202010%20and%202025%2C%20the,percent%20of%20the%20state's%20population.>

AGRICULTURAL TRENDS

North Dakota's agricultural industry is a key sector of the state's economy. Farms and ranches encompass approximately 90 percent of the state's land area and 24 percent of workers are employed in the sector.^{xi} We are a leading producer of durum wheat, canola, soybeans, corn, honey, and a major supplier of beef cattle. These products are traded and consumed statewide, nationally, and globally. Crops are shipped for export by both truck and rail and to markets across the world. Transportation represents roughly a quarter of the cost of some commodities, making transport a competitive factor for North Dakota producers.



North Dakota's industry is constantly changing, adapting to market conditions and adopting new production techniques and technology. The market has changed from semi-trucks with traditional crops serving local elevators in the 1940s and 1950s to trucks carrying newer, heavier crops with higher yields traveling further distances to elevators with shuttle facilities. Many of the rail spurs that served small towns have been abandoned and closed, further increasing the distance between the farmer and the market. What might the next 20 years look like?

KEY TRANSPORTATION ISSUES

- Efficient interstate highway and rail access to domestic distribution markets and trade gateways
- Condition of roads and bridges and elimination of barriers on critical intrastate freight corridors, state highways, and rural distribution roads
- Preservation and modernization for short-line and Class I rail lines and intermodal terminals
- Increased capacity and preservation needs on freight corridors to accommodate growth in agricultural tonnage, increases in train length and in truck length and weight
- Potential air cargo capacity and access to serve global agricultural export markets and support local specialty businesses and food product entrepreneurs

DRIVERS OF CHANGE IN NORTH DAKOTA

- Continuing adoption of technology and precision agriculture, including autonomous combines, grain wagons, drones and artificial intelligence for irrigation, crop management, and harvesting
- Diversifying supply chains with increases in local food production and entrepreneurship
- Shared use of agricultural land for energy production, recreation, conservation, and other cooperative uses
- Loss of prime agricultural land due to development pressures and natural disasters

FUTURE MARKET UNCERTAINTIES AND DISRUPTORS

- Fluctuations in global commodity prices and trade wars

- Rising demand from emerging agricultural export markets and increased competition from global producers
- Risks from flooding, drought, and other natural hazards
- Increasing input costs and farm expenses, including transportation and logistics costs

Growing Global Demand for Food

With a growing global population, demand for food products will increase. North Dakota producers are well positioned to supply global export markets. Growing demand in Asian markets for cattle and pork may also be served by more efficient air transport over northern routes. However, emerging producers in other countries are competing for market share and international commodity prices can impact production volumes and value year-to-year. Transport costs and freight movement efficiency are important factors for North Dakota to remain competitive. More products moving to global markets may mean more agricultural freight moving by rail and by truck. Road networks will need to be maintained more regularly as more frequent and larger trucks roll through, and rail networks will need to be maintained and expanded to accommodate future movements.

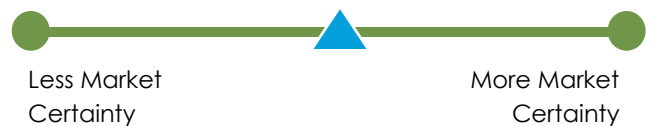
Agriculture Impacts:



Increasing Market Uncertainty

The agricultural industry depends on stability in highly variable factors such as consumer preferences, international trade, Federal programs, and consistent weather patterns. What the future holds for global commodity prices, flooding and severe storms, or even institutional programs such as ethanol mandates and the Federal Renewable Fuel Standard is unknown. Ethanol production accounts for 40 to 60 percent of North Dakota’s corn crops.^{xii} The severity of flooding and storm events is increasing, and commodity prices continuously fluctuate with the global economy. In an increasingly uncertain world, North Dakota producers must be able to adapt to growing market uncertainties. Future transport systems must also provide farmers and ranchers with multiple routes to reach local and national markets by road and rail.

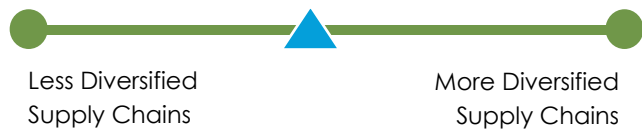
Agriculture Impacts:



Changing Supply Chains

Local food products grown or raised in North Dakota and sold directly to consumers are a growth opportunity for local entrepreneurs. Farm-to-table trends require entirely different transportation needs and supply chains for growers than for single commodity producers. Access to fresh food is critical for residents, but some areas of the state are losing distribution centers due to industry consolidations. Fewer consumer choices also means greater distances travelled to grocery stores for trucks and residents. Future agricultural supply chains will have to fulfill dual roles of moving bulk commodities to international markets while also ensuring efficient transport systems for local production and regional logistics.

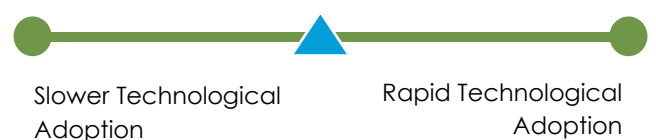
Potential Outcomes:



Accelerating Innovation and Technology

Precision agriculture involves the growing use of sophisticated sensors, GPS-guided and autonomous equipment, and automated systems. Digital farming is expanding and evolving in North Dakota. As a leader in the development of Unmanned Aerial Systems (UAS or drones), the state is positioned to be a proving ground for emerging technologies. The agricultural industry is an early adopter of technologies such as GPS-guidance and autonomous tractors, combines, and equipment. Soon droned grain wagons may drive themselves from fields to local elevators. As these technologies are deployed on more and more farms, North Dakota's roadways and ITS infrastructure must support continued innovation.

Potential Outcomes:



i National Association of State Departments of Agriculture. "North Dakota Department of Agriculture." <<https://www.nasda.org/organizations/north-dakota-department-of-agriculture#:~:text=Nearly%2090%20percent%20of%20North,fourth%20of%20the%20state's%20employment.>>>

ii ND Ethanol Council Presentation to the North Dakota Legislature. 2 Jun. 2020. "North Dakota Ethanol Industry Overview." <[>https://www.legis.nd.gov/files/committees/66-2019/21_5127_03000appendixd.pdf<](https://www.legis.nd.gov/files/committees/66-2019/21_5127_03000appendixd.pdf)>

BICYCLE AND PEDESTRIAN

Active transportation – bicycling and walking – plays a critical role in the state transportation network. Every trip we make requires some non-motorized transportation, even if it's a short walk to your car in your own driveway. In 2019, the North Dakota DOT released a Statewide Active and Public Transportation Plan, ND Moves, to begin thinking about the next 20 years of biking, walking, and public transit across the state. Transportation Connection is building on ND Moves to ensure active transportation is part of statewide planning. What might those 20 years look like?



KEY TRANSPORTATION ISSUES

- About one-third of trips are less than three mile in distance.^{xiii} Making it easier for people to walk or bike these short distances could save people money on gas, reduce traffic and automobile emissions in communities, and create more opportunities for healthy lifestyles.
- People have a wide range of comfort when it comes to biking – particularly when sharing the road with traffic. Bicycling and pedestrian facilities should be designed for all users to meet all levels of comfort and experience.

DRIVERS OF CHANGE IN NORTH DAKOTA

- The rate of walking or biking to work in North Dakota is 4.3 percent – higher than the national average of 3.4 percent, and more than 80 percent of North Dakota counties have a higher rate of active transportation commuting than the state average!^{xiv}
- Downtown areas and main streets in North Dakota communities large and small have seen a renewed level of investment and activity, becoming vibrant areas for people to live, work, and play. These areas become natural hubs for bicycling and walking.
- As part of the ND Moves public input effort in 2019, NDDOT worked with communities around the state in a series of pop-up demonstrations to install colorful, low-cost infrastructure at intersections and along roadways. These demonstrations improved the safety and visibility of pedestrians and cyclists.

FUTURE UNCERTAINTIES AND DISRUPTORS

- Safety for bicyclists and pedestrians remains a significant challenge. In North Dakota, between 2013 and 2019, crashes involving people walking and bicycling increased by 19 percent.^{xv}
- Micromobility services, such as bike-share and scooter-share systems, have seen significant growth in the past few years as a low-cost, flexible way for people to take short trips on alternative transportation modes.

- State roadway access often attract economic development, but do not include space for active transportation users to access the opportunities.
- Where active transportation networks exist, they are often broken up by system gaps that limit the distance people can travel or require them to enter mixed traffic, creating safety hazards.

Roadway and Intersection Safety

Between 2013 and 2019, crashes involving people walking and bicycling increased by 19 percent.^{xvi} These crashes occur both at intersections, where vehicles moving in opposite directions come into conflict with each other, and along roadways, where a driver may strike a pedestrian or bicyclist on the side of the road. More than one-third of these crashes occur on state-owned roadways.

Many people with the option of driving, will only bike or walk if they feel safe doing so, and the design of roadways plays a critical role in contributing to that feeling of safety. Roadways that are traveled by all types of users should be designed with all types of users in mind, with space to keep drivers, cyclists, and pedestrians from crossing each other’s paths.

Potential Outcomes:

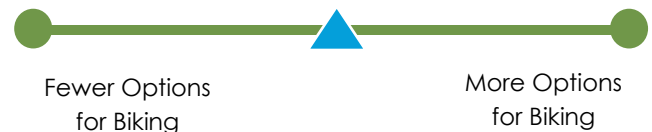


Shared-Use Micromobility Services

Shared-use micromobility services enable people to use bicycles, scooters, and other mobility devices to take short trips for a small fee. They can access these vehicles without worrying about managing their own vehicle all day – mobility with flexibility. These programs have already arrived in North Dakota and have been successful. Fargo’s Great Rides bikeshare system has a higher number of rides per bike per day than New York City and Paris.^{xvii}

These services are often owned or operated by private companies under an agreement with a city. To ensure that these systems are successful and sustainable, the local transportation networks should provide access to safe bicycle facilities that are visible to cyclists, pedestrians, and drivers.

Potential Outcomes:

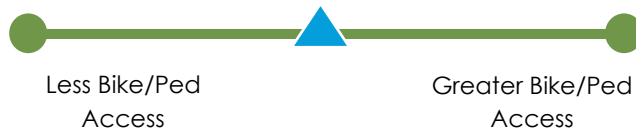


Active Transportation Access on Economic Corridors

State roadways, such as highways, arterials, and collector roads, play a critical role in connecting communities to new markets. Economic development often follows new roadways. Yet if these developments are only available to people with cars, economic opportunities will be limited for people who do not own a car or are unable to drive.

Incorporating design standards for active transportation, such as bike lanes or sidewalks, into roadway planning guides can ensure that when roadways are maintained, improved, or widened, they become corridors for all users.

Potential Outcomes:

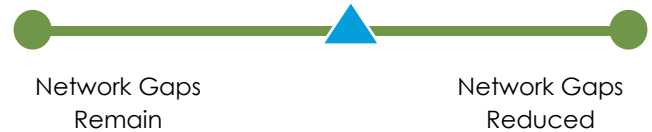


Active Transportation Network Gaps

Active transportation networks are often built out incrementally and do not cover the full length of a person’s bike or walking trip. As a result, people who walk or bike can find themselves suddenly losing the bike lane or sidewalk and moving in mixed traffic with a very narrow shoulder between them and larger vehicles. This creates a safety risk that can limit active transportation usage in communities.

Changes in active transportation planning can promote a network-based approach to project development. These planning techniques should focus on eliminating gaps in existing networks and extending new facilities in ways that align with local land uses to ensure that the network serves areas amenable to active transportation usage.

Potential Outcomes:



i National Household Travel Survey, 2017. < <https://nhts.ornl.gov> >
 ii NDDOT, ND Moves. Pg 7. < <https://www.dot.nd.gov/plans/statewide/docs/NDMovesPlanWithExecSummary.pdf> >
 iii NDDOT, ND Moves. Pg 9 < <https://www.dot.nd.gov/plans/statewide/docs/NDMovesPlanWithExecSummary.pdf> >
 iv1 NDDOT, ND Moves. Pg 9 < <https://www.dot.nd.gov/plans/statewide/docs/NDMovesPlanWithExecSummary.pdf> >
 v The Better Bike Share Partnership “Why the Country’s Best Bike Share Might Be In Fargo.”
 < <https://betterbikeshare.org/2016/05/19/countrys-best-bike-share-might-fargo> >

ENERGY

North Dakota is one of the nation's largest energy producers. The state is among the top-ten producers for coal, natural gas, oil, and wind energy. The state even has a presence in the biodiesel sector, with five ethanol plants and one biodiesel plant. With all these sources in abundance, it is no surprise that North Dakota is a net energy exporter – the state produces six times as much energy as it consumes. The processing and exporting of these fuels rely on an extensive multimodal network – road, rail, and pipelines all play a critical role for the energy sector.

This sector has a significant impact on North Dakota's economy. In 2017, the industry supported over 72,000 jobs, while extraction and production taxes on oil and natural gas generated nearly 45 percent of all state tax revenue.^{xviii}^{xix} Even before the dramatic changes brought about by the coronavirus in 2020, energy production projections suggested that the boom times of the 2000s and 2010s would not extend into the 2020s as the Bakken oil play matured. Changes in global demand for fossil fuels and a growing alternative energy sector suggest that the state's energy sector will diversify and adapt. What might the next 20 years look like?



KEY TRANSPORTATION ISSUES

- Efficient interstate highway and rail access to domestic distribution markets and trade gateways
- Elimination of barriers on critical intrastate freight corridors, state highways, and rural distribution roads to allow for heavy tanker trucks and longer trailers carrying wind turbines
- Increased maintenance of roadways to repair wear-and-tear caused by freight trucks
- Growth in the electric vehicle market will decrease oil demand and increase need for vehicle charging infrastructure

FUTURE MARKET UNCERTAINTIES AND DISRUPTORS

- Fluctuations in global commodity prices
- Long-term disruptions to oil supply and demand caused by international trade and coronavirus-related travel impacts and economic slowdowns
- Risks from flooding, drought, and other natural hazards

DRIVERS OF CHANGE IN NORTH DAKOTA

- Early 2020 oil production forecasts indicate oil drilling will plateau over the next 12 years as high-producing locations are completely drilled and activity moves to lower-producing locations^{xx}
- Planned closure of North Dakota's largest coal-fired powerplant in 2022 will reduce domestic market for coal^{xxi}
- Improved drilling technology and extraction practices have reduced truck trips per well site.

Growing Electric Vehicle Market

Electric vehicles (EVs) may only make up 6 percent of total vehicles worldwide, but they are forecast to reach 20 percent by 2050, according to the US Energy Information Agency. The shift away from gasoline-powered vehicles will reduce the demand for oil. However, EVs will rely on their local power grids for electricity, and natural gas will likely remain a significant part of utility-scale energy production around the world, expanding the market for North Dakota natural gas. Locally, North Dakota drivers will look for EV charging infrastructure as they choose their next vehicles. Municipalities, large employers, and other partners will have to make decisions about where they locate EV chargers and how they add them to the grid. Reduced oil demand and increased natural gas demand may shift the balance of fuel moving by rail and by truck, but transportation networks will have to be maintained and expanded to accommodate future movements to ensure markets are connected.

Potential Outcomes:



Changes in Oil and Gas Drilling

In early 2020, the North Dakota Petroleum Council predicted that core wells in the western part of the state would be completely drilled within the next two to five years.^{xxii} At that point, drilling will move into the non-core areas that have seen less activity (as long as they are economically viable). The shift in drilling activity will require the build-out of new road and pipeline infrastructure to move the new sources of oil and gas. However, these new facilities may not need to serve the same traffic volumes that were seen in the core areas. Advancements in drilling technology and the rise of infill drilling activity, in which a larger number of oil well heads are established at each well site, have reduced the number of truck trips needed to serve each well site. The result is a more efficient drilling operation that generates less traffic on the access roads. North Dakota's next generation of energy sector roads may see less extensive wear-and-tear and require less intensive design standards.

Potential Outcomes:



Declining Energy Demand for Freight Rail

Historically, the energy sector was one of the largest customers for freight rail operators in North Dakota. In 2014, coal was the single largest source of inbound tonnage on the freight rail network.^{xxiii} In 2018, when oil production surpassed pipeline capacity, rail cars moved 20 percent of total crude oil volumes. However recent changes and forecasted energy production suggests demand for freight rail will decrease. In 2019, coal production declined by 8 percent and in 2022 the largest coal-fired power plant in North Dakota is scheduled to be shut down.^{xxiv xxv} Oil production volumes are forecast to plateau over the next five to ten years. These market changes may create new capacity on freight rail networks and alleviate bottlenecks.

Potential Outcomes:



Alternative Energy Installations

Wind energy is the second-largest source of energy in North Dakota's electric grid.^{xxvi} In the summer of 2020, North Dakota had over 3,640 megawatts (MWs) of wind capacity installed and an additional 649 MWs planned or under construction.^{xxvii} With a more distributed and variable energy source to power the grid, North Dakota will have to install wind turbines throughout the state to ensure sufficient capacity. The turbines are moved on oversized trucks, and routes must be carefully planned to minimize risk. Expanded wind installation efforts will rely on a network of well-maintained roads that can accommodate oversized vehicles and intelligent transportation systems that can provide drivers with information about roadway conditions and hazards.

Potential Outcomes:



i Radio Oklahoma Network. "Task force created to help North Dakota's oil and gas industry." 7 May 2020. <<http://www.okenergytoday.com/2020/05/task-force-created-to-help-north-dakotas-oil-and-gas-industry/>>
 ii Energy of North Dakota. "Tax Revenues." < <https://energyofnorthdakota.com/home-menu/bakken-benefits/tax-revenues/>>
 iii AP News. "Officials: North Dakota oil output may peak within 5 years." 11 Feb. 2020. <<https://apnews.com/article/60ba897e9aa4ea7091f03b8730a85079>>
 iv Bismarck Tribune. "Coal Creek Station slated to close in 2022." 7 May 2020. <https://bismarcktribune.com/news/state-and-regional/coal-creek-station-slated-to-close-in-2022/article_e23d6007-e56d-56e2-b414-e380251b818c.html>
 v AP News. "Officials: North Dakota oil output may peak within 5 years." 11 Feb. 2020. <<https://apnews.com/article/60ba897e9aa4ea7091f03b8730a85079>>
 vi NDDOT North Dakota State Rail Plan. Pg. 10. <<https://www.dot.nd.gov/divisions/planning/railplan/3Executive%20Summary.pdf>>
 vii Bismarck Tribune. "North Dakota coal production drops 8% in 2019." 2 Feb. 2020. <https://bismarcktribune.com/business/north-dakota-coal-production-drops-in/article_58053c99-bf35-5520-8cdc-dea11847ebfd.html>
 viii West Central Tribune. "North Dakota's largest coal-fired power plant will shut down in 2022 unless new buyer can be found." 7 May 2020. <<https://www.wctrib.com/business/energy-and-mining/6482047-North-Dakotas-largest-coal-fired-power-plant-will-shut-down-in-2022-unless-new-buyer-can-be-found>>
 ix U.S. Energy Information Administration. "North Dakota State Profile and Energy Estimates." <<https://www.eia.gov/state/analysis.php?sid=ND#:~:text=Renewable%20energy,-North%20Dakota%20is&text=In%202019%2C%20wind%20was%20the,electricity%20generated%20from%20wind%20energy.>>
 x American Wind Energy Association. "Wind Energy in North Dakota." <<https://www.awea.org/Awea/media/Resources/StateFactSheets/North-Dakota.pdf>>

INFRASTRUCTURE

North Dakota has almost 88,000 miles of public roads and has more than 4,800 bridges.^{xxviii} These roads and bridges are maintained by state and local governments to keep them in a State of Good Repair (SGR). SGR is a condition in which a transportation asset is functioning as designed and is sustained throughout its useful life. The North Dakota Department of Transportation is responsible for the preservation of transportation infrastructure located on the state highway system.



The on-going monitoring and management of the transportation network is critical to keep the network functioning and to keep people and goods moving safely, reliably, and efficiently. Over the past several years, North Dakota's population and freight movement volumes have both increased. This growth has increased the amount of wear-and-tear on the state's transportation network. While recent years have seen a slight decrease in how much people travel, freight continues to grow, driven by the state's commodity sectors. What might the next 20 years look like?

KEY TRANSPORTATION ISSUES

- State highways represent 7 percent of all roadways in the State of North Dakota, but carry 63 percent of all Vehicle Miles Traveled (VMT).^{xxix}
- While less than 4 percent of state structures and pavements are in poor condition, one-third of structures are in fair condition and need regular monitoring and maintenance in order to avoid falling into poor condition.^{xxx}
- As of 2019, 43 percent of North Dakota's bridges were older than 50 years, which means they are past their initial design life and must be rehabbed in order to be safely used by drivers.^{xxxi}

FUTURE MARKET UNCERTAINTIES AND DISRUPTORS

- Increased frequency and severity of weather events, like flooding and snowstorms, puts additional strain on infrastructure and may reduce the useful life of roads and bridges.
- Advances in technology, including drones, may provide NDDOT's capabilities for inspection and monitoring of roads and bridges.
- Advancements in materials for roads and bridges may improve their longevity and resiliency.
- North Dakota's economy is dominated by commodity sectors like agriculture and energy that rely on physical infrastructure to move goods to global markets. Growth in these sectors and the increased size and weight of vehicles servicing those industries over time will influence wear-and-tear on roads and bridges.

DRIVERS OF CHANGE IN NORTH DAKOTA

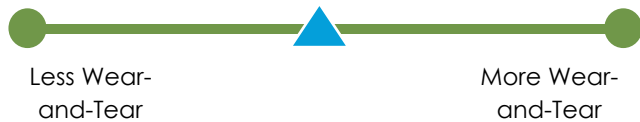
- Annual miles traveled per person grew by 28 percent between 2000 and 2014, but declined by 8 percent between 2014 and 2019.^{xxxii}
- Only 17 percent of trips taken by North Dakotans are for work.^{xxxiii} The growth of online shopping, social media platforms, and other social changes may reduce the amount of non-work trips that people take.

Export Sectors and Infrastructure Condition

North Dakota’s farms, food processors, and energy producers send their products around the globe. These export-driven sectors rely on the condition of the roads and bridges that connect the farms, wells, and factories to the broader markets. Transportation costs are important factors for North Dakota producers to remain competitive due to our distance to markets.

However, uncertainty in energy and agricultural markets — will play a significant role in the growth of North Dakota’s economy. Roads and bridges must be maintained to not only keep up with today’s demand, but with future demand as well. Addressing the uncertainty requires flexible, adaptable planning to respond to changes and maintain critical infrastructure.

Potential Outcomes:

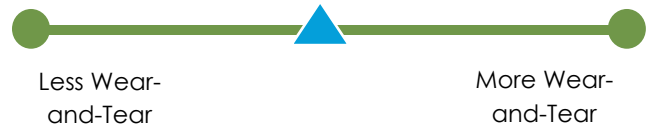


Weather Events and Infrastructure Condition

The number of severe weather events in North Dakota designated by the Federal Emergency Management Administration (FEMA) has increased over the past thirty years. While every road and bridge is designed to withstand the elements, more intense and more frequent weather events will create larger and more frequent stresses on these assets.

As a result, the effects of wear-and-tear on these roads and bridges will accelerate, and the useful life of the assets – the duration of time in which the roads and bridges can be used at their designed level of service – will decrease. These roads and bridges will need more frequent and more extensive repairs and will need to be replaced sooner, while the next generation of assets will need more robust design in order to withstand a more extreme environment.

Potential Outcomes:



Emerging Inspection & Monitoring Technology

New technologies to improve road and bridge inspection and monitoring are starting to be adopted by departments of transportation (DOTs) around the country. For example, DOTs in Minnesota and Idaho have used drones to take more detailed pictures of the undersides of bridges using less equipment and fewer labor hours. These drones also improve safety for the staff by eliminating the need for them to climb up into the structures. While in-depth reviews of potential risks require hands-on inspections by engineers and inspectors, the drones have enabled DOT staff to conduct baseline inspections more efficiently. The more detailed data enables DOTs to make more informed decisions about how to prioritize funds for maintenance. The use of drones in North Dakota’s bridge inspections may increase the DOT’s monitoring capacity.

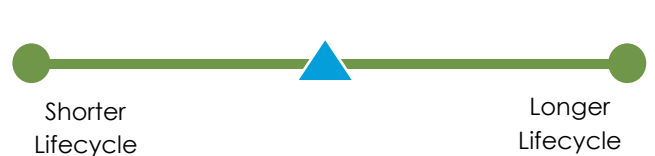
Potential Outcomes:



Emerging Materials for Roads and Bridges

Roads and bridges may seem like straightforward things to build – concrete and steel, for example, have been around for centuries. But advancements in the materials that make up roads and bridges have profound impacts for their cost and quality. Innovations in materials can reduce cost, improve environmental impacts, or enhance resiliency. The FHWA’s Exploratory Advanced Research Program conducts research on new materials for highway construction. A 2017 study found that an asphalt binder – which holds the asphalt together to keep potholes and cracks from forming – derived from waste cooking oil and paper pulp byproducts.^{xxxiv} This material may reduce the costs of paving roads and make them more resilient to normal wear-and-tear. The result is a road that can last longer while costing less to maintain.

Potential Outcomes:



i NDDOT Transportation Handbook. Pg 9 – 10.

<<http://library.nd.gov/statedocs/Transportation/TransportationHandbook/2019.pdf>>

ii NDDOT Transportation Handbook. Pg 11.

<<http://library.nd.gov/statedocs/Transportation/TransportationHandbook/2019.pdf>>

iii NDDOT Transit Asset Management Plan, 2019. Pg 14. <<https://www.dot.nd.gov/divisions/planning/docs/TAMP.pdf>>

iv American Society of Civil Engineers Report Card for North Dakota’s Infrastructure, 2019. Pg 6.

<https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/ASCE_Report-Card-2019-FINAL.pdf>

v NDDOT Annual Traffic Report, 2019. Pg 3. < <http://www.dot.nd.gov/business/docs/trafficreports/Annual-Traffic-Report-2019.pdf>>

vii National Household Travel Survey, 2017. < <https://nhts.ornl.gov/>>

viii FHWA Exploratory Advanced Research Program Fact Sheet. “Novel Development of a Bio-Based Binder for Sustainable Construction.” Published 2017. <https://www.fhwa.dot.gov/publications/research/ear/18030/18030.pdf>

POPULATION

North Dakota has grown at a rapid pace over the last ten years, and its demographics are changing as well. As growth continues, North Dakota will need to ensure that its transportation system can meet the needs of an expanding – and changing – population. What might the next 20 years look like?

DRIVERS OF CHANGE IN NORTH DAKOTA

- Over the last decade, North Dakota has seen a high rate of migration into the state, largely due to growth in the energy sector. Foreign-born residents have increased from 2.5 percent of the population to 4.1 percent of the population between 2010 and 2017.^{xxxv xxxvi}
- North Dakota has the highest percentage of people aged 18 to 29 in the country. Young people beginning their careers will be looking for entry-level jobs with growth opportunities and seeking affordable housing.
- North Dakota's second-largest population cohort is between 46 and 64 – the state will see a large increase in the number of retirees in the coming years.

FUTURE DEMOGRAPHIC UNCERTAINTIES AND DISRUPTORS

- The population is moving to urban areas. In 1990, for the first time in North Dakota history, the urban population surpassed the rural population. In 2017, the urban population surpassed 60 percent.^{xxxvii xxxviii}
- Energy sector growth was leveling off after several years of growth before the oil market collapsed, which may have an impact on the state's labor market and rate of growth.

KEY TRANSPORTATION ISSUES

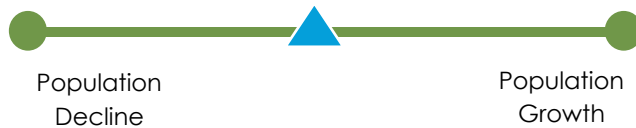
- People's transportation choices and travel needs are linked to demographic factors like income, ethnicity, age, and disability.
- Increasing population means increasing numbers of trips taken on the transportation network, leading to more wear-and-tear on roads and bridges.
- Younger North Dakota residents are preparing to start families, which creates a growing demand for infrastructure, such as improved access to public spaces and parks.
- A growing elderly population will need alternative mobility options, like shuttle buses and vans, to help them get around as they age and stop driving.
- Teenagers in urban areas have more options to get around – including transit and Transportation Network Companies like Uber and Lyft – and may choose to delay getting their licenses and take alternative forms of transportation instead.

Increasing Urbanization

North Dakota has always been a rural state, but the percentage of its residents living in urban areas increased to 60 percent in 2017.^{xxxix}

Urbanization has tremendous economic benefits, as companies that set up there enjoy economies of scale and infrastructure costs per capita decrease. But the growing demand can lead to higher housing prices and congestion for urban residents. Urbanization also poses a risk to rural areas as people move from smaller communities to the cities. It is critical to ensure infrastructure investments reach all communities and that all parts of the state remain connected and well-served by a modern transportation network.

Potential Outcomes:



Growth and Movement within the State

A 2016 analysis by the North Dakota Department of Commerce estimated that the state would reach nearly 1,000,000 residents by 2040 – an increase of nearly 25 percent.^{xi} In March 2020, North Dakota had its' first COVID-19 infection. The pandemic kept people at home and demand for oil withered. As oil prices dropped, drilling slowed. In September, about 80 percent of drilling rigs were closed.^{xii} This drastic change in the economy has created an unknown future for North Dakota and the oil industry. If the pandemic ends and oil prices rebound, North Dakota may continue to see increases in population. Conversely, the pandemic may end and travel demand may be forever altered with more people working from home and less business travel. Subsequently, North Dakota's population may level off or decline.

Potential Outcomes:

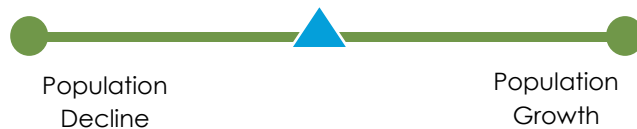


Energy Sector Slowdown

While the energy sector is one of North Dakota’s largest industries, the sector’s rate of growth has slowed down from its peak in the mid-2010s. Before the pandemic, it employed a large number of North Dakotans.

In July 2020, employment in the oil industry had declined by 35 percent from the previous year.^{xiii} It’s unclear if and how much of a recovery the energy sector may experience in North Dakota. While the slowdown may reduce demand for new infrastructure, North Dakota still needs to maintain the existing transportation system. This will become more difficult if state tax revenues from the oil industry remain low. As of September 2020, oil tax revenues were predicted to come in \$145 million under original projections.^{xiiii}

Potential Outcomes:

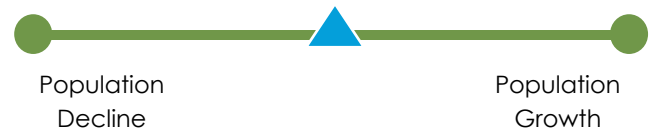


Getting Older, Getting Younger

North Dakota is seeing an increase in the number of young residents through migration and the number of older residents as the long-term population ages. A plurality of North Dakotans are either just starting their careers or preparing to retire. It is a testament to the culture of North Dakota that people want to come here and they want to stay here!

However, these two demographic trends require careful analysis and response, because the residents in each group have different mobility needs. Younger residents will start new families and need new amenities – daycare centers, schools, and parks – and the roads and bike lanes to get there. Older residents who will stop driving will need alternative mobility services to get to the grocery store, the doctor’s office, and the community center.

Potential Outcomes:



i North Dakota Department of Commerce. “ND Foreign-Born Residents: Then/Now” June 2019. <<https://www.commerce.nd.gov/uploads/34/CensusNewsletterJun2019.pdf>>
 ii American Community Survey, 2010 and 2017 1-Year Estimates. <data.census.gov>
 iii North Dakota Department of Commerce. “Changes to City Populations & the Urbanization of ND.” Sep. 2015. <<https://www.commerce.nd.gov/uploads/8/CensusNewsletterSep2015.pdf>>
 iv North Dakota Department of Commerce. “Defining Rural Population.” Dec. 2017. <<https://www.commerce.nd.gov/uploads/26/CensusNewsletterDec2017.pdf>>
 v North Dakota Department of Commerce. “Defining Rural Population.” Dec. 2017. <<https://www.commerce.nd.gov/uploads/26/CensusNewsletterDec2017.pdf>>
 vi North Dakota Department of Commerce. “North Dakota Census Office Population Projections of the State, Regions and Counties 2016.” 19 Jan. 2016. <<https://www.commerce.nd.gov/uploads/8/2016PopulationsProjectionsFinal.docx>>
 vii Washington Post. “Spiking coronavirus cases and falling oil prices deliver dual blow to North Dakota.” 11 Sep. 2020. <<https://www.washingtonpost.com/business/2020/09/10/spiking-coronavirus-cases-falling-oil-prices-deliver-dual-blow-north-dakota/>>
 viii Washington Post. “Spiking coronavirus cases and falling oil prices deliver dual blow to North Dakota.” 11 Sep. 2020. <<https://www.washingtonpost.com/business/2020/09/10/spiking-coronavirus-cases-falling-oil-prices-deliver-dual-blow-north-dakota/>>
 ix Washington Post. “Spiking coronavirus cases and falling oil prices deliver dual blow to North Dakota.” 11 Sep. 2020. <<https://www.washingtonpost.com/business/2020/09/10/spiking-coronavirus-cases-falling-oil-prices-deliver-dual-blow-north-dakota/>>

TECHNOLOGY

Emerging technologies are transforming the transportation sector, with the opportunity to achieve new levels of safety and efficiency while expanding mobility options for all users. Connected Vehicles (CVs) and Autonomous Vehicles (AVs) use on-board communication systems and sensors to monitor and respond to the driving environment. Mobility as a Service (MaaS) represents an integration of public and private transportation services through technology platforms to provide an alternative to privately-owned and operated vehicles. Alternative fuels provide lower-emission fuel options for drivers. These technologies are starting to appear on the North Dakota transportation network, but their adoption is not yet widespread. What will the next 20 years look like?



KEY TRANSPORTATION ISSUES

- High-capacity and widely-available Intelligent Transportation System (ITS) infrastructure is critical to allow these new technologies to send and receive data quickly and reliably.
- AVs and CVs also rely on well-maintained roadways with clear markings and good pavement condition in order to send and receive information about the travel environment.
- Alternative fuels, including biodiesel and ethanol, are both consumed within the state and shipped outside of North Dakota. The consumption of alternative fuels relies on both an efficient freight network of roads and rails for producers as well as a well-distributed network of fuel pumps for consumers.

DRIVERS OF CHANGE IN NORTH DAKOTA

- Changing policy for deploying AVs and CVs and studying their potential and impact.
- Installation of Intelligent Transportation System (ITS) technology along state highways to provide information to state agencies, law enforcement, and the public.
- Initial planning and testing for urban autonomous shuttles as part of urban transit systems and MaaS platforms.

FUTURE UNCERTAINTIES AND DISRUPTORS

- Adoption rates of new technologies depend on pricing, consumer behavior and trust, supportive policy, and infrastructure readiness.
- AVs will likely be limited to operating at low speeds for the next five to ten years, limiting their ability to meet a wide array of travel needs.

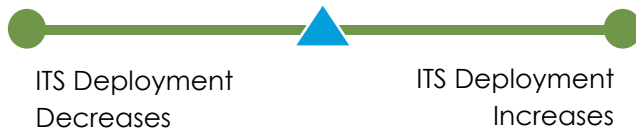


- Conflicts in data-sharing and transparency between technology companies and public agencies may hinder the ability to integrate more sophisticated data into transportation planning and infrastructure projects.

Intelligent Transportation Systems

NDDOT's 2016 Statewide ITS plan guides technology implementation within the transportation network. Current ITS deployments focus on surveillance cameras and dynamic messaging signs, to provide drivers with information on road conditions, accidents, weather events, and other possible transportation disruptions. Future ITS deployments will add sensors and weather stations. These additions will create an automated weather detection system, capable of slowing speed limits or closing roadway sections when inclement weather is occurring or about to occur.^{xliv} The ability to expand these systems to collect and share more information depends on the capacity of the roadway telecommunications network, the durability of the technology, and the ability to access and analyze data quickly and reliably.

Potential Outcomes:



Connected and Autonomous Vehicles

CV and AV technology is already in use today, with pre-collision braking and lane drift detection systems on new vehicles. The next generation of CV and AV technology will increase safety and efficiency as these vehicles' on-board systems will know how to maintain optimal distance and speed. However, these vehicles will rely on information from their environment and will need well-maintained roadways with sophisticated ITS infrastructure – down to the striping of the lanes and the signage on the roadside – in order to perform effectively. North Dakota is preparing for AVs and CVs through regulatory changes to allow them to operate within the state and is studying the impacts of AVs on laws related to licensing, registration, insurance, data ownership and use, and inspection. The next step is to ready the roadways for the next generation.

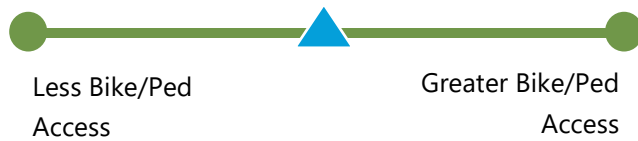
Potential Outcomes:



MaaS and Urban Autonomous Shuttles

MaaS services use applications and communications platforms to allow customers to select from several mobility options, such as transit, carshare, or bikeshare, to meet their needs. Urban autonomous shuttles are seen as a key part of the MaaS portfolio since their low operating costs and smaller vehicle sizes make them easy to deploy. North Dakota has begun to explore the potential of these systems, including demonstrations of autonomous shuttles for visitors at the NDDOT Transportation Expo in 2018.^{xiv} MaaS and urban autonomous shuttles can expand mobility quickly and at a lower cost than traditional transit. But like other systems, they rely on the flexibility of the regulatory environment and the availability of smart infrastructure to guide and monitor the services as they operate.

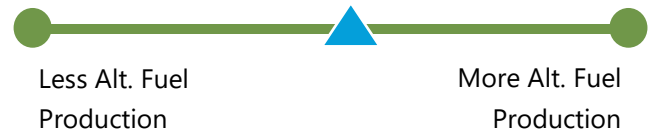
Potential Outcomes:



Alternative Fuels

North Dakota’s alternative fuels industry has focused on biodiesel, derived from canola oil, and ethanol, derived from corn. The state’s 6 ethanol plants produce up to 550 million gallons per year and consumes 40 to 60 percent of the state’s corn crop.^{xlv} The state’s one biodiesel plant produces up to 85 million gallons per year and consumes 65 percent of the state’s canola crop.^{xlvii xlviii} The increasing use of alternative fuels in the future will be determined by federal regulations regarding fuel standards, national policy, gas prices, and vehicle technologies. North Dakota must maintain a transportation network for its residents’ consumption of these alternative fuels as well as an interstate network to ensure fuel exports reach out-of-state markets.

Potential Outcomes:



i KX News “NDDOT aiming to make highways smarter.” 24 Jul. 2020. <<https://www.kxnet.com/news/local-news/nddot-aiming-to-make-highways-smarter/>>

ii Bismarck Tribune “Driverless bus demonstration held at Transportation Expo.” 11 May 2018. <https://bismarcktribune.com/news/local/bismarck/driverless-bus-demonstration-held-at-transportation-expo/article_decc4ab7-2f93-57e3-af43-7a6384d4bdf0.html>

iii ND Ethanol Council Presentation to the North Dakota Legislature. 2 Jun. 2020. “North Dakota Ethanol Industry Overview.” <https://www.legis.nd.gov/files/committees/66-2019/21_5127_03000appendixd.pdf>

iv North Dakota Department of Commerce. “Spotlight on North Dakota Energy, 2018 Annual Report.” <<https://www.business.nd.gov/uploads/14/SpotlightOnEnergy2018.pdf>>

v North Dakota Department of Commerce. “Biodiesel.” <https://www.business.nd.gov/energy/Biodiesel/>

TRANSIT

Transit services are available across North Dakota, serving small towns, tribal lands, and cities. Urban areas are served by fixed-route bus systems, with regular schedules and stops, and demand response services, which provide trips when people request them within designated service areas. Rural areas and tribes are served by demand response services. In total, 34 transit agencies provide services.^{xix} Although there are transit services located across the state, nearly 80 percent of all transit trips occur in urban areas.^l



Residents in North Dakota also have transit options to travel long-distances within the state and to cities across the country. Jefferson Lines and Greyhound provide east-west bus service across I-94, serving five cities. Both intercity bus providers also serve Grand Forks. In total, 6 cities in North Dakota have intercity transit service. In addition, two rural agencies provide regional transit services from Minot to Bismarck and Bismarck into South Dakota.

While we are familiar with what a traditional transit system looks like, the world of mobility is changing fast. In the last decade, Transportation Network Companies (TNCs), such as Uber and Lyft, bike share, scooter share, and car share have launched across the country. Most are owned and managed by private companies and a few are public entities. What might the next 20 years of transit look like as these new options evolve?

KEY TRANSPORTATION ISSUES

- Population changes in North Dakota have brought more people to urban areas, where all types of transit service is provided. These transit services are more efficient at moving people when their origins and destinations are clustered together in one region.
- Since 2010, transit ridership has declined 10 percent in Bismarck, Fargo, and Grand Forks.^{li} This decline happened during a time of population increases in these same cities.

DRIVERS OF CHANGE IN NORTH DAKOTA

- Emerging mobility services, such as TNCs and bikeshare provide residents with alternatives for short trips. When coupled with a transit system, they encourage people to travel without a car.
- As more people move to urban areas, there will be opportunities for transit agencies and other partners to increase Transportation Demand Management (TDM) activities that can reduce single-car use and encourage transit use.
- Growing urbanization and new mobility options also create opportunity for alternative travel between cities as intercity transit can complement robust mobility networks within cities.

FUTURE UNCERTAINTIES AND DISRUPTORS

- With more people moving to cities, it is unclear if transit-dependent people will also concentrate in urban areas. If they do, they may be able to access more frequent fixed route services. If the general populations

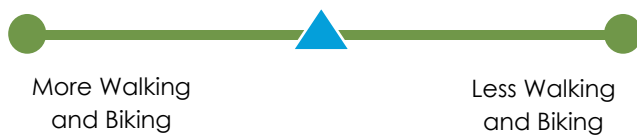
migration to urban areas outpaces the migration of transit-dependent people to those same urban areas, there may not be funding to maintain transit services in rural areas.

Customer Preferences

An attraction to urban living is the ability to walk and bike for both recreation and utility purposes. As the population increases in urban areas, customer preferences may change with more interest in safe infrastructure for walking and biking. Transportation Demand Management (TDM) programs can reduce single-car use by influencing customer preferences. Current TDM programs in North Dakota include free transit for students at UND and NDSU. These programs encourage students to take transit because they do not pay a fare each time they board, although they may be paying a flat fee through their tuition. These types of programs can be expanded with large employers in urban areas.

When residents start to see they can move around the city with ease by walking, biking, and taking transit, they may take fewer trips with cars.

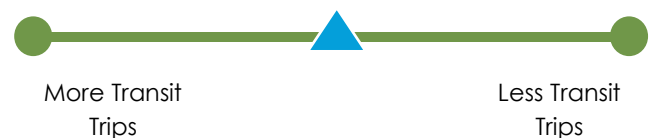
Potential Outcomes:



Pandemic

With the onset of COVID-19, the public’s willingness to travel in confined spaces with other people has been reduced. It is unclear, if this change will be temporary or permanent. For the immediate future, transit revenues from fares and sales tax will remain below pre-COVID levels. The long-term future of transit demand and transit funding are unknown. To keep transit agencies afloat and operational during COVID, the federal government supplied additional funding to transit agencies. However, it is not clear how long additional funds will be provided. When the pandemic ends, transit agencies may need to launch marketing campaigns and customer outreach efforts to identify customer expectations and travel demand. Through this process they should learn which services will be most appropriate for their customer base and how frequent those services will need to be to meet travel demands.

Potential Outcomes:

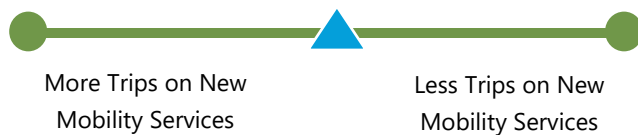


Shared Mobility

Advances in technology have inspired new forms of mobility. These new options include TNCs, such as Uber and Lyft, bike and scooter sharing, car share, and private transit services. Some of these services are complementary to public transit and some services are in direct competition with public transit. Many of the private companies providing these services have technology platforms that are intuitive and easy to use.

As technology and the shared economy unfold, the new types of shared mobility options may increase, as well as the number of service providers.

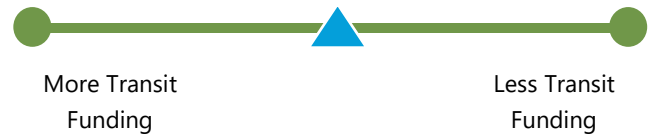
Potential Outcomes:



Funding

Traditional transit funding from the federal government is not expected to significantly increase in the coming years. With new mobility options becoming available and cities becoming denser, there may be options for new funding sources to augment traditional sources. These funding sources may come from local improvement districts, VMT mileage-based fees, vehicle license fees, income tax, advertising, or fees paid by shared mobility providers. New funding sources may come with added flexibility, for example they may be used for capital, service, and maintenance.

Potential Outcomes:



i NDDOT 2019 Transportation Handbook. <<http://library.nd.gov/statedocs/Transportation/TransportationHandbook/2019.pdf>>
 ii National Transit Database, 2018. < <https://www.transit.dot.gov/ntd/ntd-data>>
 iii 2018 and 2010 National Transit Database, Federal Transit Administration.
 <<https://www.transit.dot.gov/ntd/data-product/2010-annual-database-service>>
 <<https://www.transit.dot.gov/ntd/data-product/2018-annual-database-service>>

-
- i Feeding America. "Food Insecurity in North Dakota, 2018."
<<http://map.feedingamerica.org/county/2018/overall/north-dakota>>
- ii North Dakota Compass. "Health Trends." Jun 2019.
<https://www.ndcompass.org/trends/Health_Trends_June_12_2019.pdf>
- iii National Household Travel Survey, 2017.
- iv KFYR. "New initiative to help rural grocery stores." 20 Dec. 2019. <<https://www.kfyrtv.com/content/news/New-initiative-to-help-rural-grocery-stores-566395781.html>>
- v ND Compass. "Health trends." <https://www.ndcompass.org/trends/Health_Trends_June_12_2019.pdf>
- vi United States Centers for Disease Control and Prevention. Overweight & Obesity.
- vii Dakota Carrier Network. "DCN delivers one-gigabit internet access to North Dakota K-12 schools." 21 Aug 2019.
<<https://dakotacarrier.com/dcn-delivers-one-gigabit-internet-access-to-north-dakota-k-12-schools/>> Internet Access in North Dakota. <<https://broadbandnow.com/North-Dakota>>
- viii North Dakota Department of Commerce Census Office. Population Projections of the State, Regions, and Counties 2016.
- ix KFYR. "New initiative to help rural grocery stores." 20 Dec. 2019. <<https://www.kfyrtv.com/content/news/New-initiative-to-help-rural-grocery-stores-566395781.html>>
- x ND Compass. "Aging Overview."
<<https://www.ndcompass.org/aging/#:~:text=Between%202010%20and%202025%2C%20the,percent%20of%20the%20state's%20population.>>
- xi National Association of State Departments of Agriculture. "North Dakota Department of Agriculture."
<<https://www.nasda.org/organizations/north-dakota-department-of-agriculture/#:~:text=Nearly%2090%20percent%20of%20North,fourth%20of%20the%20state's%20employment.>>
- xii ND Ethanol Council Presentation to the North Dakota Legislature. 2 Jun. 2020. "North Dakota Ethanol Industry Overview." <https://www.legis.nd.gov/files/committees/66-2019/21_5127_03000appendixd.pdf>
- xiii National Household Travel Survey, 2017. <<https://nhts.ornl.gov>>
- xiv NDDOT, ND Moves. Pg 7.
<<https://www.dot.nd.gov/plans/statewide/docs/NDMovesPlanWithExecSummary.pdf>>
- xv NDDOT, ND Moves. Pg 9
<<https://www.dot.nd.gov/plans/statewide/docs/NDMovesPlanWithExecSummary.pdf>>
- xvi NDDOT, ND Moves. Pg 9
<<https://www.dot.nd.gov/plans/statewide/docs/NDMovesPlanWithExecSummary.pdf>>
- xvii The Better Bike Share Partnership "Why the Country's Best Bike Share Might Be In Fargo."
<<https://betterbikeshare.org/2016/05/19/countrys-best-bike-share-might-fargo>>
- xviii Radio Oklahoma Network. "Task force created to help North Dakota's oil and gas industry." 7 May 2020.
<<http://www.okenergytoday.com/2020/05/task-force-created-to-help-north-dakotas-oil-and-gas-industry/>>
- xix Energy of North Dakota. "Tax Revenues." <<https://energyofnorthdakota.com/home-menu/bakken-benefits/tax-revenues/>>
- xx AP News. "Officials: North Dakota oil output may peak within 5 years." 11 Feb. 2020.
<<https://apnews.com/article/60ba897e9aa4ea7091f03b8730a85079>>
- xxi Bismarck Tribune. "Coal Creek Station slated to close in 2022." 7 May 2020.
<https://bismarcktribune.com/news/state-and-regional/coal-creek-station-slated-to-close-in-2022/article_e23d6007-e56d-56e2-b414-e380251b818c.html>
- xxii AP News. "Officials: North Dakota oil output may peak within 5 years." 11 Feb. 2020.
<<https://apnews.com/article/60ba897e9aa4ea7091f03b8730a85079>>

-
- xxiii NDDOT North Dakota State Rail Plan. Pg. 10.
<<https://www.dot.nd.gov/divisions/planning/railplan/3Executive%20Summary.pdf>>
- xxiv Bismarck Tribune. "North Dakota coal production drops 8% in 2019." 2 Feb. 2020.
<https://bismarcktribune.com/business/north-dakota-coal-production-drops-in/article_58053c99-bf35-5520-8cdc-dea11847ebfd.html>
- xxv West Central Tribune. "North Dakota's largest coal-fired power plant will shut down in 2022 unless new buyer can be found." 7 May 2020. <<https://www.wctrib.com/business/energy-and-mining/6482047-North-Dakotas-largest-coal-fired-power-plant-will-shut-down-in-2022-unless-new-buyer-can-be-found>>
- xxvi U.S. Energy Information Administration. "North Dakota State Profile and Energy Estimates."
<<https://www.eia.gov/state/analysis.php?sid=ND#:~:text=Renewable%20energy,-North%20Dakota%20is&text=In%202019%2C%20wind%20was%20the,electricity%20generated%20from%20wind%20energy.>>
- xxvii American Wind Energy Association. "Wind Energy in North Dakota."
<<https://www.awea.org/Awea/media/Resources/StateFactSheets/North-Dakota.pdf>>
- xxviii NDDOT Transportation Handbook. Pg 9 – 10.
<<http://library.nd.gov/statedocs/Transportation/TransportationHandbook/2019.pdf>>
- xxix NDDOT Transportation Handbook. Pg 11.
<<http://library.nd.gov/statedocs/Transportation/TransportationHandbook/2019.pdf>>
- xxx NDDOT Transit Asset Management Plan, 2019. Pg 14.
<<https://www.dot.nd.gov/divisions/planning/docs/TAMP.pdf>>
- xxxi American Society of Civil Engineers Report Card for North Dakota's Infrastructure, 2019. Pg 6.
<https://www.infrastructurereportcard.org/wp-content/uploads/2016/10/ASCE_Report-Card-2019-FINAL.pdf>
- xxxii NDDOT Annual Traffic Report, 2019. Pg 3. <<http://www.dot.nd.gov/business/docs/trafficreports/Annual-Traffic-Report-2019.pdf>>
- xxxiii National Household Travel Survey, 2017. <<https://nhts.ornl.gov/>>
- xxxiv FHWA Exploratory Advanced Research Program Fact Sheet. "Novel Development of a Bio-Based Binder for Sustainable Construction." Published 2017.
<<https://www.fhwa.dot.gov/publications/research/ear/18030/18030.pdf>>
- xxxv North Dakota Department of Commerce. "ND Foreign-Born Residents: Then/Now" June 2019. <<https://www.commerce.nd.gov/uploads/34/CensusNewsletterJun2019.pdf>>
- xxxvi American Community Survey, 2010 and 2017 1-Year Estimates. <data.census.gov>
- xxxvii North Dakota Department of Commerce. "Changes to City Populations & the Urbanization of ND." Sep. 2015.
<<https://www.commerce.nd.gov/uploads/8/CensusNewsletterSep2015.pdf>>
- xxxviii North Dakota Department of Commerce. "Defining Rural Population." Dec. 2017.
<<https://www.commerce.nd.gov/uploads/26/CensusNewsletterDec2017.pdf>>
- xxxix North Dakota Department of Commerce. "Defining Rural Population." Dec. 2017.
<<https://www.commerce.nd.gov/uploads/26/CensusNewsletterDec2017.pdf>>
- xl North Dakota Department of Commerce. "North Dakota Census Office Population Projections of the State, Regions and Counties 2016." 19 Jan. 2016.
<<https://www.commerce.nd.gov/uploads/8/2016PopulationsProjectionsFinal.docx>>
- xli Washington Post. "Spiking coronavirus cases and falling oil prices deliver dual blow to North Dakota." 11 Sep. 2020. <<https://www.washingtonpost.com/business/2020/09/10/spiking-coronavirus-cases-falling-oil-prices-deliver-dual-blow-north-dakota/>>
- xlii Washington Post. "Spiking coronavirus cases and falling oil prices deliver dual blow to North Dakota." 11 Sep. 2020. <<https://www.washingtonpost.com/business/2020/09/10/spiking-coronavirus-cases-falling-oil-prices-deliver-dual-blow-north-dakota/>>

-
- xliii Washington Post. "Spiking coronavirus cases and falling oil prices deliver dual blow to North Dakota." 11 Sep. 2020. <<https://www.washingtonpost.com/business/2020/09/10/spiking-coronavirus-cases-falling-oil-prices-deliver-dual-blow-north-dakota/>>
- xliv KX News "NDDOT aiming to make highways smarter." 24 Jul. 2020. <<https://www.kxnet.com/news/local-news/nddot-aiming-to-make-highways-smarter/>>
- xlv Bismarck Tribune "Driverless bus demonstration held at Transportation Expo." 11 May 2018. <https://bismarcktribune.com/news/local/bismarck/driverless-bus-demonstration-held-at-transportation-expo/article_decc4ab7-2f93-57e3-af43-7a6384d4bdf0.html>
- xlvi ND Ethanol Council Presentation to the North Dakota Legislature. 2 Jun. 2020. "North Dakota Ethanol Industry Overview." <https://www.legis.nd.gov/files/committees/66-2019/21_5127_03000appendixd.pdf>
- xlvii North Dakota Department of Commerce. "Spotlight on North Dakota Energy, 2018 Annual Report." <<https://www.business.nd.gov/uploads/14/SpotlightOnEnergy2018.pdf>>
- xlviii North Dakota Department of Commerce. "Biodiesel." <<https://www.business.nd.gov/energy/Biodiesel/>>
- xlix NDDOT 2019 Transportation Handbook. <<http://library.nd.gov/statedocs/Transportation/TransportationHandbook/2019.pdf>>
- l National Transit Database, 2018. <<https://www.transit.dot.gov/ntd/ntd-data>>
- li 2018 and 2010 National Transit Database, Federal Transit Administration. <<https://www.transit.dot.gov/ntd/data-product/2010-annual-database-service>> <<https://www.transit.dot.gov/ntd/data-product/2018-annual-database-service>>