EXHIBIT
tabbies PC 1

TESTIMONY BEFORE THE PSC CONCERNING THE APPLICATION OF BADGER WIND/ORSTED

Members of the Public Service Commission, Senators and Representatives, County and City Officials, landowners and guests, my name is Blanche Schumacher; I serve as the Chairperson of the Board of Logan County Commissioners and am here to briefly discuss the outcome of the Conditional Use Permit hearing that was held in Logan County on May 11, 2022.

When the public hearing for the Conditional Use Permit was held before the Board of Logan County Commissioners, there were a total of 39 individuals present. The Orsted representatives were allowed to explain the proposed Badger Wind project, followed with a brief question and answer period for those present to make inquiries about the project. Persons in favor of the project were then allowed to present their testimony, followed by those who were opposed to the project. An additional rebuttal period was allowed for both those in favor of and those opposed to the project. The County Commission asked for a Closing Statement by the Badger Wind representatives, followed with a request for a show of hands of those either in favor of or opposed to the project. We found there were 17 persons in favor and 7 opposed. There were approximately 16 who chose not to vote, some of whom were employees of Orsted, county employees and/or friends and neighbors of those within the project area.

At the conclusion of the hearing, the Board of County Commissioners individually considered the purpose and intent of our County Zoning Regulations; the project appeared to pose no threat to public health; it appeared to promote the orderly development of the county's resources; there appeared to be no conflict among land uses and structures; the majority of the testimony offered was in favor of the project and since the landowners were the persons who would be most directly affected by having

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Exhibit PC-1 – Public comments received
Public Service Commission

to work around the turbines and these same landowners were willing to allow their lands to be utilized for this purpose and the schools, county, fire and ambulance service districts would benefit as well, it was for these reasons that we as a Board decided that we, too, should support our landowners and the majority of the persons who were in favor of the project.

In our experience, we have found that Orsted and their representatives have been honest, trustworthy, diligent and cooperative in working with the county and that they have honored all their commitments to us.

I would like to thank the Public Service Commission for giving us the opportunity to be present here today to be heard at this public hearing, and I respectfully request that the North Dakota Public Service Commission consider casting a favorable vote in support of the application of Orsted for the Badger Wind Project.

Thank you.

Blanche Schumacher

Blanche Schumacher,
Logan County Commissioner

Wishek Wind Project Testimony
Provided by Anna Novak

Thank you for the opportunity to provide written testimony today. I'd also like to thank Mark Pierce for his willingness to read it on my behalf, since I am unable to attend this hearing.

My name is Anna Novak and I recently won in the primary for the House of Representatives in District 33. As the Public Service Commissioners are likely aware, District 33 now encompasses all of Coal Country, after the redistricting process took place last year. We are now home to 4 coal mines and 5 coal-fired power plants. These facilities are the lifeblood of my district's economy and tax base, and to the state of North Dakota as well. 10% of the state's ~~budget~~ gross domestic product comes from the lignite industry. On top of those things, my district provides the majority of power to the state of North Dakota in addition to our surrounding states via the SPP and MISO grids. Both of these grids have been strained in the past few years with brownouts actually taking place right here in North Dakota.

The PSC's Public Utilities Division is responsible for overseeing the public utilities. Your website states that "the division enforces siting requirements to ensure that the location, construction and operation of energy conversion and transmission facilities will have minimal adverse effects on the environment and people."

With that in mind, it is important to ask yourself the following questions when evaluating whether or not to grant permitting for this wind project, or any other wind projects for that matter.

1. **Will this wind turbine farm help or hurt the local environment, including wildlife and the native grasslands?**
2. **Will this wind farm likely increase or decrease consumer prices in the long term?** Excel Energy and MDU have gone away from coal in the past few years, have added more wind energy to their portfolio and have both asked for huge rate increases – over 10% for each of them just in the past 6 months. It is worth noting that Basin Electric has held on to their coal-fired fleet and has not implemented a rate increase in several years, which is unlikely correlated.
3. **Is the company requesting this permit a reputable North Dakota-based company that has a history of contributing to our economy, or is it a company based elsewhere simply looking to cash in on the federal production tax credit and green energy credits?**
4. **Will permitting this project adversely affect North Dakotans working and living in a different part of the state because they work at a coal mine, a coal fired power plant or a natural gas power plant?**
5. **Lastly, does adding these 250 megawats of wind energy potentially affect how much power is produced at our baseload power plants – and possibly make them uneconomical?** As you know, baseload power plants are designed to be run 24 hours a day, 7 days a week, and don't perform well when ramped up when needed and shut down when not needed. If permitting this project affects the long-term viability of energy sources that are reliable and affordable 100% of the time, is it in the best interest of North Dakota residents to put them at risk by adding more energy to an already-congested grid?

Anna S. Novak

I recognize that granting permitting isn't clear cut and there isn't necessarily a right or wrong answer. However, you do have a responsibility to the public! I believe that if you answered the 5 questions above accurately and truthfully, you will all agree that the good that this wind project brings to the state of North Dakota, specifically to the Wishek area, does not outweigh the potential bad for the rest of the state, especially when considering reliability and affordability. I close by asking you to not grant permitting for this wind project.

Thank you for your time and service to the state of North Dakota.



Anna S. Nork

Badger Wind, LLC: Public Service Commission Testimony – 6/28/2022

Submitted by: Mark L. Pierce
Faces of North Dakota Coal
1024 Cherry Lane
Beulah, ND 58523

My name is Mark Pierce. I am a coal miner from Beulah, ND. Starting off, I would like to thank you all for the opportunity to testify today on behalf of thousands of coal miners and plant workers in ND Coal Country.

We are currently living in history. These are truly very interesting and challenging times. We owe much of this to the uncertainty of Federal Policy coming out of Washington, DC. Inflation, interest rates, commodity prices, etc. are hurting good people more and more as each day passes. Sadly, this is the exact environment that my livelihood has been dealing with for over a decade. Yet, we are still here today doing the same work to provide energy our society needs. How long will we be able to continue to provide the critical baseload electricity? Honestly, I don't know, but a lot of that depends on decisions made regarding issues like we are testifying on here today. Today is the most important day for my livelihood, and tomorrow maybe for yours. Access to affordable, reliable electric power is the single greatest eradicator of poverty in human history. This project and many others proposed like it threaten the very electric grid stability we have all grown to take for granted. We as a society are no longer able to ignore the reality of what we have allowed to happen to our grid. We are sacrificing our one last global competitive advantage.

I have devoted a lot of my personal time over the last several years to advocating for my industry. I have found our coal industry is one of the most misunderstood industries. People do not understand what they don't know. Unfortunately, our story of prosperity in Coal Country and the vast benefit we provide society is rarely told. If told, it is seldom told accurately in today's hyperpolarized world.

This lead me in 2019 to start "Faces of North Dakota Coal". We are a grassroots organization dedicated to telling the great story of Coal Country from the perspective of those of us who live and breathe it each and every day. Humanizing our industry and putting a "face" to the black rock and electron we produce is an aspect that most never even consider. Our motto is "People, Families, Communities". It is far reaching from ours to yours.

Over a decade ago, our industry began to question the direction federal policy was taking our electric grids with the never ending subsidization of intermittent energy. Many spoke about the potential consequences replacing baseload energy with intermittent energy would likely bring to our electric grids. It fell on deaf ears for years because nothing happened. Our electric grid infrastructure had excess capacity that was able to absorb the redundant buildout of generation. Today, that is no longer the case. We are now at the point of displacing baseload electrons with intermittent electrons. This displacement by subsidized energy has been undermining the economics of traditional energy putting our baseload plants at risk of closure. Many throughout the Midwest have succumbed to this economic pressure.

There is no doubt in my mind that this project if built as proposed would do irreparable harm to some of our critical baseload infrastructure in North Dakota. Fortunately for me, you don't have to rely on my words to see this quite clearly. It is plainly clear from the information the two (2) grid operators serving ND have on their respectively public websites. Below is the detail of MISO's grid level notifications since May 13th. So far, MISO's 2022 has been quite interesting in their efforts to maintain the juggling act of grid stability that used to be an afterthought. Air Traffic Controllers have nothing over on MISO Grid Operators.

Max Gen Alert effective 05/13/2022 15:35 EST - *5/13/2022 3:33 PM*

https://www.misoenergy.org/mcsnotification/?id=1322

Current NERC EEA Level = 0
Current MISO Max Gen Level = Alert
Current Emergency Pricing Level = Tier 0

Reliability Actions:

The MISO Reliability Coordinator is declaring a Maximum Generation Emergency Alert effective from 05/13/2022 15:35 EST until 05/13/2022 19:00 EST for the following entities: Central Region area(s) of: ALT, ALTE, AMIL, AMMO, AMRN, ATC, BREC, CIN, CONS, CWLD, CWLP, DECO, GLH, HE, HMPL, IPL, ITC, MECS, METC, MGE, MIUP, NIPS, PION, RTX, SIGE, SIPC, UPPC, WEC, WPS

The reason for the Event is because of Forced Generation Outages, Higher than Forecasted Load, Above Normal Temps.

The MISO Reliability Coordinator instructs the following:

Stakeholder Major Actions	Max Gen Step Level
MPs communicate available Module E Resources	Alert
MPs update energy interchange transaction E-Tags of Capacity Resources	Alert
LBA/TOP provide potential exclusion of constrained pockets within the declaration area	Alert
TOPs coordinate with MISO RC to identify potential reconfiguration options	Alert
LBAs/MPs ensure accuracy of LMM/LMR availability and Self Scheduled values in MCS/DSRI	Alert
Affected GOPs communicate capacity limited facilities to MISO and update limits and offers	Alert
Prepare to implement this procedure and follow procedures for emergency conditions	Capacity Advisory
Follow instructions per Conservative System Operations procedure and declaration	Capacity Advisory
If notified by MISO, Implement LMRs	Capacity Advisory

Max Gen Alert effective 05/18/2022 14:30 EST - *5/18/2022 2:33 PM*

https://www.misoenergy.org/mcsnotification/?id=1325

Current NERC EEA Level = 0
Current MISO Max Gen Level = Alert
Current Emergency Pricing Level = Tier 0

Reliability Actions:

The MISO Reliability Coordinator is declaring a Maximum Generation Emergency Alert effective from 05/18/2022 14:30 EST until 05/18/2022 20:00 EST for the following entities: South Region area(s) of: AXLT, CLEC, EAI, EES, EMBA, LAFA, LAGN, LEPA, SME

The reason for the Event is because of Forced Generation Outages, Above Normal Temps, Higher than Forecasted Load.

The MISO Reliability Coordinator instructs the following:

Stakeholder Major Actions	Max Gen Step Level
MPs communicate available Module E Resources	Alert
MPs update energy interchange transaction E-Tags of Capacity Resources	Alert
LBA/TOP provide potential exclusion of constrained pockets within the declaration area	Alert
TOPs coordinate with MISO RC to identify potential reconfiguration options	Alert
LBAs/MPs ensure accuracy of LMM/LMR availability and Self Scheduled values in MCS/DSRI	Alert
Affected GOPs communicate capacity limited facilities to MISO and update limits and offers	Alert
Prepare to implement this procedure and follow procedures for emergency conditions	Capacity Advisory
Follow instructions per Conservative System Operations procedure and declaration	Capacity Advisory
If notified by MISO, Implement LMRs	Capacity Advisory

MISO declares Conservative Operations for Reliability Coordinator Footprint effective 05/31/2022 04:45 EST - *5/31/2022 4:37 AM*

https://www.misoenergy.org/mcsnotification/?id=1333

The MISO Reliability Coordinator (RC) is declaring Conservative Operations, effective from 05/31/2022 04:45 EST to 05/31/2022 20:00 EST for the following entities: Reliability Coordinator Footprint and instructs that:

- TOPs, GOPs and LBAs are to review outage plans to determine any maintenance or testing, scheduled or being performed on any monitoring, control, generation or transmission equipment that can be deferred, revoked or cancelled. Coordinate with MISO and LBA for completing any maintenance that may enhance BES reliability, monitoring and control. The return to service of equipment on outage should be coordinated between MISO and the applicable entity.

Max Gen Alert for MARKET FOOTPRINT effective 06/15/2022 13:00 EST *- 6/14/2022 11:49 AM*

https://www.misoenergy.org/mcsnotification/?id=1340

Current NERC EEA Level = 0
Current MISO Max Gen Level = Alert
Current Emergency Pricing Level = Tier 0

Reliability Actions:

The MISO Reliability Coordinator is declaring a Maximum Generation Emergency Alert effective from 06/15/2022 13:00 EST until 06/15/2022 20:00 EST for the following entities: MISO Balancing Authority Area

The reason for the Event is because of Forced Generation Outages, Above Normal Temps, High Congestion.

The MISO Reliability Coordinator instructs the following:

Stakeholder Major Actions	Max Gen Step Level
MPs communicate available Module E Resources	Alert
MPs update energy interchange transaction E-Tags of Capacity Resources	Alert
LBA/TOP provide potential exclusion of constrained pockets within the declaration area	Alert
TOPs coordinate with MISO RC to identify potential reconfiguration options	Alert
LBAs/MPs ensure accuracy of LMM/LMR availability and Self Scheduled values in MCS/DSRI	Alert
Affected GOPs communicate capacity limited facilities to MISO and update limits and offers	Alert
Prepare to implement this procedure and follow procedures for emergency conditions	Capacity Advisory
Follow instructions per Conservative System Operations procedure and declaration	Capacity Advisory
If notified by MISO, Implement LMRs	Capacity Advisory

MISO declares Conservative Operations for Reliability Coordinator Footprint effective 06/21/2022 00:00 EST *- 6/17/2022 11:06 AM*

https://www.misoenergy.org/mcsnotification/?id=1350

Due to:

Extreme high temperatures and near record high loads, in order to maximize generation availability and

transmission system transfer capability.

The MISO Reliability Coordinator (RC) is declaring Conservative Operations, effective from 06/21/2022 00:00 EST to 06/23/2022 22:00 EST for the following entities: Reliability Coordinator Footprint and instructs that:

- TOPs, GOPs and LBAs are to review outage plans to determine any maintenance or testing, scheduled or being performed on any monitoring, control, generation or transmission equipment that can be deferred, revoked or cancelled. Coordinate with MISO and LBA for completing any maintenance that may enhance BES reliability, monitoring and control. The return to service of equipment on outage should be coordinated between MISO and the applicable entity.

Capacity Advisory for the Market footprint effective 06/21/2022 06:00 EST *- 6/17/2022 11:12 AM*

https://www.misoenergy.org/mcsnotification/?id=1351

Current NERC EEA Level = 0
Current MISO Max Gen Level = Capacity Advisory
Current Emergency Pricing Level = N/A

Reliability Actions:

The MISO Reliability Coordinator is declaring a Maximum Generation Capacity Advisory effective from 06/21/2022 06:00 EST until further notice.

MP's and TOP's please ensure outages are up to date in CROW and offers are up to date in the portal.

The MISO Reliability Coordinator instructs the following:

- Prepare to implement the MISO Market Capacity Emergency procedure and follow procedures for emergency conditions
- Ensure all market data is updated with best available information
- If notified by MISO, Implement LMRs

MISO Declarations for all regions and follow up information. - *6/21/2022 6:38 AM*

https://www.misoenergy.org/mcsnotification/?id=1356

All,

MISO currently has 3 declarations that includes all three regions:

Hot Weather Alert
Conservative Operations
Capacity Advisory

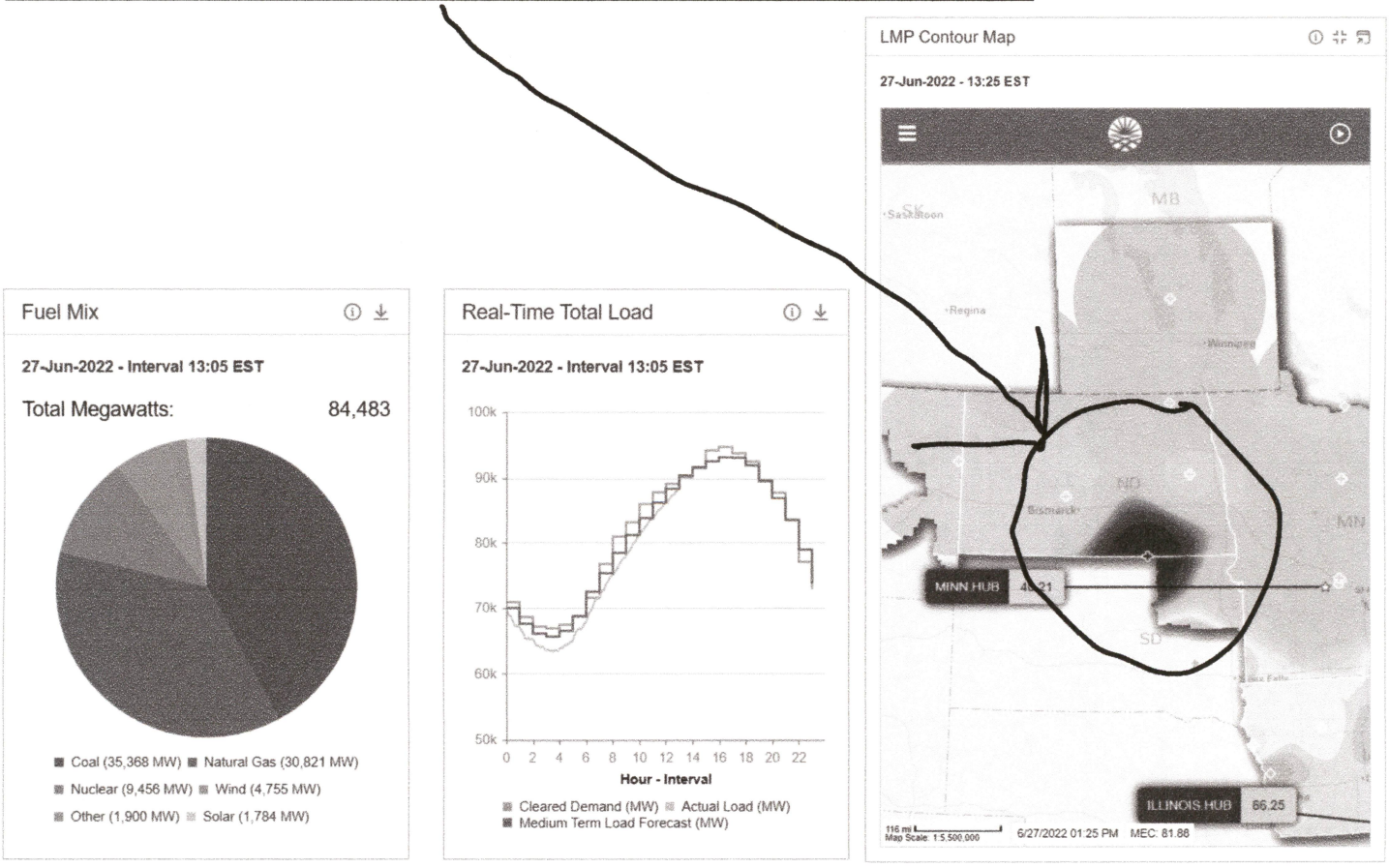
Please make extra efforts to have generation and other resource information updated in the portal accurately for today and tomorrow and keep your Regional operations staff updated with any changes.

Thanks,

MISO Shift Manager

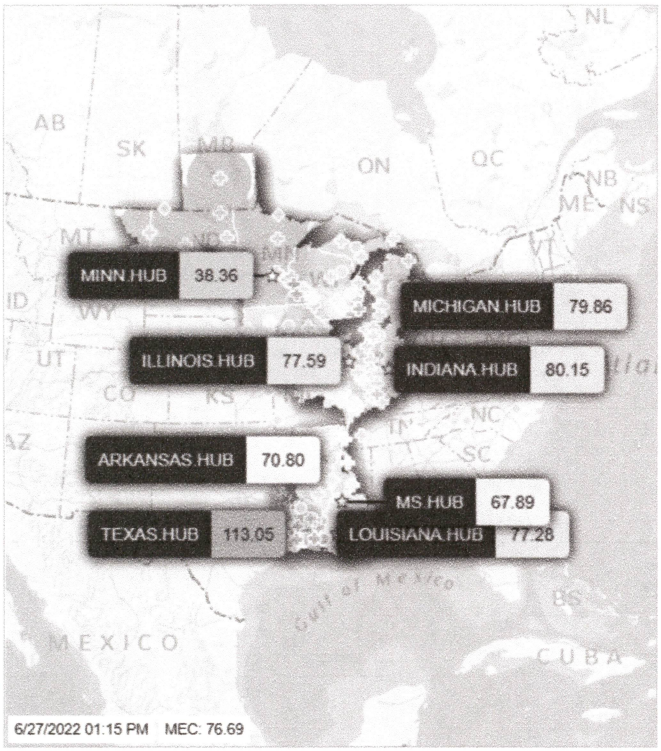
In addition, the proposed location for this wind farm would be in an area of MISO's footprint that is already known to be an area of high congestion and binding constraints. Without a significant investment in transmission infrastructure that is not disclosed currently, it is hard to fathom why anyone would propose this project in this location. Why would you develop and sell a product in a marketplace that frequently has negative pricing without a commitment of a power purchase agreement from a utility? The answer can only be to harvest the lucrative tax credits our federal policy provides in my opinion. Below is an example of the negative pricing in this area on June 27, 2022.

Area of negative locational marginal pricing on June 27, 2022 in ND's MISO footprint.



LMP Contour Map

27-Jun-2022 - 13:15 EST



ExAnte LMP

27-Jun-2022 - Interval 13:15 EST

Name	LMP	MCC	MLC
ARKANSAS.HUB	51.19	-17.41	-2.19
ILLINOIS.HUB	74.23	3.11	0.33
INDIANA.HUB	77.66	2.61	4.26
LOUISIANA.HUB	73.25	1.58	0.88
MICHIGAN.HUB	77.15	2.62	3.74
MINN.HUB	37.58	-24.93	-8.28
MS.HUB	63.59	-6.54	-0.66
TEXAS.HUB	76.65	6.38	-0.52

Real-Time Binding Constraints

27-Jun-2022 - Interval 13:20 EST

Name	Shadow Price	Override	Curve Type	BP1	PC1	BP2	PC2
Butler_Bluemound_138_5061_flo_Arcadian_Granvil_3	-350.52	0	MW	0	2000		
El_Dorado_500_345_AT2_FLO_El_Dorado_Mount_Olive_	-222.57	0	MW	0	2000		
Ellendal_AberdeenJunction_115kV_flo_Ellendal_Oak	-46.11	0	MW	0	2000		
PrairieIsland_NorthRochester_345_FLO_Hampton_Nor	-107.93	0	MW	0	2000		

To a lesser extent, ND's other grid operator struggles with much of the same dynamics. Below is a capacity advisory issued for the SPP on June 22, 2022. The Southwest Power Pool is a much smaller grid in terms of electric load and frequently experiences negative pricing throughout its footprint.

From: **Southwest Power Pool** <communication@spp.org>
Date: Wed, Jun 22, 2022 at 9:56 AM
Subject: **External Email** Grid Notice: SPP is issuing a Conservative Operations Advisory effective at 10 a.m. CT Wednesday, June 22, 2022
To: SPP Grid Notice <gridnotice@spplist.spp.org>

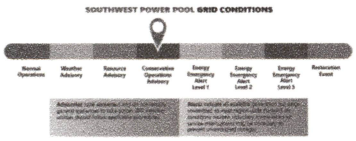
CAUTION: **This email originated from outside of the SPP network. Do not click links or open attachments unless you recognize or can verify the sender, or were expecting an email from the sender. The original sender of this email is communications@spp.org**

SPP is issuing a Conservative Operations Advisory for its entire 14-state Balancing Authority footprint in the eastern interconnection effective at 10 a.m. CT Wednesday, June 22, 2022, with an anticipated end at 10 p.m. CT Wednesday, June 22, 2022. **Conservative Operations Advisories do not require the public to conserve energy.**

This Conservative Operations Advisory is being declared due to high loads and wind generation output availability. As a result, the SPP Balancing Authority may use greater unit commitment notification timeframes, including making commitments prior to Day-Ahead Market and/or committing Resources in Reliability Status.

SPP issues Conservative Operations Advisories when SPP there is a need to operate its system conservatively based on weather, environmental, operational, terrorist, cyber or other events. Generation and transmission operators have been provided instructions on applicable procedures, including to report any limitations, fuel shortages or concerns. SPP will send additional information if necessary. Conservative Operations Advisories do not require the public across our 14-state regional transmission organization (RTO) region to conserve energy. Individuals should contact their local utility for details specific to their area.

The following chart shows the relative severity of the Conservative Operations Advisory in effect from 10 a.m. CT Wednesday, June 22, 2022, through 10 p.m. CT Wednesday, June 22, 2022.



I understand there are many factors involved in a permit evaluation. In my opinion, my testimony and the information provided is as critical of a factor as any other, if not more so. Someone has to draw the line in the sand at some point, and say that we can't continue to serve the greater good of society if we continue down this path.

With all I have presented, too often our detractors paint our grassroots group as anti-wind and anti-business. Nothing could be farther from the truth. Yes, it is true that we dislike the unlevel playing field that Federal policy has created, giving wind developers an unfair advantage in the marketplace. Yes, it is true that we have supported county level policy that has restricted wind development in Coal Country to avoid the transmission congestion that has plagued many baseload plants throughout the Great Plains. Neither of those facts will change.

The honest truth, though, is that we support value-added wind development that is a true comprehensive energy solution for North Dakota...we always have and we always will. Wind has an opportunity to be a +1 for North Dakota, but most people don't understand the complexities required to make that happen. There is currently a McLean County Project that appears at face-value to be the prototype for the +1 model that will not displace coal-fired baseload electrons to accommodate the windblown intermittent electrons. It is a project that would feed and maximize the capacity of a HVDC line to Minnesota. It avoids the North Dakota AC grid in its entirety. Minnesota would get the intermittent renewables they want and more importantly, the baseload they need. All this will take place without negatively impacting the people, families, and communities in Coal Country or North Dakota.

You may hear "coexist", "grow the pie" and "all of the above" taglines often from elected officials. They sound great and make for good campaign slogans, but most don't understand the physics behind the rhetoric. In the last legislative session, sound energy policy bills that were designed to facilitate that rhetoric into becoming reality were killed before they were introduced in committee or watered-down in committee. The +1 opportunity slipped through North Dakota's fingers, in large part because of the powerful lobbyists representing the wind interests.

In summary, this project does not appear to fit the +1 economic model we advocate for benefitting North Dakota.

Respectfully submitted,

Mark L. Pierce, Founder

Faces of North Dakota Coal

Beulah, ND

State of North Dakota Public Service Commission
Case No. PU-22-86
Public Hearing
Wishek Civic Center
715 1st Avenue South
Wishek, ND 58495

Hello Commissioners and staff! Greetings to all in attendance today. My name is Jessica Bell and I am the Environmental Manger for the Northern Operations for The North American Coal Corporation. I am here today to represent the company, but I know it is safe to say that I also stand here today carrying a message of thousands of coal miners, power plant workers, and small businesses that support the coal industry in North Dakota.

Since 1957, North American Coal has been mining coal right here in North Dakota at four different locations. With nearly 1,000 workers in the state, three mining operations in Mercer and McLean Counties operate today. The Freedom Mine, Falkirk Mine and Coyote Creek Mine sever nearly 25 million tons of coal. The coal is in turn utilized to produce electricity for our customers, for a total capacity factor of over 3,000 megawatts, employing another nearly 1,000 people. Average wages for all private jobs in North Dakota are estimated at $74,689. The average job in coal mining is estimated at $151,667 and in electricity generation at $165,498. These types of wages make not just jobs, but careers, in communities where people can live safely and grow their families.[1] Annually, the lignite industry as a whole contributes $5.4 billion to the economy, with $1.1 billion in direct annual expenditures, and approximately $125 million in tax revenue to the state of North Dakota and local political subdivisions[2].

National security starts with energy security, and America has come upon a grand experiment attempting to balance its energy and electric power sectors. Energy has an intrinsic national security value that is not accounted for in US policy. As America's competitors continue to engage in a true all-of-the-above energy technology strategy including fossil fuels, America continues the move away from fossil fuels. The Ronald Reagan Institute released a report in 2019 that stated:

> "The United States has entered an era of long-term competition with revisionist powers. A key aspect of this competition will revolve around a contest for technological superiority waged

[1] North Dakota Lignite Energy Industry Workforce. Agribusiness and Applied Economics Report 810. October 2021. https://ageconsearch.umn.edu/record/314930?ln=en
[2] Economic Contribution of the North Dakota Lignite Industry in 2019. Agribusiness and Applied Economics Report 804. December 2020. https://ageconsearch.umn.edu/record/308239/files/AAE804.pdf
3 Ronald Reagan Institute. The Contest for Innovation: Strengthening America's National Security Innovation Base in an Era of Strategic Competition. 2019. https://www.reaganfoundation.org/media/355297/the_contest_for_innovation_report.pdf
[4] U.S. News. *Big Wind's Bogus Subsidies*. May 2014. https://www.usnews.com/opinion/blogs/nancy-pfotenhauer/2014/05/12/even-warren-buffet-admits-wind-energy-is-a-bad-investment
[5] Wall Street Journal. *America's Summer of Rolling Blackouts*. May 2022. https://www.wsj.com/articles/americas-summer-of-rolling-blackouts-green-energy-grid-north-american-electric-reliability-corporation-11653683348?mod=Searchresults_pos3&page=1
[6] Wall Street Journal. *Green Energy's Big Looming Problem Is Red Tape*. June 2022. https://www.wsj.com/articles/green-energys-big-looming-problem-is-red-tape-11655809380?mod=Searchresults_pos3&page=1
[7] Wall Street Journal. Germany Steps Up Measures to Conserve Gas as Russia Slows Supply to Europe. June 2022. https://www.wsj.com/articles/germany-steps-up-measures-to-conserve-gas-as-russia-slows-supply-to-europe-11655642717
[8] Wall Street Journal. America Leans on Aging Power Plants to Fend Off Electricity Shortages. May 2022. https://www.wsj.com/articles/america-leans-on-aging-power-plants-to-keep-the-lights-on-11652693581?mod=Searchresults_pos4&page=1
[9] MISO's Response to the Reliability Imperative. January 2022. https://cdn.misoenergy.org/MISO%20Response%20to%20the%20Reliability%20Imperative504018.pdf

between the national innovation bases of the respective competitors. The outcome of this competition will determine not just American national security but also how the nations of the world interact – and whether a free and open political and economic system will remain the foundation of those interactions."[3]

This is why I am here today. The Badger Wind Project is the culmination of policies driven by ideologues working toward an energy transition but with no end goal that protects our citizens. We have a responsibility to consider this and adhere to the law. Some key questions I will present to you today to consider are:

- How does this project affect the welfare of the citizens of this state?
- Does this project contribute to the requirement in the century code to continue system reliability and integrity to ensure energy needs are met?
- Does this project meet the burden of proof for need of the facility?
- Does this project minimize adverse effects?
- What are the direct and indirect economic impacts of the proposed facility?
- As we look to the future, what tools do we need to protect our citizens?
- What role do future projects like this play in decarbonization strategies and maintaining grid reliability?

Given the PTC has been around for four decades, is it a policy that has proven to be a detriment to the ratepayers and taxpayers? It is proven that using it to generate electricity does not help reliability of the electrical grid. It is proven that using it has not made electricity cheaper. And it is proven that using it displaces and replaces existing electricity sources. It is a redundant approach to building power because we've already met current demand with the power produced now. So that begs the question – is the market demanding this project or are the subsidies driving it?

Even Warren Buffet said it outright almost a decade ago: "For example, on wind energy, we get a tax credit if we build a lot of wind farms. That's the only reason to build them. They don't make sense without the tax credit."[4]

The Wall Street Journal Editorial Board has "been warning for years that climate policies would make the grid more vulnerable to vacillations in supply and demand. And here we are. Some…still don't

[1] North Dakota Lignite Energy Industry Workforce. Agribusiness and Applied Economics Report 810. October 2021. https://ageconsearch.umn.edu/record/314930?ln=en

[2] Economic Contribution of the North Dakota Lignite Industry in 2019. Agribusiness and Applied Economics Report 804. December 2020. https://ageconsearch.umn.edu/record/308239/files/AAE804.pdf

3 Ronald Reagan Institute. The Contest for Innovation: Strengthening America's National Security Innovation Base in an Era of Strategic Competition. 2019. https://www.reaganfoundation.org/media/355297/the_contest_for_innovation_report.pdf

[4] U.S. News. *Big Wind's Bogus Subsidies*. May 2014. https://www.usnews.com/opinion/blogs/nancy-pfotenhauer/2014/05/12/even-warren-buffet-admits-wind-energy-is-a-bad-investment

[5] Wall Street Journal. *America's Summer of Rolling Blackouts*. May 2022. https://www.wsj.com/articles/americas-summer-of-rolling-blackouts-green-energy-grid-north-american-electric-reliability-corporation-11653683348?mod=Searchresults_pos3&page=1

[6] Wall Street Journal. *Green Energy's Big Looming Problem Is Red Tape*. June 2022. https://www.wsj.com/articles/green-energys-big-looming-problem-is-red-tape-11655809380?mod=Searchresults_pos3&page=1

[7] Wall Street Journal. Germany Steps Up Measures to Conserve Gas as Russia Slows Supply to Europe. June 2022. https://www.wsj.com/articles/germany-steps-up-measures-to-conserve-gas-as-russia-slows-supply-to-europe-11655642717

[8] Wall Street Journal. America Leans on Aging Power Plants to Fend Off Electricity Shortages. May 2022. https://www.wsj.com/articles/america-leans-on-aging-power-plants-to-keep-the-lights-on-11652693581?mod=Searchresults_pos4&page=1

[9] MISO's Response to the Reliability Imperative. January 2022. https://cdn.misoenergy.org/MISO%20Response%20to%20the%20Reliability%20Imperative504018.pdf

grasp the real problem: The forced transition to green energy is distorting energy markets and destabilizing the grid."[5]

Some may ask why North American Coal would stand up here today to express our concerns. We are here to oppose being displaced. Ensuring long-term success to allow all of us to grow successfully is our goal. No longer can we stay silent and watch power producers send wind electrons down transmission lines built with revenue from our products to replace coal electrons to a distorted and unfair marketplace. Keith Martin, a partner at Norton Rose Fulbright said at the Acore Finance Forum recently "Developers say it's not the PPA that is the scarce resource, it is the interconnection."[6] New transmission, new load growth and plus-one models like we've seen from other producers are all business models we can support for local labor and continued economic development for all areas in this county, across the state and throughout the nation.

All of us want affordable and reliable power, and dispatchability of that power when it's needed most is key. Capital flows to where it is welcomed, and it stays where it is treated fairly. We are asking for fairness to be returned to the market that has been skewed against electricity produced with fossil-fuels.

Companies with plans to allow different energy sources with different attributes like baseload and intermittent power to complement each other instead of compete with each other in a distorted market have a business plan we can support. Not allowing one resource to displace the other and instead allowing both sources of electricity to work hand in hand with one another to maximize both is the direction we all need to be looking. When power-producing projects complement one another, true flexibility is achieved to ensure the success of every type of power and allows all facilities to run at a higher capacity that meets the demands of consumers at all times, not intermittently.

Allowing the injection of a new source of electricity into an already full existing transmission system only causes existing electricity to be curtailed or displaced. New generation sources should invest their money into a new transmission line to market. According to the WSJ, "Electricity supplier Vistra has announced it will retire 6,800 MW of coal power by 2027, blaming an "irreparably dysfunctional" market and state renewable subsidies. The former is partly a result of the latter." Vistra's CEO also recently told the Center Square newsletter, "We don't have the opportunity to just shut down a facility for four hours or six hours or eight hours a lot of time."[5]

[1] North Dakota Lignite Energy Industry Workforce. Agribusiness and Applied Economics Report 810. October 2021. https://ageconsearch.umn.edu/record/314930?ln=en

[2] Economic Contribution of the North Dakota Lignite Industry in 2019. Agribusiness and Applied Economics Report 804. December 2020. https://ageconsearch.umn.edu/record/308239/files/AAE804.pdf

3 Ronald Reagan Institute. The Contest for Innovation: Strengthening America's National Security Innovation Base in an Era of Strategic Competition. 2019. https://www.reaganfoundation.org/media/355297/the_contest_for_innovation_report.pdf

[4] U.S. News. *Big Wind's Bogus Subsidies*. May 2014. https://www.usnews.com/opinion/blogs/nancy-pfotenhauer/2014/05/12/even-warren-buffet-admits-wind-energy-is-a-bad-investment

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Operating a coal-fired power plant at full capacity is not only built into the business model, it's engineered into the facility. Coal-fired power plants are not designed to cycle, a phenomenon the industry has been challenged with since the federal production tax for wind came into existence. Cycling not only reduces the amount of electricity available for a plant to sell, it increases maintenance costs. Those increases in cost are passed directly to the users of electricity.

The electrical grid in North Dakota, and the regional transmission operators coordinating the delivery of service to the residents in our state, needs assurance it will be able to take advantage of the power they produce at all times. The game of finger-pointing about who is responsible for that needs to end and policies need to be put in place. There has to be a balance, and it hasn't been balanced for a long time. Today is the day to say no more intermittency, at least not without a firming requirement to help rebalance the grid toward reliable, affordable energy, and to assert America's need for energy independence. If the federal government won't help us, it's time we help ourselves.

The rate at which we've incorporated intermittent power into our grid while simultaneously reducing baseload power has resulted in real issues not only here, but across the globe. Just this past week Germany restarted their coal-fired power plants and offered incentives for companies to curb natural gas consumption[7].Here in the US, we're heading rapidly down the same path. "MISO…is studying whether to permit the closure of a coal plant owned by Ameren. MISO…determined the plant's closure could affect the reliability of the system."[8] Even just this past week, SPP issues a Conservative Operations Advisory. This Advisory was declared due to high loads and wind generation output availability. If the situation deteriorates, the next advisory level is an Energy Emergency Alert. MISO was also in a Conservative Operations warning for their south region. Increasing grid reliance on intermittent power is obviously not a wise path for us to continue to barrel down. Not without a plan in place to ensure high demand times can be met if the wind isn't blowing and the sun isn't shining. Grid reliability is not for sale.

Unlike transmission lines, the PSC does not have to approve an application for an energy conversion facility such as a wind farm. See NDCC 49-22-08(5). It says the Commission "may designate", and "the Commission shall indicate the reason for any refusal of designation." For example, the Commission denied the application of Burke Wind in case PU-18-344, mostly on the grounds of adverse impacts to birds and wildlife habitat.

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[6] Wall Street Journal. *Green Energy's Big Looming Problem Is Red Tape*. June 2022. https://www.wsj.com/articles/green-energys-big-looming-problem-is-red-tape-11655809380?mod=Searchresults_pos3&page=1

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The statement of policy in NDCC 49-22-02 provides in part that the Commission must consider how such a facility would affect the welfare of the citizens of this state, and produce minimal adverse effects upon such welfare. It goes to provide that sites must be chosen which ensure "continuing system reliability and integrity and ensuring that energy needs are met and fulfilled in an orderly and timely fashion." The question of system reliability should be considered.

NDCC 49-22-08 lists the items that must be included in an application. Note that one is "a statement explaining the need for the facility." While the Commission cannot determine the "need" for the facility, the applicant must provide a statement of it. The Badger Wind application does not do so as it notes it has no "off-taker" and no power purchase agreement. The application has not adequately explained why the facility is needed.

NDCC 49-22-09 lists the factors the Commission is to consider in evaluating a wind farm application. Note that in subsection 1 it states that the Commission shall be guided by, but is not limited to, such factors in its consideration. That is, it can consider other matters not on this list that the Commission considers relevant. Among the items to consider are "alternatives to the proposed site which minimize adverse effects." Using existing coal facilities instead of building this wind farm certainly minimizes adverse effects.

Also, to be considered are "the direct and indirect economic impacts of the proposed facility." Operation of this new facility potentially puts the coal plants and coal mines operating in the state in further economic jeopardy. The wind farm would replace electrons coming from coal facilities given the preference for renewable power as directed by federal policies. I outlined the economic impact of lignite in North Dakota, including the number of jobs provided by the industry.

Another item that can be considered is "available research and investigations relating to the effects of...operation of the proposed facility on public health and welfare." What could be more detrimental to the public welfare than energy blackouts in the winter or even the summer?

The reduction in the reliability of deliveries of electric power may be the best argument why additional wind farms in either the SPP or MISO systems just increases the problem. MISO recently published the "MISO's Response to the Reliability Imperative."[9]

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On page 10 it states in part that the of output of wind resources can fluctuate significantly which complicates MISO's efforts to maintain system reliability. On page 12 it states that increased reliance on renewable resources has altered the region's risk profile--and that such risks occur in seasons of the year that did not pose challenges in the past. On page 13, "MISO expects reliability risks to increase going forward as the region's resource mix continues to evolve." Further, "the direction and the magnitude of the continuing fuel-mix changes that are forecast...would likely exacerbate the reliability challenges described above."

MISO knows renewables are the cause of reliability issues being experienced and that those reliability risks will increase as more renewables are added to the system. MISO acknowledges that given current state and federal policies there really is little if anything that can be done about this pressing issue and that the public will have to live with blackouts on an increasing scale as more renewables assets are brought online.

We have an opportunity here to demonstrate we will not allow North Dakota to be a part of this calamity. Wind farms such as Badger Wind with no demonstration of need can be denied. The Commission must do what it can to protect the citizens of North Dakota, it must under the power provided to it by the Siting Act protect the welfare of the public and do what it can to protect North Dakota from increased blackouts and system unreliability. If other states want to mandate renewable energy standards so be it but they accept the consequences, but North Dakota will do what it can to protect the public and the economy of the state.

The Burke Wind Project has failed to meet its burden of proof in numerous areas:

(a) the site does not "ensure continuing system reliability and integrity", rather it exacerbates the problem of reliability,

(b) that adverse effects upon the welfare of the citizens of this state will not be minimal, but major,

(c) that it has not adequately explained the "need" for the facility,

(d) that the Commission is not required to designate a site, but has the power under the Siting Act to refuse designation,

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(f) that the Commission is guided by available research and investigations, such as the MISO reliability report,

(g) that the alternative of relying on existing generation sources in North Dakota, primarily baseload coal power, is a better alternative rather than putting such existing sources at further risk,

(h) that adverse direct and indirect economic impacts of the proposed facility upon existing generation sources, and upon highly paid existing careers, greatly outweighs any positive economic benefit from the wind farm,

(i) that the MISO reliability report clearly states that increased renewable penetration is the cause of greatly increased system unreliability and blackouts, and that these will only increase over time, and that the Commission must protect the citizens of North Dakota as much as it can from this occurring here.

We are not asking you to deny this wind farm. We are not asking you to deny the injection of capital into the local community and landowners. We are not asking you to stop development.

We are asking you to not approve a plan that isn't fully developed. This plan takes away from an existing energy generation that is supported by hard working coal miners and power plant workers. We are asking you to not take away from one and give to the other, as has happened so often over the past decades.

We are asking you to not approve a plan that will reduce the reliability of the electrical grid that all North Dakotan's rely on for health, safety and quality of life. Given the extreme temperature ranges that exist within ND's seasons, it is that same reliability that allows us to sustain our way of life at winter's coldest moments.

We are asking you to ensure the coal miners and power plant workers get a chance to allow their efforts to continue and allow the grid to continue to accept those electrons. These same workers have helped the North Dakota economy become what it is today. What's ironic, and to many—insulting, is that the federal tax dollars used to fund these projects are partially coming out of these same workers' pockets.

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Difficult decisions are in front of you today, Commissioners. One of the leaders in our great state once said to me – Commissioners are tasked with choosing projects that divide neighbors with relationships that have stood the test of time for decades. Until a project like this comes into the picture. The County Planning and Zoning group, the County Commissions and the Public Service Commission have all been tasked to ensure as projects move forward, all voices are heard. That's why we stand here today. Our voice has been silent, but we won't be any longer.

Please accept this testimony for the record.

Sincerely,

Jessica K. Bell

Jessica K. Bell
Environmental Manager for Northern Operations
NACCO Natural Resources & North American Coal Corporation

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MISO'S RESPONSE TO THE RELIABILITY IMPERATIVE

- UPDATED JANUARY 2022 -

Living Document

This is a "living" report that is updated periodically as conditions evolve, and as MISO, stakeholders, and states continue to assess and respond to the Reliability Imperative.

MISO

misoenergy.org

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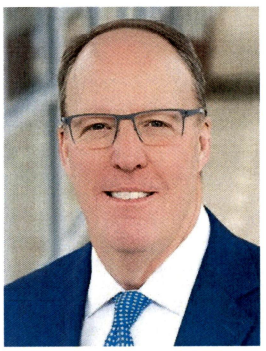


A lot has happened in the MISO Region since we published the first version of this report in late 2020. MISO has made significant progress in responding to the Reliability Imperative — the shared responsibility that MISO, our members, and the states have to address the complex and urgent challenges to electric system reliability in our region.

Despite progress we have made, we still have much to do. Our region's fleet of generating resources continues to evolve in ways that are creating new system needs that we must address, driven by factors such as utility and state policies to reduce carbon emissions.

Another driver of the Reliability Imperative that came into sharp focus in 2021 is the increasing frequency and severity of extreme weather events, which is posing additional challenges.

In the first version of this report, we introduced the four major efforts MISO is undertaking to respond to the Reliability Imperative: Market Redefinition, Long Range Transmission Planning, Operations of the Future, and Market System Enhancements. In this updated version, we discuss what we've learned throughout 2021, our accomplishments to date, and our focus areas going forward.

One clear takeaway from 2021 is that the Reliability Imperative is critical. The work we are doing is not optional — to maintain system reliability, we must respond to the unprecedented change we all face and to avoid the severe health, safety, and economic impacts of prolonged outages. This work cannot be put off for months or years — much of it has long lead times, so we need to act now. And our stakeholders are counting on us — regulatory agencies, utilities, and other entities are looking to MISO to identify problems and find solutions. We appreciate all of the collaboration from stakeholders and are counting on continued support and dialogue as we confront these challenges and opportunities together.

Thank you,



Executive Summary

INTRODUCTION

MISO is making significant progress addressing the Reliability Imperative — the shared responsibility that MISO, our members, and the states have to address the urgent and complex challenges to electric system reliability in the MISO Region.

MISO first outlined its response to the Reliability Imperative in the initial version of this report published in December 2020. This updated version highlights the progress we have made since then, new learnings and insights we have developed, additional challenges we see emerging, and our focus areas going forward.

A year after we first published the Reliability Imperative report, we can confirm the urgency of the work and our focus on the four workstreams: (1) Market Redefinition, (2) Long Range Transmission Planning, (3) Operations of the Future, and (4) Market System Enhancements.

FLEET CHANGE CONTINUES TO POSE CHALLENGES

As we discussed in the initial report, many of the challenges we face stem from the changes that are transforming the region's fleet of generating resources. To briefly recap, these challenges include:

- Declining reserve margins and fewer always-on "baseload" resources, due to retirements of thermal units.
- Aging coal resources that remain in service can be more prone to outages, rendering them potentially unavailable when they are needed most.
- Wind and solar resources are not always available to provide energy during times of need. Additionally, renewables must sometimes be curtailed due to transmission constraints.
- The growing fleet of natural gas resources may not be able to procure all the fuel they need at key times, often seasonally based, because of limitations in contractual gas services, lack of dual fuel capabilities, and reliance on a pipeline system that is shared with heating and manufacturing uses.
- The region's penetration of distribution-level and behind-the-meter resources is increasing, yet MISO does not have functional control or visibility into how these resources may affect the larger grid system.

The aggregate impact of these and other challenges has altered the region's historical summer-centric risk profile, making it more prone to grid emergencies in winter and shoulder-seasons that rarely posed risks in the past.

ADDITIONAL DRIVERS AND CHALLENGES ARE EMERGING

While fleet change challenges continue to drive MISO's response to the Reliability Imperative, several additional drivers have become evident since we published the first version of this report. They include:

More frequent and severe extreme weather events: While extreme weather has always been commonplace in the MISO Region, there is evidence that severe weather events that impact electric reliability have been increasing since the early 2010s. For example, in January 2021 the Electric Power Research Institute found that hurricanes are increasing in intensity and duration, extreme heat events are increasing in frequency and intensity, and cold events are increasing in frequency.

- Recent examples of these kinds of impacts in the MISO Region include Hurricanes Laura, Delta and Zeta in 2020, Winter Storm Uri in February 2021, and Hurricane Ida in August 2021. These events reinforced the need for MISO's work under various parts of the Reliability Imperative. For example, Winter Storm Uri illustrated the need to better weatherize generation resources, continued gas/electric coordination improvements, and to improve real-time control room decisions, all of which align with efforts MISO is pursuing under the **Operations of the Future** workstream.

- Recent extreme weather events also underscored the need for the **Long Range Transmission Planning** workstream. For example, even though the MISO Region had an adequate supply of generation during Winter Storm Uri, MISO's ability to move even more energy to specific areas was hindered by increased unplanned generation outages and derates, transmission constraints and overloaded lines, and the contractual transfer limit between the MISO South subregion and the rest of the footprint. Uri also illustrated the importance of transfer capability in moving power; robust regional and interregional transmission capacity resulted in limited impacts in MISO's North and Central Regions.

- The recognition of more frequent and severe weather events also aligns with the major efforts executed in the **Market Redefinition** workstream in 2021, wherein MISO led efforts to shift from the summer-focused Resource Adequacy construct to a new 4-season construct, which better reflects the risks in non-summer seasons. MISO submitted the proposal to the Federal Energy Regulatory Commission in late 2021, along with an accompanying proposal to align the accreditation of thermal resources to their availability in high-risk hours. MISO plans further work to continue in 2022.

Electrification of adjacent industries: While year-over-year demand for electricity in the MISO Region has been flat for many years, it is expected to increase going forward due to the electrification trends in other sectors of the economy. Electric vehicles are growing in popularity, and the residential and commercial building sectors are increasingly using electricity for heating and cooling purposes — with the desire to source this new electric load from renewables.

- In MISO's Electrification Insights April 2021 report, MISO found that electrification could transform the region's grid from a summer-peaking to a winter-peaking system, and that uncontrolled vehicle charging and daily heating and cooling load could result in two daily power peaks in nearly all months of the year.

- The four focus areas of the Reliability Imperative seek to ensure that markets, transmission, operations, and systems — all of which will be directly impacted by electrification — are ready for the coming transition.

HELPING UTILITIES AND STATES MEET THEIR GOALS

The first version of this report outlined the multiple trends that are driving the transformation of the region's resource fleet, such as consumer preferences for clean energy, changing economics, and technological advancements.

While all those trends continue to drive fleet change, perhaps the most notable and important driver is that utilities and states are increasingly adopting policies and goals that reflect and embrace consumers' preferences for clean energy. As of late 2021, for example, 17 of the region's utilities (representing approximately 80% of the region's total load) had committed to reducing their carbon emissions by at least 80% by 2040 or sooner. The federal government has also set ambitious goals to decarbonize the electric sector by 2035, the economy by 2050, and specific goals related to vehicle and building electrification.

Although MISO as an Independent System Operator does not set policy, MISO has an important role in enabling member and state policy goals. MISO uses its markets, planning processes, and operational functions to help its members achieve their policies and goals — and the Reliability Imperative provides a framework to do that.

For example, the **Long Range Transmission Planning** workstream is identifying investments in transmission solutions that will help MISO's members and states meet their ambitious carbon-reduction goals — as many promising locations to build new renewables are not currently served by transmission or otherwise experience constraints. And the **Market Redefinition** workstream will craft necessary revisions to the current market construct and develop the market products that are needed to incentivize and fairly compensate emerging technologies such as battery storage. To account for the uncertainty in policy outcomes and timing, MISO is utilizing the Futures process to model several different policy trajectories and identify least regrets actions.

STAKEHOLDER INPUT IS CRUCIAL

Much of the work cited in this report is already underway. Many of the ideas and proposals in this report reflect a great deal of technical input from stakeholders. For example:

- MISO proposals to revise the Resource Adequacy construct and to improve how resources are accredited are discussed in the Resource Adequacy Subcommittee.
- Similarly, MISO initiatives for scarcity pricing and the Market System Enhancement effort reflect input at the Market Subcommittee.
- Long Range Transmission Planning is taking place in the Planning Advisory Committee, and cost allocation discussions in the Regional Expansion Criteria and Benefits Working Group.

As we emphasized in the first version of this report, the Reliability Imperative is not intended to replace existing initiatives with which stakeholders are already familiar. Instead, it pulls together a number of strategic initiatives under a single framework for the purpose of ensuring more alignment, reinforcing the sense of urgency, and highlighting the connections among the workstreams.

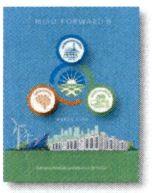
We designed this to be a "living" report that that we will continue to update as needed as conditions change, and as we learn more about how to best respond to the challenges the region faces from ongoing fleet change, extreme weather events, and other risk factors.

MISO appreciates all of the helpful feedback we have received on the Reliability Imperative, and we look forward to continuing the dialogue with our stakeholders going forward. Urgent attention and action is necessary.

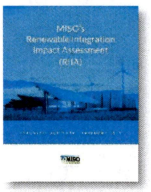


Informing and Responding to the Reliability Imperative

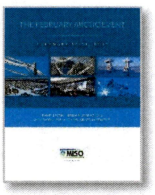
MISO's response to the Reliability Imperative has been informed by years of conversations with our stakeholders. MISO has also undertaken numerous studies to assess the region's changing risk profile and to explore how reliability is being affected by other drivers such as electrification and extreme weather events. This work includes:



MISO FORWARD: This report series, launched in 2019, identifies and assesses key trends that are reshaping the electricity sector. The inaugural FORWARD report focused on the need to enhance resource Availability, Flexibility and Visibility. The 2020 report looked at how different types of members will require different things in their interactions with MISO and the 2021 FORWARD report examined adjacent industries that are expected to exert new demands on the grid going forward. Subsequent iterations will continue to share insights informed by customer and industry interviews.

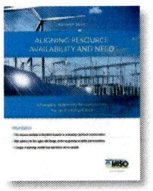


Renewable Integration Impact Assessment (RIIA): This technical study assesses the impacts of integrating increasingly higher levels of renewables into the MISO system. RIIA indicates that planning and operating the grid will become more difficult when more than 30% of the footprint-wide load is served by wind and solar. However, RIIA also indicates that renewable penetrations of 50% or higher could be reliably achieved if MISO, our members, and the states coordinate closely on the advanced actions that would be needed.

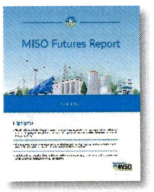


The February (2021) Arctic Event: This report discusses lessons learned from the extreme winter weather event, also referred to as Winter Storm Uri, that affected the MISO Region and other parts of the country in February 2021. MISO and its members took emergency actions during that event in order to prevent more widespread grid failures, which underscores the urgency of MISO's Reliability Imperative efforts. The February 2021 event is just one example of how extreme weather is becoming more frequent and severe in the region, and we are seeing that the impacts of these events can be further exacerbated by the changes that are transforming the region's resource mix. For these reasons, preparing for extreme weather events is a significant part of MISO's response to the Reliability Imperative.

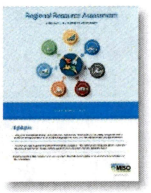
Resource Availability and Need (RAN): This initiative was launched in 2017 to address multiple reliability issues that have emerged due to the region's changing resource mix, declining reserve margins, and other factors. RAN's focus areas included improving processes for resource outages and resource accreditation, as well as transitioning from MISO's summer-focused Resource Adequacy construct to a new seasonal construct that better reflects the region's risk profile. This work is discussed in five RAN whitepapers, and the proposed solutions were filed with the Federal Energy Regulatory Commission (FERC) in 2018, 2019, and 2021. Following the late 2021 FERC filing, RAN was folded into the Market Redefinition workstream of the Reliability Imperative.



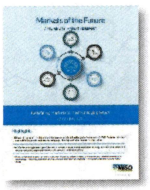
MISO Futures: A product of continued collaboration between MISO and its stakeholders, the three MISO Futures provide a set of bookends to explore a wide range of future outlooks. Updated in late 2021, these forward-looking planning scenarios are being used throughout the organization to prioritize and pace the Reliability Imperative work.



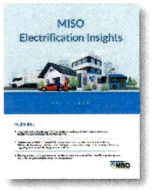
Regional Resource Assessment (RRA): The RRA is a new recurring study based on the plans and goals MISO's members have publicly announced for their generation resources. The RRA aggregates these plans and goals — many of which seek to reduce carbon emissions — and uses them to develop an indicative view of how the region's resource mix might evolve going forward in order to meet utilities' stated objectives. The view the RRA produces is designed to help MISO, our members, and state regulatory agencies to better plan and operate the system in a reliable, cost-effective manner.



Markets of the Future: This report illustrates how and when MISO's existing market structures will need to evolve in order to accommodate the profound changes that are occurring in the energy sector. The report presents a timeline of reliability needs that aims to answer the question: "What will be needed and by when?" The needs are presented in four broad categories: (1) Uncertainty and Variability; (2) Resource Models and Capabilities; (3) Location; and (4) Coordination. The report also outlines a transparent path forward for market solutions that anticipate and meet the changing needs.



Electrification Insights: This report explores the challenges and opportunities the grid could face from the growth of electric vehicles and the increasing electrification of other sectors of the economy, such as residential and commercial buildings. Among other things, the report indicates that electrification could transform the grid in the MISO Region from a summer-peaking to a winter-peaking system, and that uncontrolled vehicle charging and daily heating and cooling load could result in two daily power peaks in nearly all months of the year. These and other implications of electrification are addressed through the efforts that MISO is mounting under the Reliability Imperative.



From this groundwork, we know there are many challenges ahead. But we also believe we can respond to the Reliability Imperative in a manner that enables our members to achieve their plans and goals — such as increasing their use of renewables or reducing their carbon emissions. We are determined to do the hard work required to ensure all of our members and their end-consumers benefit from MISO membership.



Current Reliability Challenges Will Become More Significant, and New Ones Will Emerge

Many utilities and states in the MISO Region have announced ambitious plans and goals to reduce some or all of their carbon emissions by some future date. There is also discussion at the national level about how to decarbonize the electric sector and the economy as a whole. So naturally, there's much discussion about what the "end state" of the region's electrical system would look like if these plans and goals are realized.

While MISO also cares about the eventual end state, we are currently focused on — and concerned about — the ***transition*** that is required to achieve a lower-carbon or zero-carbon end state, because this transition may cause reliability challenges as we learn how to accommodate new resource types and as a large portion of today's generation fleet retires.

Chief among these risks is the region's declining levels of generation capacity and reserves. Today, MISO operates with less excess capacity than in the past because MISO's large footprint has facilitated the sharing of reserve capacity, a direct benefit to customer rates. Nevertheless, many thermal resources have recently retired from service due to economic, regulatory, and environmental pressures, and the aging thermal assets that remain in service may be more prone to unplanned outages and face supply chain issues. While MISO believes it is certainly possible to reliably operate the system with substantially lower levels of thermal resources, we need to ensure that the resources that replace them provide the commensurate capabilities needed to ensure reliable operations. Historically MISO has depended on some of the capabilities that are bundled in thermal generation — such as dispatchable flexibility and inertia — but which are not inherently part of wind or solar generation. Our markets can and will adapt to require, incent, and/or procure those capabilities, but developing those new market mechanisms will take time and stakeholder collaboration, as discussed more in the Market Redefinition section.

The transition to a lower/no-carbon end state also poses risks in the realm of fuel assurance. As the electric generation and fuel industries anticipate the changing fleet composition, there has been contraction in the coal industry. An expansion of renewable and energy storage resources is needed and underway, but during the transition to that new fleet, MISO has concerns about the fuel assurance related to conventional generators providing flexibility and reliability to the system.

- Coal resources have historically been considered very fuel-assure because large stockpiles of fuel can be stored on-site. However, as this report was being developed in late 2021, there were indications that coal supplies were tightening due to a confluence of factors, including contraction of the mining and transportation sectors and supply chain issues related to the COVID-19 pandemic. Additionally, natural gas prices increased significantly going into the winter of 2021-22, which in some instances made coal resources more



economic to dispatch than gas. These factors have combined to increase the risk that a coal plant will be dispatched but will be unable to perform due to fuel availability.[1] Beyond these factors, coal resources have occasionally experienced fuel-assurance issues in the past due to extreme winter weather freezing onsite coal inventories and/or impacting coal-handling equipment.

- Natural gas resources are also subject to fuel-assurance risks because they typically rely on pipelines to deliver gas to them when they need it. However, because the gas pipeline system was largely built for home-heating and manufacturing purposes, situations sometimes arise when gas power plants cannot procure all the fuel they need due to contractual issues related to delivery priorities. In the MISO Region, this has historically occurred during extreme winter weather events that drive up home-heating needs for gas. Typically, many gas generating resources do not have "firm" fuel-delivery contracts, opting instead for less costly "interruptible" pipeline service or a blend thereof.[2]

- Additionally, natural gas power plants, gas pipelines, and coal generators can be forced out of service by icing and other effects of severe winter weather — as occurred in the MISO Region and elsewhere during the February 2021 Arctic event.

MISO has implemented a variety of tools and processes to develop situational awareness around and mitigate fuel assurance-related reliability issues, such as engaging in direct communications with generation and pipeline operators, and using real-time mapping tools and other means to increase situational awareness of potential problems.

Fuel availability is also a challenge for wind resources, as the graphic below illustrates. The energy output of wind resources can fluctuate significantly on a day-to-day and even an hour-by-hour basis, which complicates MISO's efforts to maintain system reliability. Additionally, when wind output is high, congestion on the transmission system may require MISO to curtail, or turn off, wind resources that could otherwise provide energy. The chart below illustrates how wind output in the region varied significantly in the fall of 2020. The orange areas show instances when high wind output had to be curtailed.

Another trend associated with the changing resource mix is that the region has become reliant on a category of resources that MISO can only access in emergencies. These assets, known as Load Modifying Resources (LMRs), comprise a significant portion of the resources that MISO members currently use to satisfy their Resource Adequacy Requirements.

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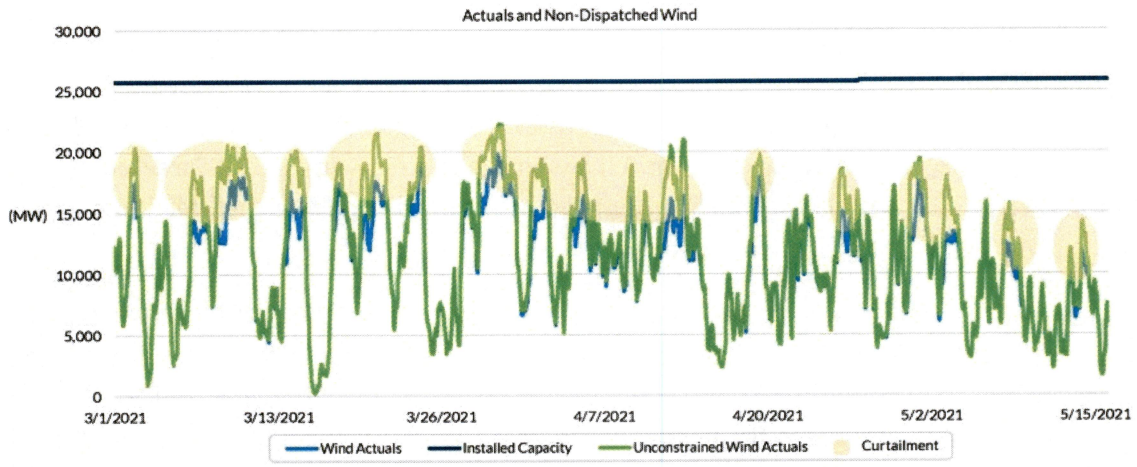
[1] About 11 GW of coal capacity (approximately 20% of the region's total coal capacity) reported being at high risk of experiencing coal supply issues in the 2021-2022 winter season, according to survey responses. See MISO Reliability Subcommittee, December 2021.

[2] Less than 25% of the gas generation that responded to MISO's 2021-2022 Generator Winterization Survey indicated it had firm transport contracts in place for all of their supplies during the 2021-2022 winter season. See MISO Reliability Subcommittee, October 2021.

Recent examples of MISO wind generation variability and curtailment



The use of LMRs increased markedly in 2016, when the region's reserve margins began declining due to a combination of factors, including environmental regulation and economic considerations, among other things. Since then, LMRs (including Demand Resources and Behind the Meter Generation) have consistently comprised a little more than 8% of the total resources that have cleared MISO's annual Planning Resource Auction.

Under the MISO Tariff, MISO can only access LMRs to curtail or offset load by progressing through the steps of its emergency operating procedures and formally declaring a grid emergency. The Tariff also limits MISO's use of LMRs in other ways, such as capping how many times a year MISO can call them and requiring MISO to provide certain amounts of lead time before LMRs are expected to perform. Historically, some LMRs were afforded up to 12 hours of lead time before they were expected to perform, but under a MISO initiative that was approved by FERC in August 2020, the lead time for LMRs will be reduced to six hours or less, with 50% accreditation for LMRs with notice time greater than 6 hours in the Planning Year 2022/23 and disqualification beginning with MISO's 2023/24 Planning Year.

Emergency-only use of LMRs is a long-established planning practice in the utility industry. However, as the region's resource fleet continues to evolve and reserve margins continue to tighten, MISO is increasingly dependent on the successful deployment of LMRs to ensure capacity sufficiency. More frequent use of LMRs can result in a host of sub-optimal outcomes. For example, MISO may not be able to access LMRs in time to mitigate rapidly evolving system conditions. Even when LMRs attempt to respond in time, the performance of LMRs may fall short of what they were accredited for.

The long lead times of some LMRs can also require MISO operators to make difficult decisions. If operators do not make a required emergency declaration ahead of time, they risk not having the LMRs needed to meet obligations. If they do make a declaration and dispatch LMRs, they may create uplift and reduce the efficiency of market outcomes in pursuit of reliability. Lastly, given the

limited number of annual LMR calls per the MISO Tariff, a decision to call an LMR that is ultimately unneeded reduces the availability of that resource in future periods.

MISO has already made several improvements related to LMRs in recent years, such as enhancing LMR participation in MISO's markets, implementing testing requirements to ensure that LMRs can actually curtail firm load, and improving how LMRs are accredited. MISO has also recently implemented improvements to emergency pricing which is in effect when LMRs are deployed. MISO intends to pursue additional improvements going forward as part of the Reliability Imperative's Market Redefinition workstream.

In sum, trends such as thermal retirements and lower excess reserve margins, increasing reliance on LMRs, and the region's increasing reliance on gas and renewable resources have altered the region's risk profile — meaning the region now faces risks in seasons of the year and hours of the day that did not pose challenges in the past. A key indicator of this is the 41 MaxGen emergencies that MISO has had to declare since the summer of 2016. While the emergency protocols are a legitimate way for MISO to access additional resources, relying on such protocols much more frequently and in non-traditional times are evidence of MISO's changing risk profile.

MaxGen Alerts, Warnings, and Events

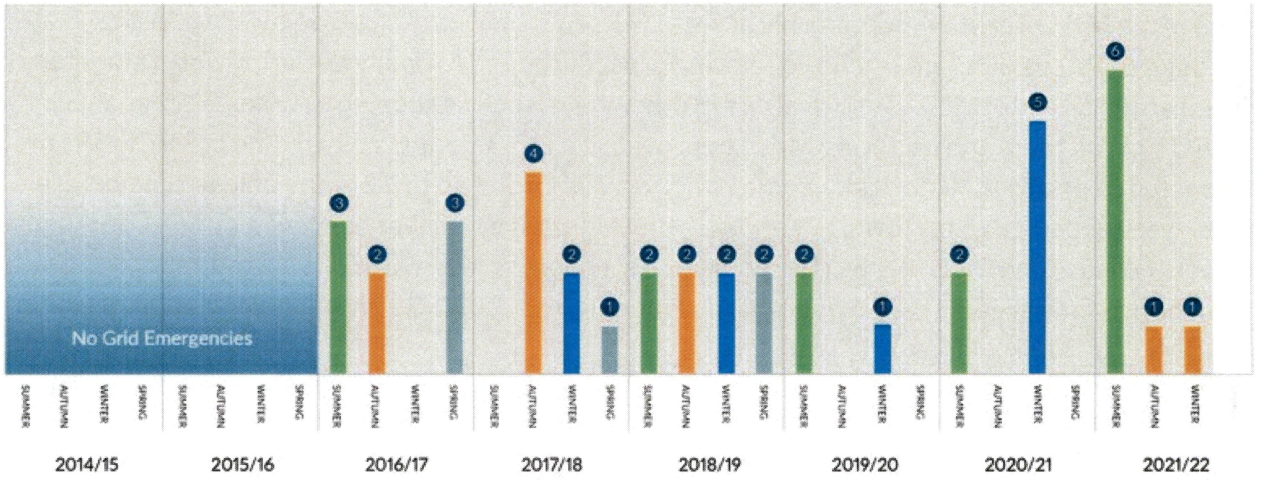
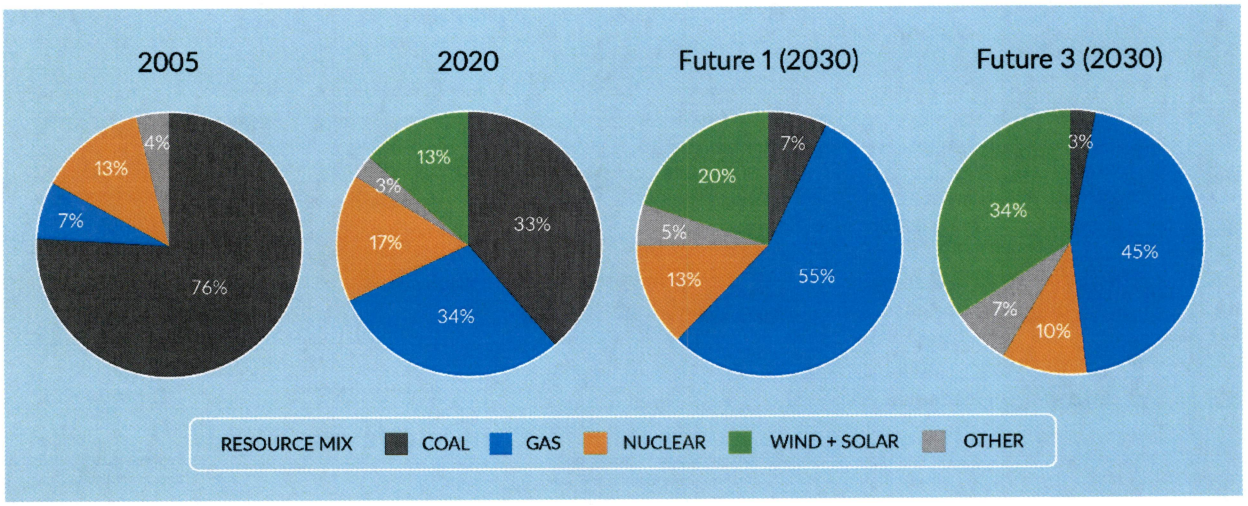


Chart indicates the number of days under a max gen alert, warning or event.

MISO expects reliability risks to increase going forward as the region's resource mix continues to evolve. The figure below shows two scenarios of what the region's resource mix could potentially look like in 2030. These scenarios are based on MISO's forward-looking Futures, which use a range of economic, policy, and technological assumptions to create plausible "bookend" views of what the region's resource mix could look like in 20 years. MISO uses the Futures to inform the development of transmission plans, including those under the Reliability Imperative's Long Range Transmission Planning workstream.

Future 1 is the more "conservative" of these two Futures, as it assumes that state and utility decarbonization/renewable energy goals that are not legislated or otherwise binding are achieved at only 85% of their aspirational targets. Nevertheless, the direction and the magnitude of the continuing fuel-mix changes that are forecast in Future 1 would likely exacerbate the reliability challenges described above. Future 3 pictured above is even more aggressive in terms of forecasted thermal retirements and incorporating additional renewables, so this path would also foster additional reliability challenges. For a detailed look at the reliability challenges that could manifest as additional renewables are incorporated the system, see MISO's Renewable Integration Impact Assessment.

MISO Generation Mix (% of total annual energy by fuel type)



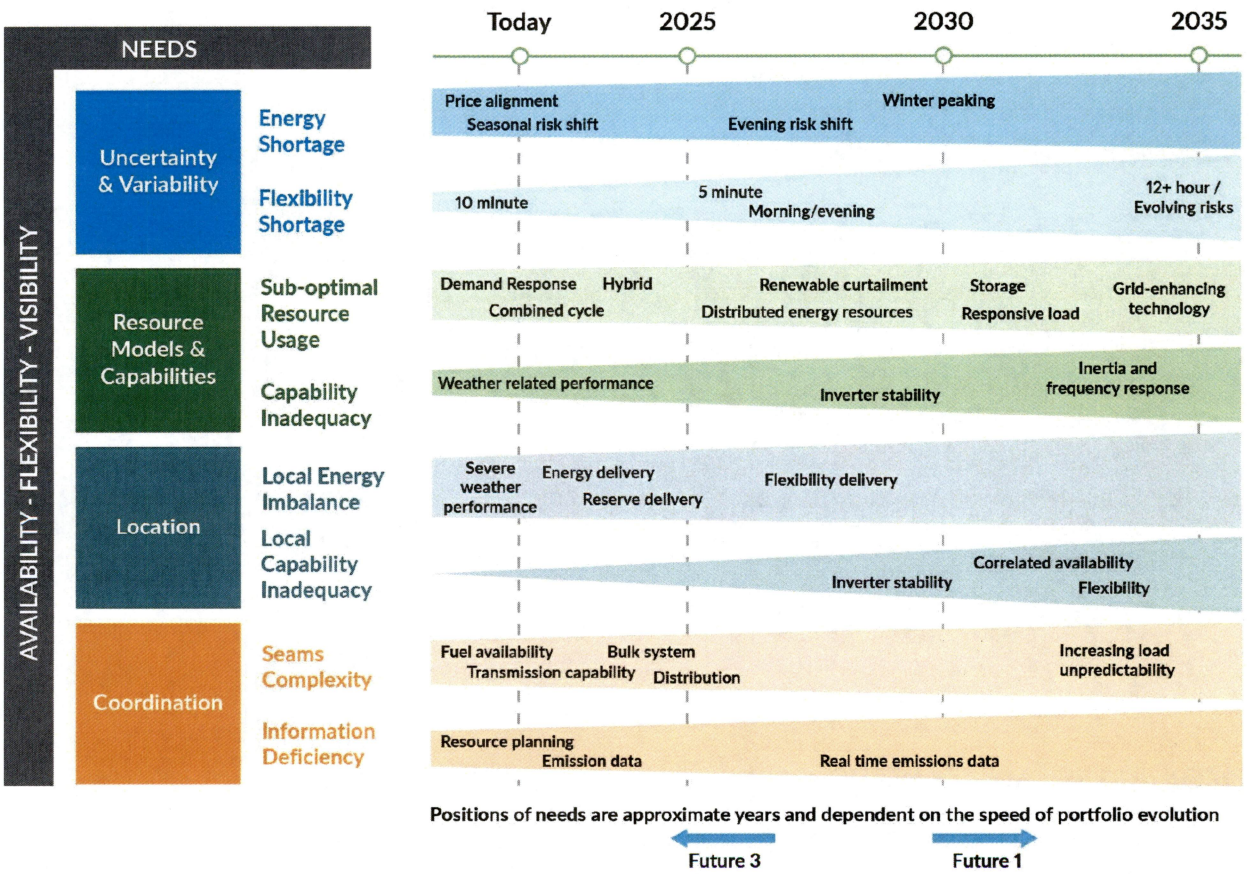
EMERGING RELIABILITY NEEDS

MISO has distilled the system's emerging and shifting reliability needs into four categories: **Uncertainty and Variability** considers new and growing risks, spotlighting energy and flexibility shortages; **Resource Models and Capabilities** considers the optimal use of resources and their inherent capabilities; **Location** examines regional differences and transmission limitations; and **Coordination** explores complexity along the seams (bulk power system *and* transmission-distribution) and information needs to enhance collaboration and shared visibility.

"We see very little risk of over-building the transmission system; the real risk is in a scenario where we have underbuilt the system. Similarly, across markets and operations, our job is to be prepared."

Clair Moeller, MISO President

Having gathered insights from MISO's modeling, Futures analyses, operational experience, and customer conversations, MISO's 2021 *Markets of the Future report* put forward a comprehensive view and sequencing of emerging and shifting needs. The growing risks illustrated in the figure below serve as a guidepost for the Reliability Imperative work, informing priority and pace. Efficient risk mitigation requires a coordinated response from markets, operations, and technology workstreams.

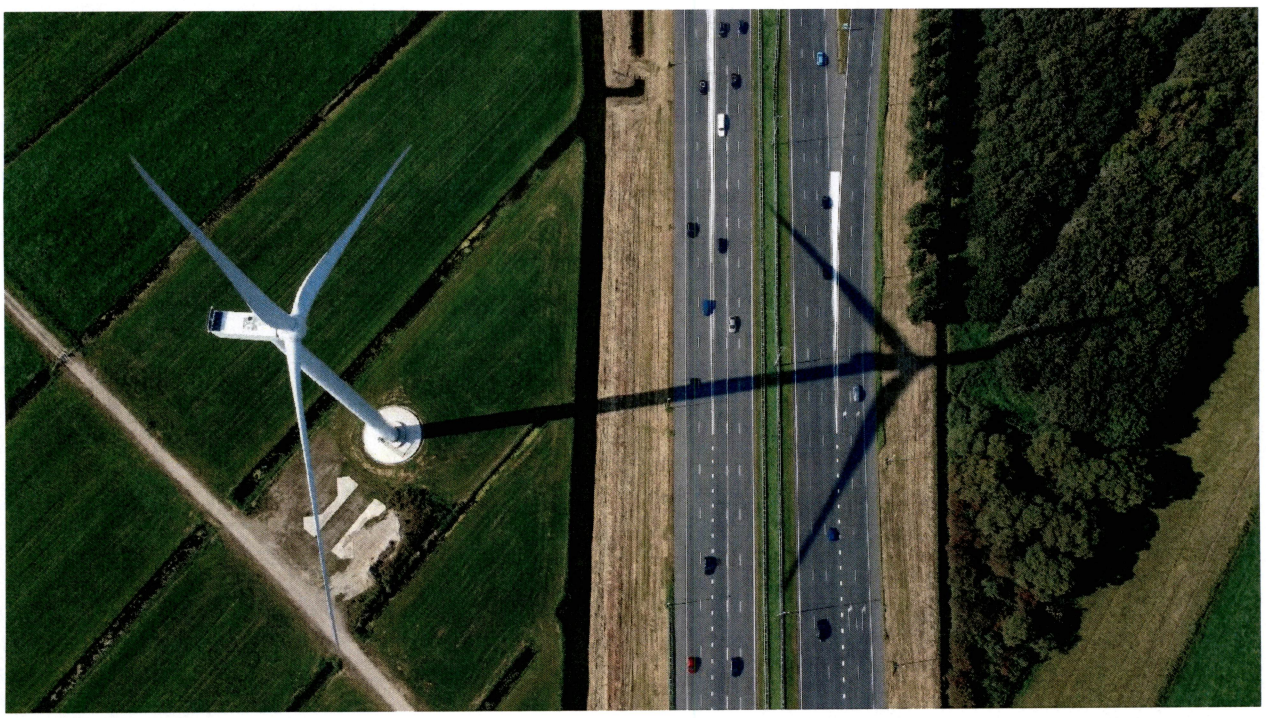


This figure shows future needs by category and estimated timing of emergence or significant shift in need for the region. Detailed descriptions of each need can be found in the Markets of the Future report. Expanding colors are illustrative of relative size of aggregated category risk over time. Future arrows indicate potential shift in timing depending on the pace of change.

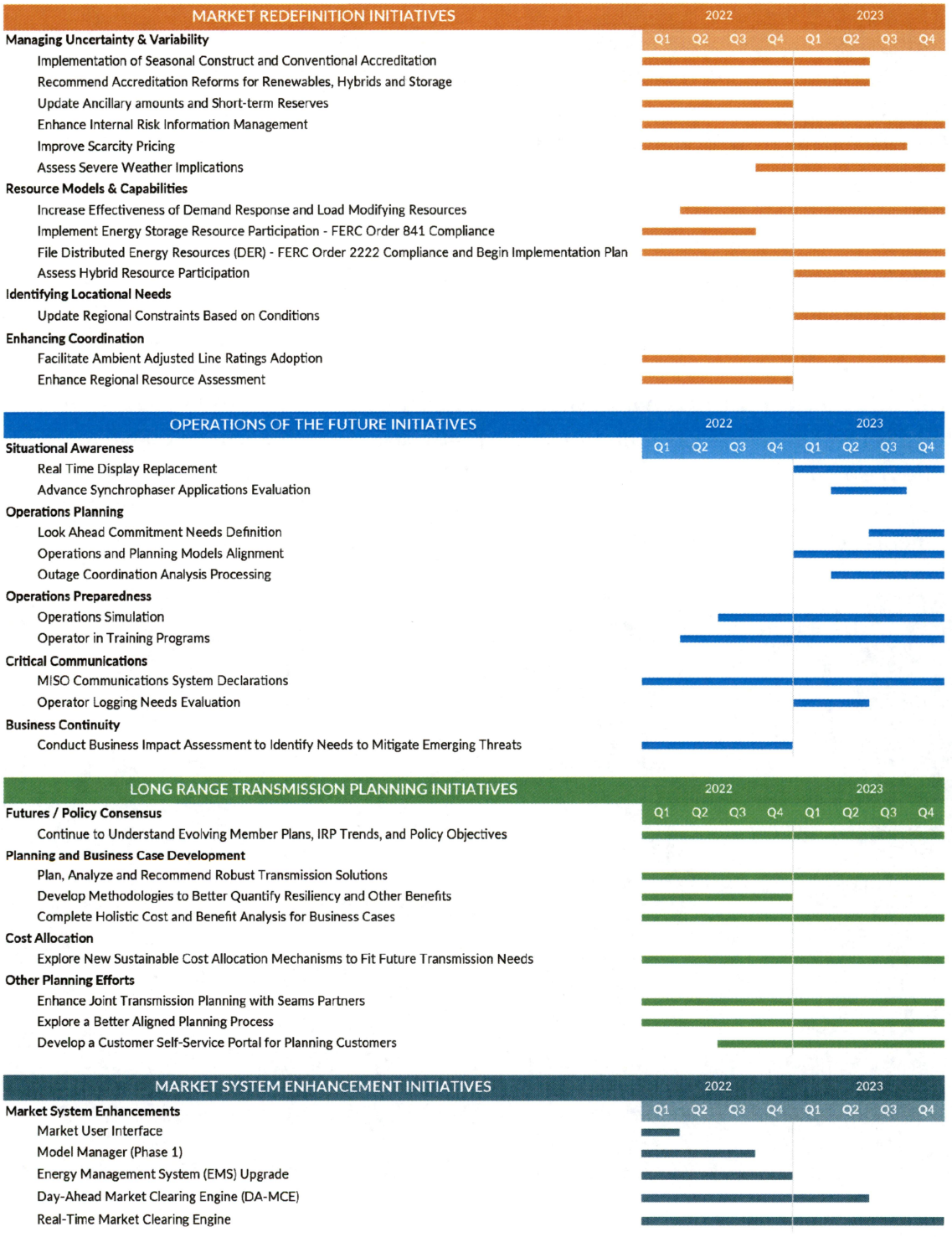
MISO Roadmap

Increasing risks and challenges require MISO to act with more urgency. In response, MISO in early 2022 evolved what had been called the Integrated Roadmap into the MISO Roadmap. As illustrated on the following page, the MISO Roadmap lays out MISO's strategic priorities and MISO's view on the path forward to address the urgent challenges we face. It resides on MISO's public website, providing a user-friendly and transparent way for stakeholders to learn about and stay apprised of MISO's strategic priorities. The items on the roadmap will be collaboratively undertaken in the Stakeholder Process, and MISO's attention and resources across those forums will be primarily allocated to those efforts. Where available, the MISO Roadmap links directly to additional detailed materials on MISO's priorities, including the venue, process, and timing for stakeholders to engage in these topics through the formal Stakeholder Process.

The MISO Roadmap focuses on what MISO considers to be most urgently needed to ensure that we reliably meet members' plans and goals. Currently, the MISO Roadmap is dominated by priorities related to the Reliability Imperative, and the MISO Roadmap will be a living document that is updated as new priorities and challenges emerge and as we get more clarity on the implementation plans of the initiatives.



--- MISO Roadmap ---



The MISO Roadmap is a living document that will be revised as necessary to reflect MISO's strategic priorities and timelines.

In addition, for your convenience the document will include links to additional information contained in the MISO Dashboard (previously known as the Issue Tracking Tool). The work to update the Dashboard and links is currently underway, and the functionality will be evolving through the late-February timeframe. We appreciate your patience and understanding as we work to ensure the continued ability to track key work efforts.

CONNECTIONS BETWEEN PRIORITIES AND WORKSTREAMS

MISO's strategic priorities, such as those embodied in the Reliability Imperative's workstreams, are connected and build upon each other. Success in one area depends on progress in another, so efforts must be coordinated and sequenced. For example, achieving reliable and economically efficient grid operations requires both new tools and processes being developed under the Operations of the Future workstream, and market enhancements being developed under the Market Redefinition workstream. Similarly, the ability to interconnect renewable resources may be constrained by the existing transmission system, and is therefore dependent on some of the changes being contemplated in the Long Range Transmission Planning workstream.

By documenting our future vision in this report, and outlining next steps across the four main workstreams, MISO is conducting an important dialogue about how to prioritize different work efforts. As we continue to update this "living" document, we believe the Reliability Imperative will note dependencies and impacts of any future schedule changes. MISO plans to continue the dialogue by updating stakeholder committees regularly on the Reliability Imperative.



Market Redefinition

The transformation of the generation mix increases the complexity of ensuring sufficient resources during the highest risk periods across the year. MISO is addressing this changing risk profile across markets, planning, and future-looking studies. As the generation mix changes, it is important for MISO to provide signals about what will be needed to ensure reliability, and to give the right price incentives when the system is in need. MISO's analysis in the Markets of the Future report shows that the foundational market constructs in place today will continue to be effective in the future, but only with significant market and operational enhancements and optimizations.

Resource Assessments: In the investment and planning timeframe, MISO is looking to provide information to members about the impact of their individual plans in aggregate. Today, planning is focused on the summer peak hour for the coming year or two. The Resource Adequacy survey that MISO conducts in partnership with the Organization of MISO States (OMS) looks several years ahead, but confidence is lower in the later years. Additionally, the OMS-MISO Survey only focuses on capacity, but increasingly the system will need a forecast of flexibility and other attributes. MISO is developing the ability to provide forward resource assessments and long-term Resource Adequacy reports to better inform future investment and retirement decisions.

- In 2021, MISO published the first iteration of the *Regional Resource Assessment (RRA)* by aggregating publicly announced utility plans and goals to develop an indicative view of regional fleet evolution and model what new reliability needs and gaps may arise.
- Next up: Customer engagement, surveying, and workshops planned for this year aim to improve the accuracy and broaden the application of the next iteration of the RRA. MISO will continue to look for ways to streamline processes for collecting and sharing data for purposes of the RRA and other assessments. Additionally, MISO will explore ways to assess and incorporate severe weather risk into its assessments.

Resource Adequacy Construct: In the planning horizon, MISO is looking to better reflect the changing risk profile and send correct market signals for forward-looking investments. MISO's existing Resource Adequacy Construct was designed for a conventional fleet of resources, where reliability risk was concentrated during the typical summer peak periods. Since the early 2000s, the fleet has moved to more renewable resources that are variable and more uncertain. As the generation mix further diversifies, the "accreditation" process of evaluating each generator's contribution to the system is a key reliability and planning mechanism.

- In late 2021, MISO filed proposed Resource Adequacy reforms with FERC, which are currently pending review. MISO's proposal includes three primary objectives: (1) to change from the current annual summer-based construct to four distinct seasons, (2) to align thermal resource accreditation with availability in the highest risk periods, and (3) to

require at least 50% of capacity to be secured for each Load Serving Entity prior to the Planning Resource Auction.

- Next up: Accreditation for non-thermal resources will be a focus in the coming year, including wind, solar, battery storage, hybrid generators, and Load Modifying Resources.

Energy Market Pricing and Products: MISO will continue to evaluate the changing risk profile to assess the effectiveness of energy market pricing and products and will explore potential new products and approaches.

- MISO successfully launched the Short-Term Reserve (STR) product in December 2021. This new ancillary service, which is included in both the Day-Ahead and the Real-Time Market, co-optimizes all Energy and Operating Reserves products. The STR product provides reserved and rampable 30-minute capacity, and adds needed flexibility to help manage uncertainty on the system.

- MISO's proposed reforms to emergency pricing and initial reforms to scarcity pricing were accepted by FERC and implemented in 2021. The reforms better align prices during emergencies and tight operating conditions with underlying system risk and provide more effective price signals to help incent resource availability.

- Additionally, MISO increased the Up Ramp Capability requirement by 500 MW to address the trend of increasing operating reserve scarcity by adjusting the 'uncertainty component' that is included in the requirement's formula.

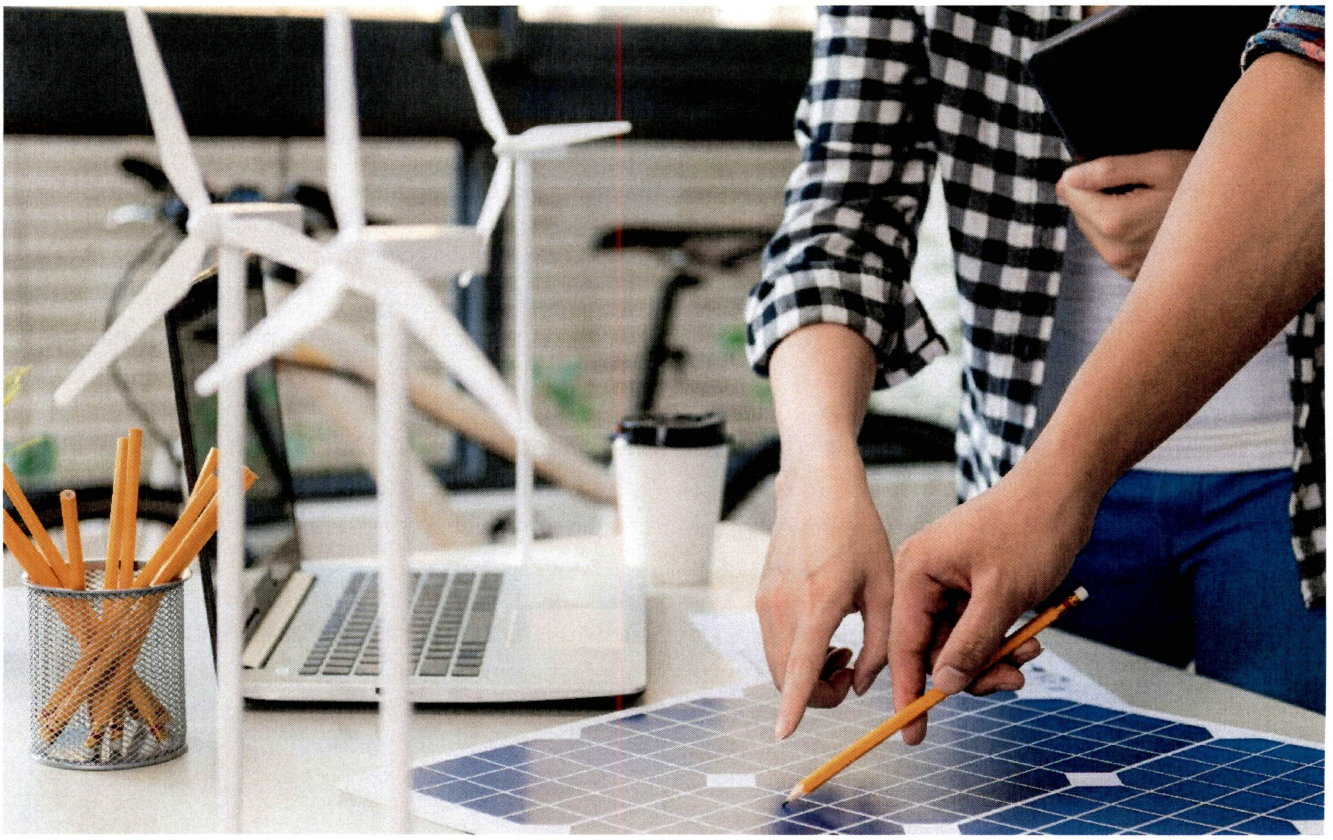
- Next up: Continued evaluation of scarcity pricing reforms, including possible reforms to reserve demand curves, the Value of Lost Load, and the Locational Marginal Pricing price cap. Continued evaluation of dynamic reserve requirements to help manage increasing uncertainty.

Resource Participation Models and Capabilities: Enhancements to MISO's suite of resource participation models are needed to realize the full advantages of increasingly complex resource capabilities. Work to enhance existing products and design new market products is an ongoing Market Redefinition priority.

- In 2021, MISO made enhancements to the Multi-Day Operating Margin forecast that included more granular wind and solar forecast information, emergency capacity forecasts, and sub-regional breakouts (North, Central, South), improving situational awareness for market participants and operators.

- Next up: MISO is working toward a June 2022 implementation date for the new Electric Storage Resource participation model that recognizes the unique characteristics of this resource type. Additionally, MISO will submit its compliance filing to FERC regarding Distributed Energy Resources (DERs) by April 2022. Further, discussion of enabling Storage As Transmission-Only Assets (SATOAs) to provide market services will continue in the Market Subcommittee.

> "Meeting the objectives of market redefinition will require a longer-term strategy, improved transparency, and sustained engagement from the MISO stakeholder community."
>
> Richard Doying, MISO EVP Market & Grid Strategy



Long Range Transmission Planning

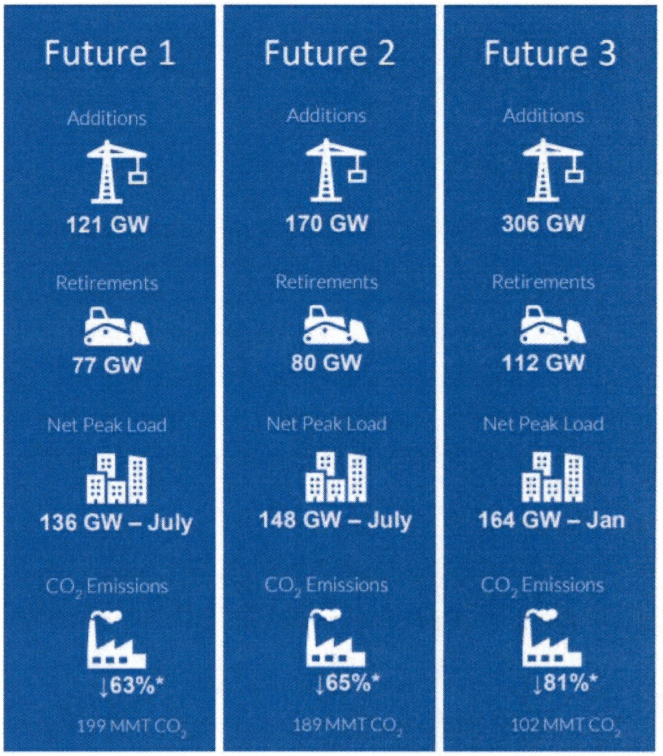
The ongoing trend of conventional power plants retiring from service as intermittent renewables continue to grow is posing significant challenges to the reliability of the transmission system in the MISO Region. MISO's Long Range Transmission Planning (LRTP) initiative is designed to address these challenges, in concert with other elements of the Reliability Imperative framework.

One focus of LRTP is to improve the transfer capability of the region's transmission system — meaning the system's ability to effectively and efficiently move energy from where it is generated to where it is needed. The need for improved transfer capability is underscored by two major trends that are playing out across the region. The first is that the best sites to build new renewable generation may be located far from existing transmission infrastructure and load centers. The second is that extreme weather events are becoming more frequent and severe in the MISO Region. For example, the Arctic Weather Event that impacted the MISO Region and other parts of the country in February 2021 showed the crucial need for a robust, "backbone" regional transmission system to move power from where it is generated to where it is needed.

Fortunately, MISO can leverage its large geographic footprint and diversity of resources to ease some of these challenges. One of the keys will be transmission infrastructure that supports these new resources and enhances transfer capability in the region. LRTP is designed to assess the region's future transmission needs in concert with utility and state plans for future generation resources.

Another focus of LRTP relates to maintaining grid stability. The U.S. transmission system is designed to operate at a frequency of 60 hertz. Historically, conventional power plants have played a key role in keeping the grid stable at that level because they have heavy rotating components that are synchronized to spin at the same frequency as the grid. This rotational kinetic energy, or inertia, helps stabilize the grid when a system failure, or contingency, occurs. The new wind, solar, and battery resources that are increasingly being built in the region, however, do not inherently provide rotational inertia in the traditional sense. It is possible for these new resource types to provide the same capabilities, but ensuring that they do will require changes to transmission specifications and compensation mechanisms. More details on how MISO is addressing this and other challenges are available in MISO's Renewable Integration Impact Assessment (RIIA) study.

It is important to keep in mind that LRTP does not replace other transmission-planning efforts that have long existed at MISO, such as the annual studies already contained in the MISO Transmission Expansion Plan, or MTEP. LRTP coordinates closely with those efforts, and it is also part of the transparent and cooperative MISO Stakeholder Process. This LRTP effort is most analogous to MISO's previous work on the Multi-Value Project (MVP) portfolio, as both are policy-driven. MISO's Board of Directors approved the 17 projects that comprised the MVP portfolio in 2011.



Futures / Policy Consensus: MISO's LRTP work is driven by changing policy and evolving resource fleet trends discussed earlier in this report. LRTP is grounded in the three robust future scenarios updated over the past year. MISO's LRTP efforts will prioritize meeting the reliability challenges embedded in Future 1, while ensuring that outcomes do not foreclose Futures 2 and 3. Future 1 tries to reflect current MISO member plans across the footprint and various policy objectives of the states. Futures 2 and 3 reflect increasing levels of electrification (e.g., more electric vehicles) and renewables.

LRTP is a comprehensive "transmission roadmap" that will identify and drive investments in transmission projects addressing all needs of the region as the resource fleet continues to evolve. In addition to identifying solutions needed to reliably operate a system with significantly more renewable resources, we are also considering other current challenges. This includes the opportunity to enhance renewable integration in the upper Midwest, as the MVPs have become fully subscribed; addressing import/export limitations in Michigan and other areas; increasing the transfer capability across North and Central MISO and between the Central and South Regions; and other policy and reliability-driven issues.

We expect projects to be approved in tranches, with the first and second tranches focused on the North and Central portions of the footprint, while the third tranche is focused on the South subregion, and the fourth on the North/South subregion interface. The roadmap will be updated as needed to align with evolving resource fleets and business plans, state energy/environmental policies and other dynamic factors that affect the region's transmission needs. As solutions are identified through LRTP, they will be moved into the ongoing MTEP process for final approval by MISO management and Board of Directors. MISO anticipates delivering the first round of suggested LRTP solutions to the Board of Directors in June 2022.

Business Case Development: MISO is developing robust business cases for LRTP projects by analyzing multiple benefits relative to the costs and building on the methodologies developed for the 2011 MVP portfolio. The business cases will reflect the need for transmission to ensure reliability of the system, in addition to any economic benefits, given the policy and fleet transition objectives of MISO members and states. This includes helping stakeholders consider both generation and transmission costs and benefits on a holistic basis, including the value of flexibility that transmission provides. Additionally, MISO is looking at how to quantify the resiliency benefits associated with the LRTP portfolio of projects.

Cost Allocation: A key aspect of LRTP will be to ensure that the costs of new transmission projects are allocated fairly. Within the MISO Stakeholder Process, the primary forum for this important work is the Regional Expansion Criteria and Benefits Working Group (RECBWG), which was established to discuss existing or proposed criteria and cost allocation policies for regional and interregional cost-shared transmission projects. OMS has a working group that focuses specifically on transmission cost allocation issues and has also been engaged in the RECBWG. MISO is committed to continuing to work with its stakeholders on cost-allocation issues in both of these forums.

MISO has put forward a proposal to utilize the MVP methodology in a bifurcated manner that recognizes subregional differences of MISO South and MISO North and Central regions to ensure a roughly commensurate "beneficiaries pay" cost allocation where costs are roughly commensurate with benefits. The MISO proposal also includes commitments for future studies of benefits associated later tranches and to maintain and preserve future options.

> "If you love renewables, you'd better love transmission."
>
> John Bear, MISO Chief Executive Officer

Other Planning Efforts: In addition to the significant work specifically associated with the LRTP study and the normal annual MTEP processes, MISO is also engaged in other transmission planning-related efforts. In parallel to the LRTP we have partnered with the Southwest Power Pool (SPP) on a joint targeted study to identify transmission enhancements required to enable the interconnection of low-cost resources along the seam, where the transmission system is currently at its capacity. A cost allocation framework to equitably allocate the cost of the portfolio of projects to both Regional Transmission Organizations is currently under development.

This joint study is an example of the work we have done, and will continue to undertake, to enhance our planning with all of our seams partners. Process improvement work is also internally focused. We are exploring the potential to better integrate the different aspects of our value-based transmission planning process. One example of the results of this work would be the ability to assess the potential market efficiency benefits of Generator Interconnection Projects to factor into the business case.

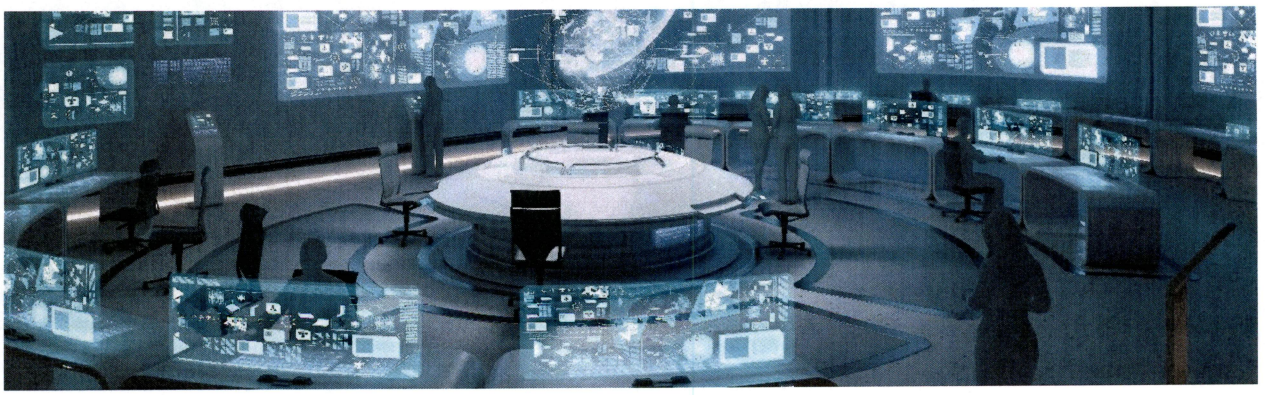


Operations of the Future

MISO Operations will also be challenged by the different types of resources connecting to the grid including at the residential level, and the increased frequency and severity of extreme weather events that we have experienced in recent years. In addition to implementing lessons-learned from past events, like the 2021 Arctic Event and hurricanes, forward-looking work is underway to ensure that MISO has the people skills, processes, and technology to anticipate and respond to operational opportunities and challenges. This work, termed Operations of the Future, is focused on five large buckets of work: (1) situational awareness, (2) operations preparedness, (3) critical communications, (4) operations planning, and (5) business continuity.

Situational awareness can be improved to turn data into actions. The shift to more weather-dependent, intermittent renewables and distributed resources means that system peaks and operating risks are becoming less predictable and more difficult to manage in day-to-day operations. Today, MISO Operations relies heavily on the expertise of its operators. While operators have access to significant amounts of data (e.g., weather, load), they must manually synthesize data into useable information. This has worked well historically, but as the system changes the solution must envision a future with more complex information and less experienced operators. In the future, MISO Operations needs an integrated toolset for operators that leverages artificial intelligence and machine learning, combined with enhanced data such as Ambient Adjusted Ratings, to provide improved information on system status and capabilities. Techniques to improve how we see and navigate will give operators important information automatically.

Operations preparedness is critical to manage rapidly shifting or challenging operating conditions. Tomorrow's control room will be very different from today's. In the future, system operators will face more rapidly changing system conditions, increased volumes of data, and enhanced technologies and tools. To ensure that control room personnel are ready to manage reliability effectively and efficiently in this new and continually evolving operations environment, MISO is developing improved operations simulations tools and enhancing operator training.

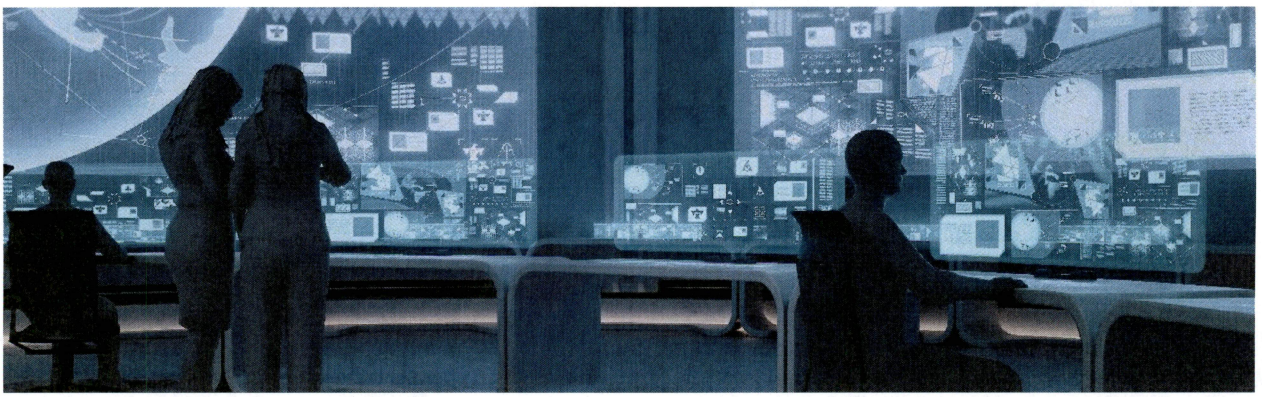


Critical communications will become even more important with the enhanced capabilities and complex operating environment of the future. New control room technologies and capabilities, improved real-time data capabilities, and more complex operating conditions driven by new load and generation patterns will require MISO and its members to communicate even more quickly and efficiently going forward. Enhancements to communications protocols, such as system declarations, are important steps to ensure that MISO and member controls room have the information they need when the need it.

> "In the past, predicting load and generation were relatively straight-forward. In the future, the operating environment will be much more variable, and we need the people, processes, and technology to deal with that variability."
>
> Jennifer Curran, MISO VP System Planning and Chief Compliance Officer

Operations planning enables MISO to remain a step ahead of the shifting energy landscape. System operators need insights into the future and processes that enable the continued reliable and efficient operation of the bulk electric system. In the future, it will be more important than ever to leverage information in new ways, including aligning operations and planning models and improving outage coordination analysis processing capabilities.

Business continuity capabilities need to evolve to align with the changing technologies, resource portfolio, and threat landscape. Improved tools and updated processes are vital to ensuring that MISO can reliably operate the grid, mitigate risks, and, if necessary, recover quickly in the event of disruptions to toolsets or control centers.



Market System Enhancements

MISO's ability to respond to the Reliability Imperative is enabled through continued market system enhancements and modeling refinements. Current systems and technology are not capable of meeting many of the new, reliability-driven market improvements and fully leveraging new resources such as Storage and Distributed Energy Resources. The Market System Enhancement (MSE) Program was initiated in 2017 to transform our current market platform into a more flexible and secure system that will better accommodate the region's evolving portfolio and technology changes while helping to ensure security and reliability for the electricity grid of the future.

The program remains focused on building and launching new systems with improved performance, security, and architectural modularity, which enhances our ability to deliver new market products more quickly and efficiently. In 2021, the program implemented several external-facing products. These products included Model Manager Phase 1, which transforms how we model the electrical system; the Market User Interface, which updated our interface for stakeholders to participate in the market; and a Short-Term Reserve market product, which is an additional Ancillary Services Market product that improves the procurement and market signals for flexible energy resources for meeting customer demand.

> "MISO's Market System Enhancement Program is transforming our technology, processes, and people skills to enable faster adoption of new technologies into the market and better accommodate the region's rapidly changing resource mix to ensure reliable and efficient operations for our customers."
>
> Todd Ramey, MISO VP and Chief Digital Officer



Building on the MSE Program's progress, flexible design, data analytics, and model management will help MISO to meet the Reliability Imperative. In contrast to the current technology, the future market platform will integrate technology and systems to better utilize data. Modern architecture means systems that provide flexibility for the evolving needs of the business. These enhancements will support and facilitate the ongoing transformation across the various workstreams of the Reliability Imperative, including Market Redefinition and Operations of the Future.



The Opportunity: Capturing the Value

As described in this paper, MISO sees the challenges of the changing resource fleet. We are facing a Reliability Imperative to prepare for the future, and MISO is hard at work on a number of key planning, operational and systems efforts.

The fleet change represents not just challenges, but also enormous opportunities for MISO to enable members, states, regulators, and consumers to meet their objectives reliably and affordably.

By listening and taking a system-wide view, MISO can help ensure that all stakeholders have the information they need to make informed decisions about their resources.

By helping forward planning, MISO will help members to develop generation and transmission portfolios that maintain system reliability without over-investing. As member portfolios materialize, MISO markets and operations will optimize the delivery of energy across the footprint. In addition, MISO will continue coordinating with our neighboring seams partners.

MISO has delivered substantial value to its members since its creation, as demonstrated by the annual Value Proposition calculation. Going forward, additional sources of value will emerge through the sharing of attributes across the region's diverse resource fleets. MISO is developing calculations for these new sources of value in an evolved, future-looking Value Proposition. Given changes to fleet, grid, markets, and operations, it is more important than ever that the MISO Region work together so that each member continues to realize the substantial benefits of our regional structure.

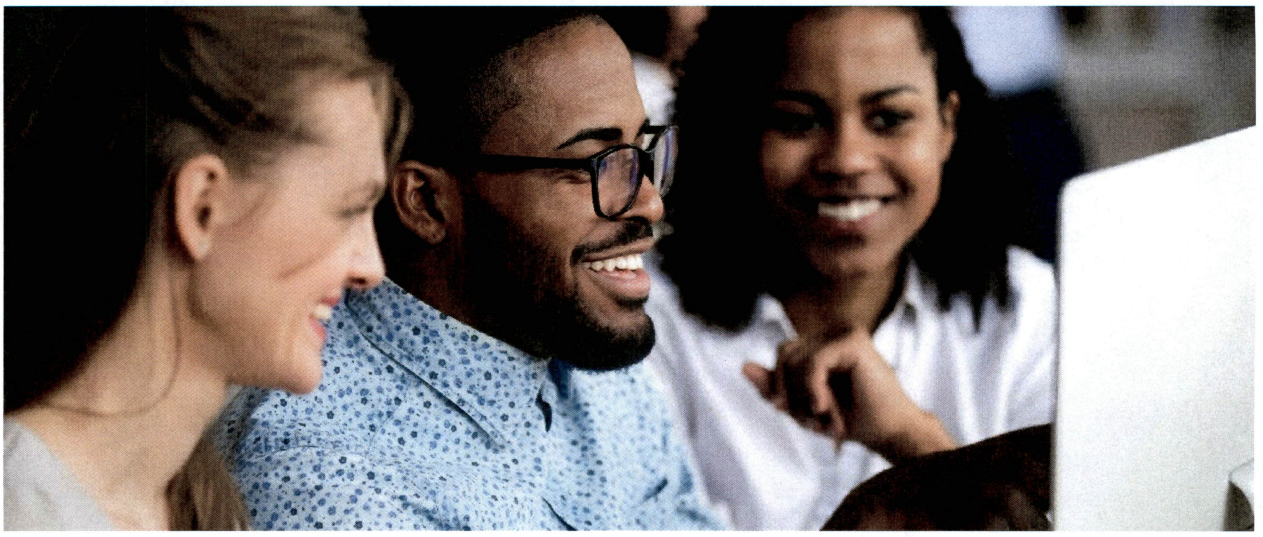
> "MISO has the opportunity to help its States and Members reach their own policy goals in the most cost-effective way while also ensuring the reliable delivery of electricity to end-use customers."
>
> Wayne Schug, MISO VP Strategy & Business Development

Working Together to Address the Reliability Imperative

This is a report written from MISO's perspective. However, the Reliability Imperative is not MISO's alone. The resource mix in the MISO Region has evolved significantly and will shift further as many members evolve their fleets to meet decarbonization goals. The Reliability Imperative work is required to ensure the grid can continue to be operated reliably as those increasingly diverse member plans are implemented.

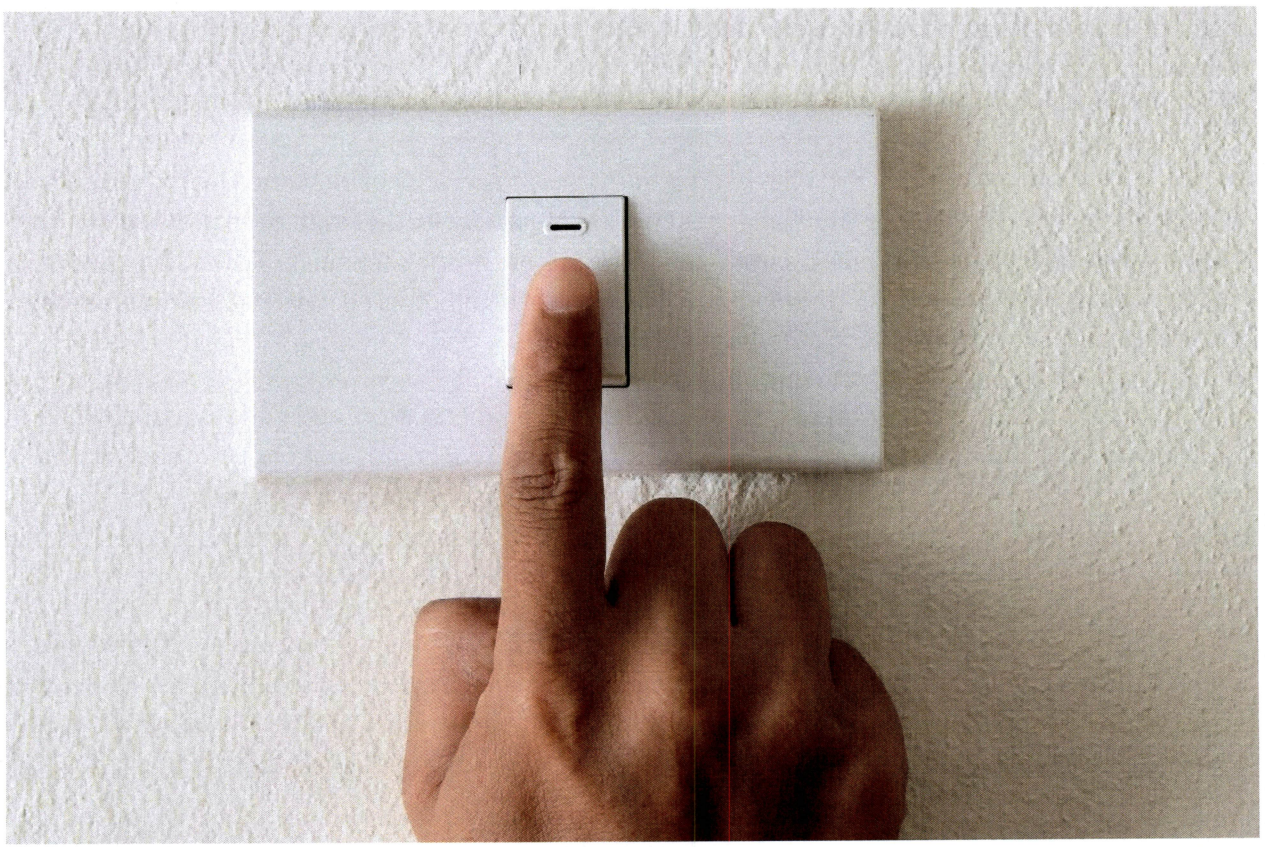
The work of the Reliability Imperative is focused on changes to MISO markets, operations, technical systems, and the grid to address the reliability risks resulting from the increasing pace of renewable integration and the increased frequency and severity of extreme weather events. And as an independent, FERC-approved system operator, MISO is responsible for the reliability of the Bulk Electric System and has the obligation to act. This work isn't performed in isolation, however. MISO engages with a broad range of stakeholders to share ideas and discuss potential solutions, including receiving input from industry trade groups, consultants, and other entities with insights into the challenges that are facing our region.

The Reliability Imperative work also involves robust, collaborative dialogue across the many forums within the Stakeholder Process. The collaboration that takes place in these forums has provided valuable policy and technical-related feedback, and MISO is committed to continuing that engagement. The MISO Roadmap, launched in January 2022, captures the strategic work needed across MISO's functions and processes to ensure preparedness for the future. The MISO Roadmap is currently organized according to the Reliability Imperative areas of focus. It will be updated as necessary, and we welcome continued stakeholder input on the process and the items MISO should prioritize.

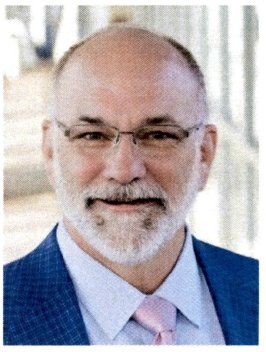


MISO also recognizes that some action will fall outside of MISO's scope and role. For example, MISO's report on the February 2021 Arctic Event pointed out the need for improved weatherization of resources, which impacts MISO, but the responsive actions fall outside of our direct responsibility. In line with those findings, FERC and the North American Electric Reliability Corporation (NERC) recently released their own findings on that event and have proposed multiple changes to the way that resources prepare for and communicate about their weatherization. As a directly impacted party, MISO has and will continue to engage the industry in these weatherization practices and appreciates FERC's and NERC's recent actions.

An additional method of engagement that is extremely critical to MISO's near-term and longer-term planning is through the information gathering tools that MISO administers. This includes participation in MISO's annual Generator Winterization Survey, as well as an ad-hoc survey related to the emerging risk related to coal supply. It also includes our work to aggregate member plans in the Regional Resource Assessment. Working together across all of these potential points of collaboration will best position the region to successfully and efficiently respond to the Reliability Imperative.



A Message from Clair Moeller, President



We need to get to the future before the future gets to us.

We need to move quickly to adapt our markets, planning processes, and operational protocols so grid reliability is not impaired by the changes that are fundamentally transforming our electrical system.

We've made some great progress since the initial version of this report in late 2020. For example, we've proposed revisions to our Resource Adequacy Construct that we think will mitigate some of the challenges we're increasingly experiencing due to factors such as fleet change and extreme weather events. We're seeking to revise certain processes in order to better incentivize resources with needed capabilities and attributes to be available when they are most needed. And through our Long Range Transmission Planning efforts, we're identifying transmission solutions that will enable members and states to achieve their policy objectives — many of which seek to increase renewables and/or reduce carbon emissions.

None of this work is easy. In fact, it's often stressful for our stakeholders, as well as for MISO. But it's necessary work. Factors such as changing customer preferences, shifting economics, technological advancements, and increased severity and frequency of extreme weather events are creating a host of new and urgent challenges that we must address to maintain system reliability. These challenges are not anyone's "fault" – but they are everyone's problem. That's why responding to the Reliability Imperative is a responsibility that's shared by MISO, our members, and the states.

We know that not everyone will support every view, recommendation, and initiative that MISO lays out in the Reliability Imperative — and that's OK. MISO welcomes stakeholder feedback on the proposals described in these pages, and if stakeholders have different ideas altogether, we want to hear them. Will we agree on everything? No. But that should not — and must not — stop us from working together to meet the obligations of the Reliability Imperative.

The time to act is now and we must continue to bring our "A" game — the industry is changing, and MISO members are poised to drive exciting, necessary changes over the coming years. Given the regional Reliability Imperative, the MISO community must act quickly and deliberately to ensure that the planning, markets, operations, and systems keep pace with our members' plans.

Let's get to work,



Acronyms Used in this Report

DER: Distributed Energy Resource

FERC: Federal Energy Regulatory Commission

LMR: Load Modifying Resource

LRTP: Long Range Transmission Planning

MISO: Midcontinent Independent System Operator

MSE: Market System Enhancement

MTEP: MISO Transmission Expansion Plan

MVP: Multi-Value Project

NERC: North American Electric Reliability Corporation

OMS: Organization of MISO States

RAN: Resource Availability and Need

RECBWG: Regional Expansion Criteria and Benefits Working Group

RIIA: Renewable Integration Impact Assessment

RRA: Regional Resource Assessment

SATOA: Storage As Transmission-Only Asset

SPP: Southwest Power Pool

STR: Short-Term Reserve

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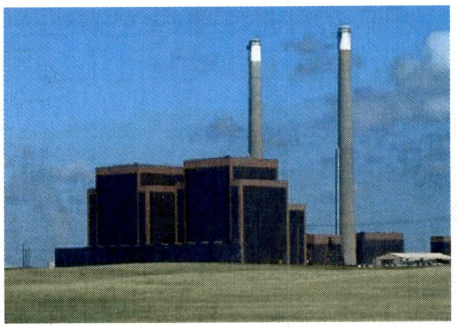
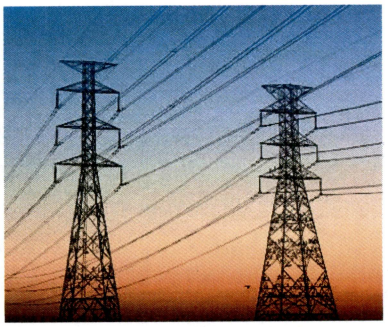
Economic Contribution of the North Dakota Lignite Industry in 2019

Dean A. Bangsund and Nancy M. Hodur

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Economic Contribution of the North Dakota Lignite Industry

Dean A. Bangsund and Nancy M. Hodur*

Commercial use of lignite coal to produce energy in North Dakota precedes the 1970s. Since that time, technology has dramatically improved the industry's environmental effects, and over that same period, society has become more concerned with issues of pollution and global warming. The convergence of social concerns and technological advancement has kept the use of coal in the middle of the debate on the future mix of energy resources. These challenges to burning coal have diminished the use of coal for stationary power generation in some regions of the United States; however, the overall size of the lignite industry in North Dakota has remained consistent for nearly a half century.

Lignite in the state is used primarily to produce electricity, which utilizes nearly 80 percent of lignite mined in the state. Other uses include synthetic gas (13%), fertilizer (7%), and miscellaneous heating (1%). Lignite coal has lower energy densities and generally higher moisture content than other forms of coal (e.g., bituminous) which makes it difficult to compete economically when markets require inter-state transportation of coal. Fortunately for North Dakota, the location of lignite coal reserves is in close proximity to substantial water resources reducing the challenges of securing adequate resources for steam and cooling operations. These circumstances led to the creation of several coal conversion facilities in North Dakota.

The lignite coal industry in North Dakota primarily represents a 'mine-to-mouth' operating structure. This type of arrangement has the coal-fired power plants located near mining operations with output from the mines contracted and delivered to nearby plants. Advantages of this arrangement include lower coal transportation costs, capacity to secure long-term market contracts between plant and mine, and ability to optimize coal burning efficiencies to match specific coal characteristics associated with a dedicated supply. Having a consistent and stable supply of coal further assists private industry and utility managers in making long-term capital investments.

Coal-fired power plants are a key component of electricity supply in the United States. Other sources include hydroelectric, solar, wind, nuclear, and natural gas-fired plants. Coal continues to provide base-load electricity—a relatively constant amount of electricity needed to meet minimum electricity demands. The coal-fired plants in North Dakota were historically designed around base load-usage in the electricity grid. The growth of other electricity sources, combined with deregulation in some markets, have changed the electricity supply structure in the United States.

North Dakota has benefited from having a stable, long-term supply of electricity through the use of lignite coal in mine-to-mouth operations. This report represents an update to numerous economic assessments, which began not long after the industry was developed, estimating the economic footprint of the industry in North Dakota.

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*The authors are, respectively, Research Scientist, Department of Agribusiness and Applied Economics, and Director, Center for Social Research, North Dakota State University.

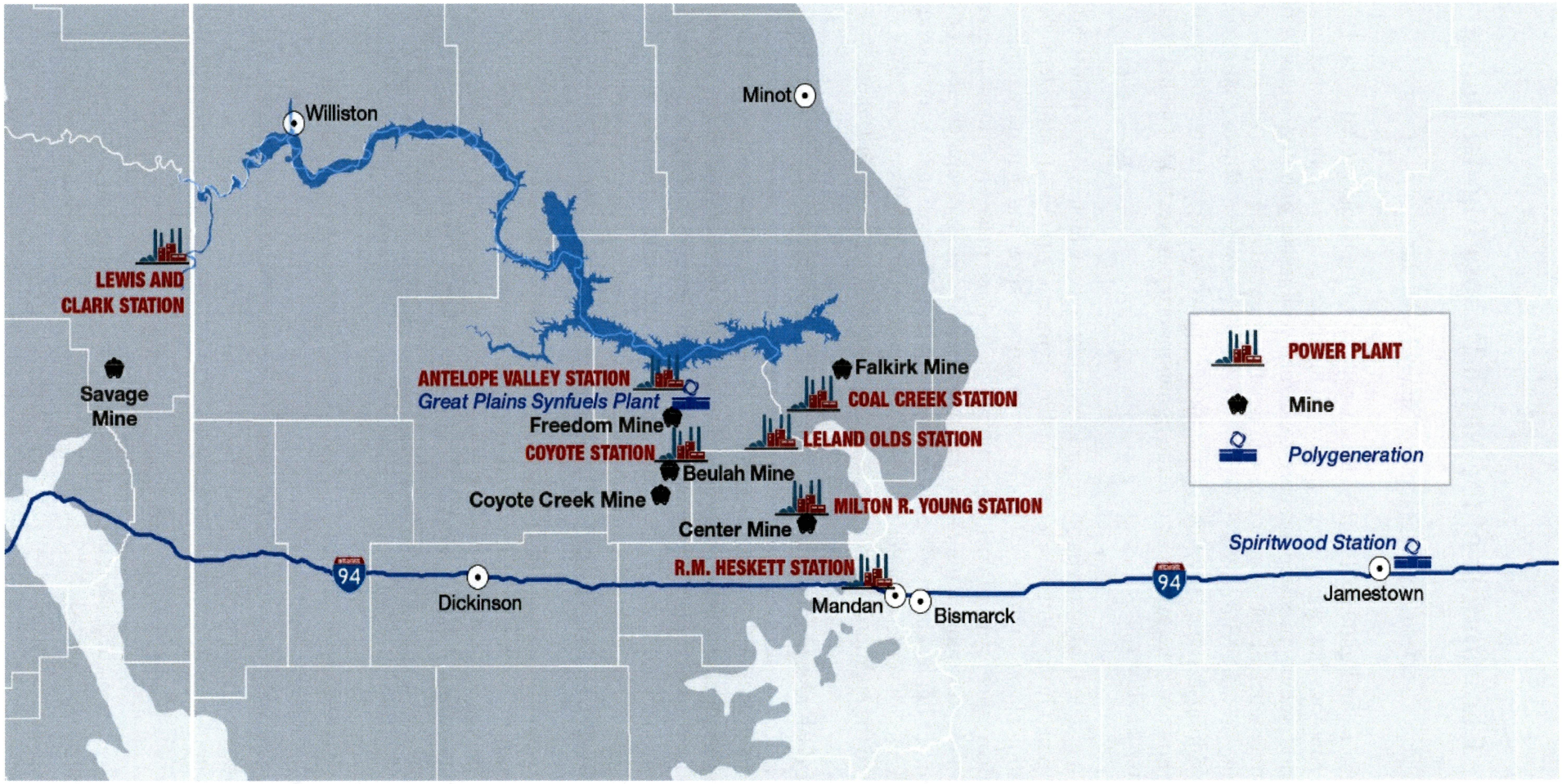

Figure 1. Distribution of Lignite Coal Mining, Conversion, and Generation Facilities, North Dakota and Eastern Montana

Source: Energy & Environmental Research Center, University of North Dakota.

Data Collection and Impact Methodology

The methods used for this analysis are similar to those used in previous lignite industry assessments (see Previous Research and Literature Cited section for listing of previous reports). Financial information of companies involved in lignite-related activities in North Dakota constitute much of the baseline data for the study, and were obtained by surveying the firms and companies comprising mining operations, electricity generation plants, coal conversion facilities, and electricity transmission (Appendix A contains sample questionnaires). The ND Lignite Energy Council provided assistance in contacting the firms. The industry survey had 100 percent participation by all firms involved in lignite-based mining, conversion, generation, and transmission. The following firms were identified by the ND Lignite Energy Council and participated in the study:

Basin Electric Power Cooperative
BNI Coal, Ltd.
Coteau Properties Company
Coyote Creek Mining Company, L.L.C.
Dakota Gasification Company
Great River Energy
Minnesota Power, Allete, Inc.
Minnkota Power Cooperative and Square Butte Electric Cooperative
Montana-Dakota Utilities Co.
NoDak Energy Services
Otter Tail Power Company
The Falkirk Mining Company

The survey collected information on sales, employment, employment compensation, total expenditures, in-state expenditures, and taxes paid in North Dakota (Tables 1 and 2). The general framework for analysis after obtaining industry data is to estimate the indirect and induced economic effects in the state's economy (Figure 2). (Appendix B contains a detailed discussion of the study's I-O methodology and terminology used in the analysis.)

The industry data, and in some cases, secondary information from other sources, represent the direct impacts of the industry. These values are then transformed for use in the IMPLAN modeling system (Table 3). (Appendix C discusses modifications to IMPLAN's social accounting matrix.)

Table 1. In-state Employment, Lignite Industry Survey, North Dakota, 2019

Employment	Coal Mining	Conversion, Generation, and Transmission	All Segments
Full-time	1185	2,379	3564
Part-time	31	28	59

Source: Industry Survey Data 2019.

Table 2. Summary Financial Data, North Dakota Lignite Industry Survey, North Dakota, 2019

	Coal Mining		Conversion, Generation, and Transmission		All Segments	
	Total	In-state	Total	In-state	Total	In-state
	000s 2019 $					
Revenue	510,937	510,937	3,029,929	3,029,929	3,540,866	3,540,866
Wages/Salaries	146,099	146,099	219,201	213,362	365,300	359,461
Benefits	28,407	24,682	78,870	24,487	107,277	49,169
Total Payroll	174,506	170,781	301,096	250,833	475,602	421,614
Expenditures[1]						
Advertising	701	630	880	467	1,581	1,096
Communication	263	199	833	280	1,096	479
Construction	3,081	2,794	89,655	36,738	92,736	39,532
Cost of goods sold	0	0	26,008	0	26,008	0
Depreciation/amortization	24,358	519	0	0	24,358	519
Engineering testing/controls	391	372	0	0	391	372
Equipment	14,783	10,444	41,664	19,105	56,447	29,549
Fees	1,303	415	13,750	3,067	15,053	3,482
Freight	0	0	16,250	49	16,250	49
Fuel	46,014	46,014	0	0	46,014	46,014
Insurance	4,525	0	12,009	841	16,534	841
Legal	324	286	967	89	1,291	375
Lime	0	0	14,437	0	14,437	0
Loan interest	12,918	5,653	178,428	17,764	191,345	23,417
Manufacturing	20,700	12,420	0	0	20,700	12,420
Materials	0	0	71,418	14,652	71,418	14,652
Meetings	924	308	1,917	659	2,842	968
Miscellaneous	140	0	684	471	824	471
Office supplies	2,464	1,264	39,761	5,233	42,225	6,497
Operations and maintenance	1,953	0	35,843	10,992	37,796	10,992
Rent	25,666	20,202	19,467	432	45,133	20,635
Repairs	72,851	59,360	137,918	73,023	210,769	132,383
Research	0	0	0	0	0	0
Royalty/easements	8,197	5,590	0	0	8,197	5,590
Security and janitorial	1,503	1,303	0	0	1,503	1,303
Supplies	21,748	17,233	0	0	21,748	17,233
Training	1,448	1,000	2,554	1,075	4,002	2,075
Transmission/wheeling	0	0	251,996	0	251,996	0
Utilities	11,029	11,029	46,284	44,092	57,313	55,121
Total	277,284	197,036	2,132,058	905,560	2,409,342	1,102,596
Taxes Paid in ND	17,314	17,314	41,274	41,274	58,588	58,588

[1]Expenditures listed here exclude in-state purchases of electricity for resale and generation plant and conversion facilities' purchases of lignite coal from in-state mines.
Source: Industry Survey Data 2019.

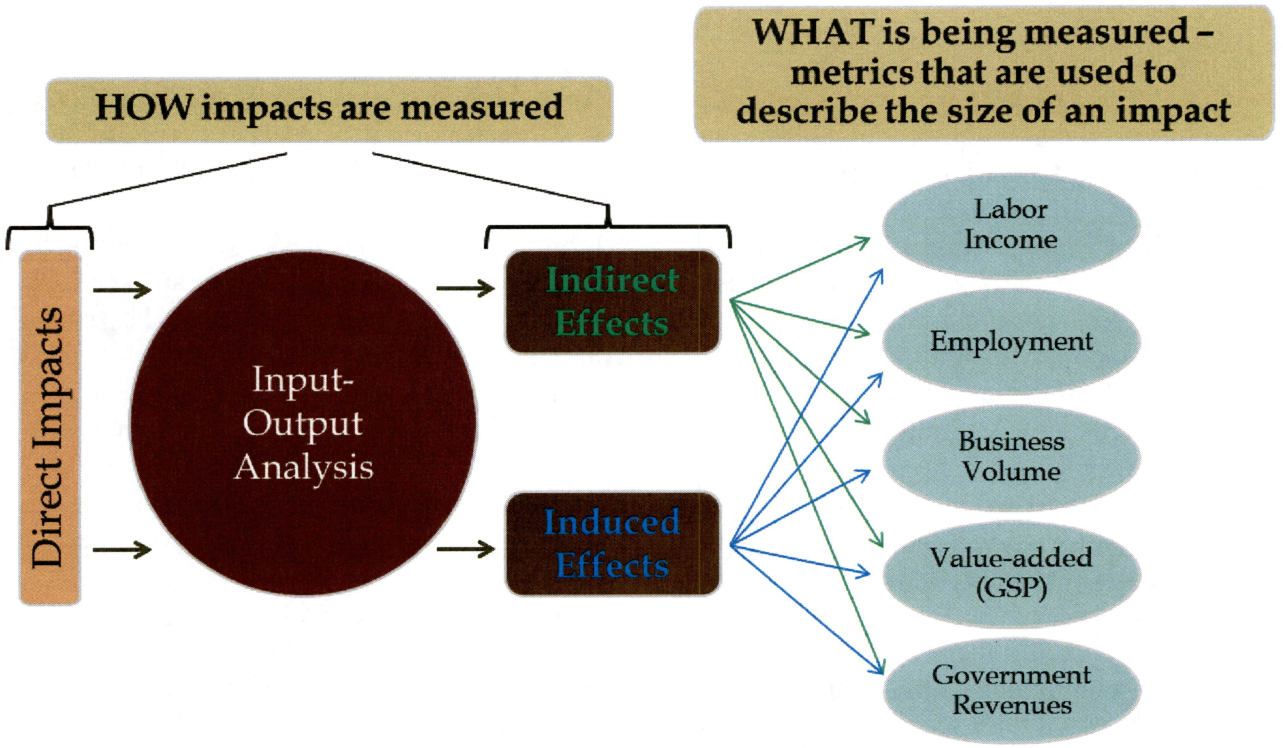

Figure 2. Impact Assessment Methodology
Source: DA Bangsund, Department of Agribusiness and Applied Economics NDSU

Table 3. Industry Profiles, by IMPLAN Economic Sector, Lignite Industry Survey Data, North Dakota, 2019

Sector Profile Components	IMPLAN Sector 22 Coal Mining	IMPLAN Sector 42 Electricity Generation	IMPLAN Sector 49 Electricity Transmission and Distribution
Output (sales)	$510,936,815	$1,730,070,591	$1,299,858,366
Employment[1]	1,216	1,898	509
Employment Compensation	$170,780,960	$236,083,164	$51,588,045
Sole Proprietor Income	$0	$0	$0
Property type income	$39,107,278	$42,738,801	$174,475,433
Tax on Production and Inputs	$23,764,977	$49,484,041	$39,562,270
Total Value-added	$233,653,215	$328,306,006	$265,625,748
Intermediate Inputs	$277,283,600	$1,401,764,585	$1,034,232,618

[1]Represents total jobs (full-time and part-time).
Source: Industry Survey Data 2019.

Economic Effects

Direct impacts were run through the IMPLAN modeling system to estimate the indirect and induced economic impacts. Secondary impacts were estimated separately for coal mining, conversion and electricity generation, and electricity transmission and distribution (Table 4).

Coal mining was estimated to have nearly 1,260 direct jobs; business activity relating to coal mining operations supported another 1,090 jobs. Personal spending on goods and services by employees working in the coal mining sector and employees of businesses affected by coal mining supported an additional 1,100 jobs. The combined effects on statewide employment from coal mining was estimated at 3,400 jobs (Table 4). Other economic effects from coal mining included $294 million in labor income and $780 million in gross business volume.

Coal conversion and electricity generation from lignite was estimated to have nearly 1,800 direct jobs, and business activity relating to those lignite operations supported another 4,500 jobs. Personal spending on goods and services by employees working in the coal conversion and generation activities and employees of businesses affected by those activities supported an additional 2,150 jobs. The combined direct, indirect, and induced effects on statewide employment from coal conversion and electricity generation was estimated at 8,500 jobs (Table 4). Other economic effects from coal conversion and electricity generation included $650 million in labor income and $3.2 billion in gross business volume.

Electricity transmission and generation from lignite-based activities was estimated to have 500 direct jobs; business activity relating to those lignite operations supported another 360 jobs. Personal spending on goods and services by employees working in coal-related electricity transmission and distribution and employees of businesses affected by those activities supported an additional 330 jobs. The combined direct, indirect, and induced effects on statewide employment from coal-related electricity transmission and distribution was estimated at 1,200 jobs (Table 4). Other economic effects from transmission and distribution included $89 million in labor income and $1.4 billion in gross business volume.

The combination of coal mining, coal conversion, coal-fired electricity generation, and electricity transmission and distribution was estimated to have 6,620 direct jobs in North Dakota in 2019. These lignite coal activities supported about 5,900 jobs through business purchases of goods and services in the state. The combined personal spending of employees in the Lignite Industry, and employees of businesses involved with supplying goods and services to the industry supported another 3,580 jobs (Table 4). Collectively, the industry was estimated to support 13,100 jobs in the state.

The lignite industry also supports about $1 billion in labor income, which represents wages, salaries, benefits, and sole proprietor's income. The industry also contributes $1.8 billion to the state's gross domestic product, and the industry's gross business volume was estimated at $5.4 billion (Table 5).

Table 4. Direct, Indirect, and Induced Economic Effects, Key Economic Metrics, North Dakota Lignite Industry by IMPLAN Economic Sectors, 2019				
Economic Sector/Type of Economic Effect	**Employment[1]**	**Labor Income**	**Value-added**	**Output**
Coal Mining		---------- 000s 2019 $ ----------		
Direct effects	1,216	170,781	233,653	510,937
Indirect effects	1,089	72,428	118,037	168,229
Induced effects	1,097	50,849	83,826	102,661
Total economic effects	3,403	294,058	435,516	781,827
Electricity Generation and Coal Conversion				
Direct effects	1,898	236,083	328,306	1,730,071
Indirect effects	4,466	314,689	531,128	1,192,868
Induced effects	2,153	99,764	164,396	305,338
Total economic effects	8,517	650,536	1,023,830	3,228,277
Electricity Transmission and Distribution				
Direct effects	509	51,588	265,626	1,299,858
Indirect effects	359	21,910	36,847	93,931
Induced effects	331	,15,358	25,310	49,357
Total economic effects	1,199	88,856	327,782	1,443,147
[1] Employment represents total jobs, and does not represent employment in FTE.				

Table 5. Direct, Indirect, and Induced Economic Effects, Key Economic Metrics, North Dakota Lignite Industry, 2019				
Type of Economic Effect	**Employment[1]**	**Labor Income**	**Value-added**	**Output**
ND Lignite Industry		---------- 000s 2019 $ ----------		
Direct	3,623	458,452	827,585	3,540,866
Indirect	5,914	409,026	686,012	1,455,029
Induced	3,582	165,971	273,531	457,356
Total	13,119	1,033,449	1,787,128	5,453,251
[1] Employment represents total jobs, and does not represent employment in FTE.				

Indirect and induced economic effects were combined, and have been estimated for 2-digit North American Industrial Classification System (NAICS) economic sectors (Figures 3 through 6). Key economic sectors affected by the industry include construction, professional and technical services, transportation, financial and real estate services, and wholesale trade.

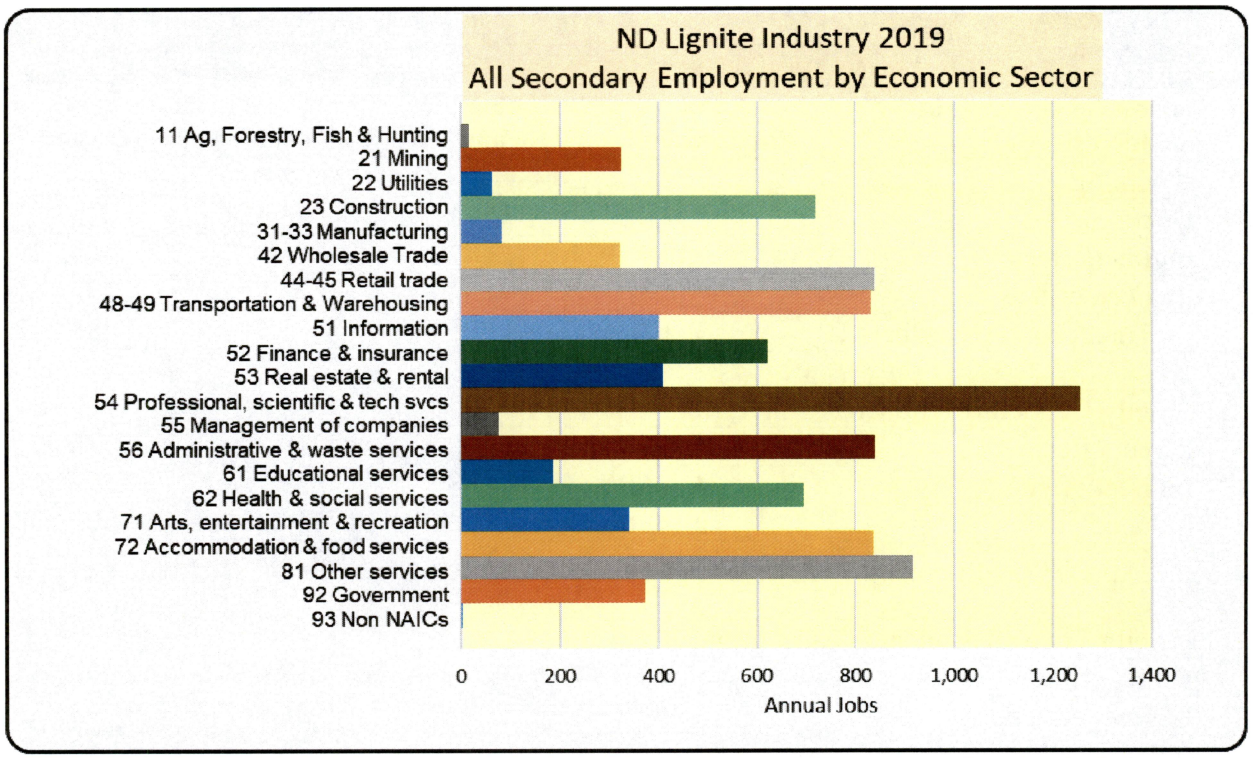

Figure 3. Secondary Employment (Indirect and Induced Effects), by Economic Sector, North Dakota Lignite Industry, 2019.

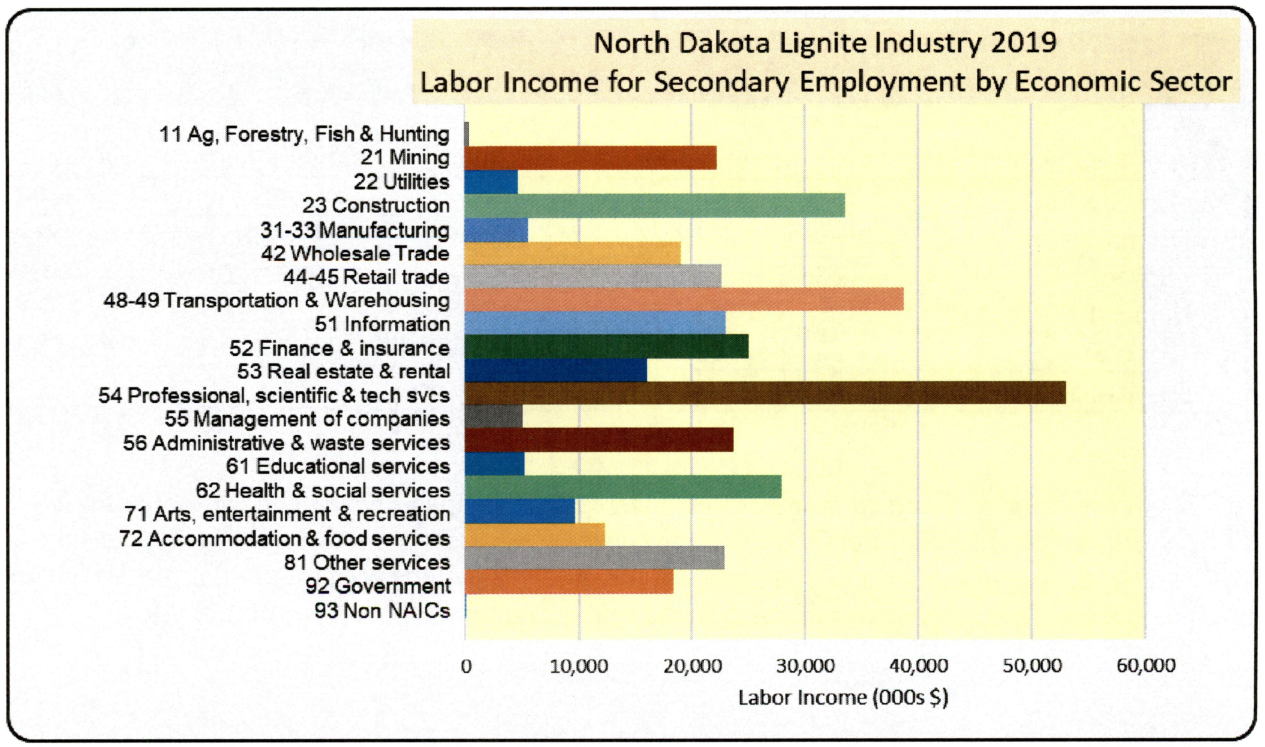

Figure 4. Labor Income from Secondary Employment (Indirect and Induced Effects), By Economic Sector, North Dakota Lignite Industry, 2019

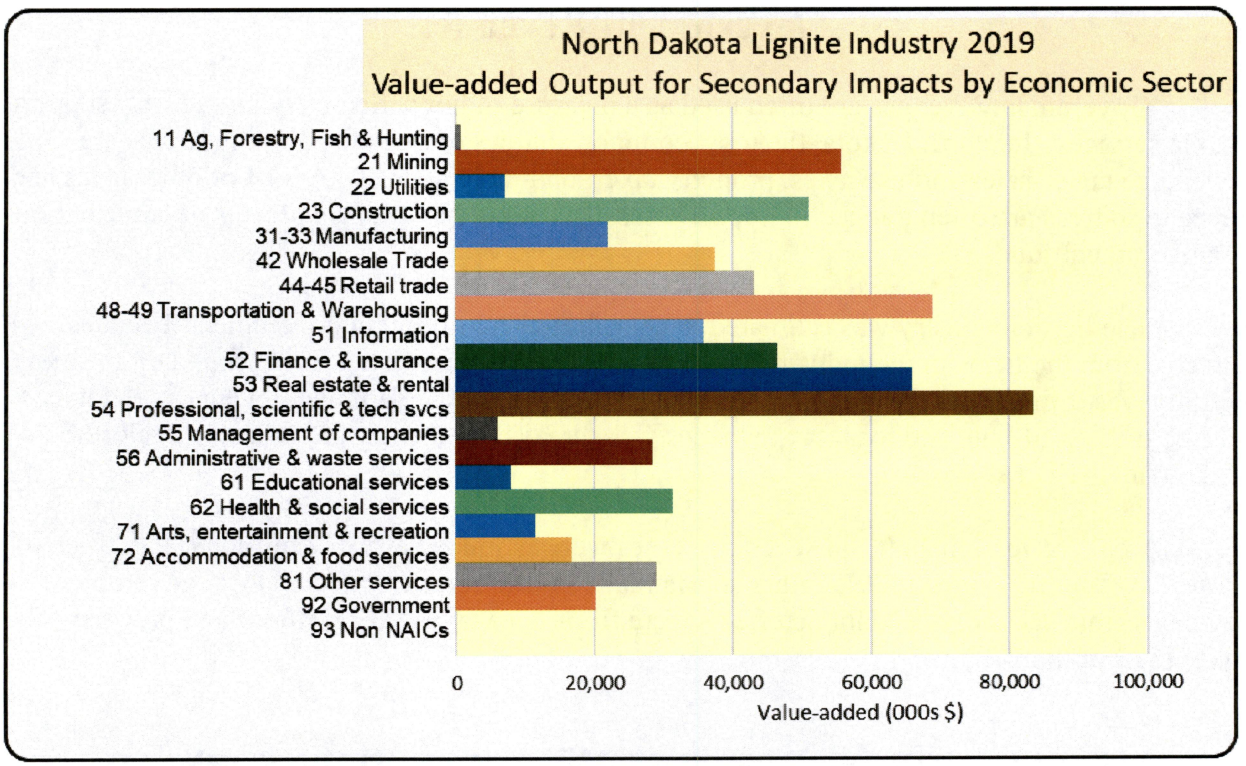

Figure 5. Value-added Economic Output from Secondary Economic Activity, by Economic Sector, North Dakota Lignite Industry, 2019

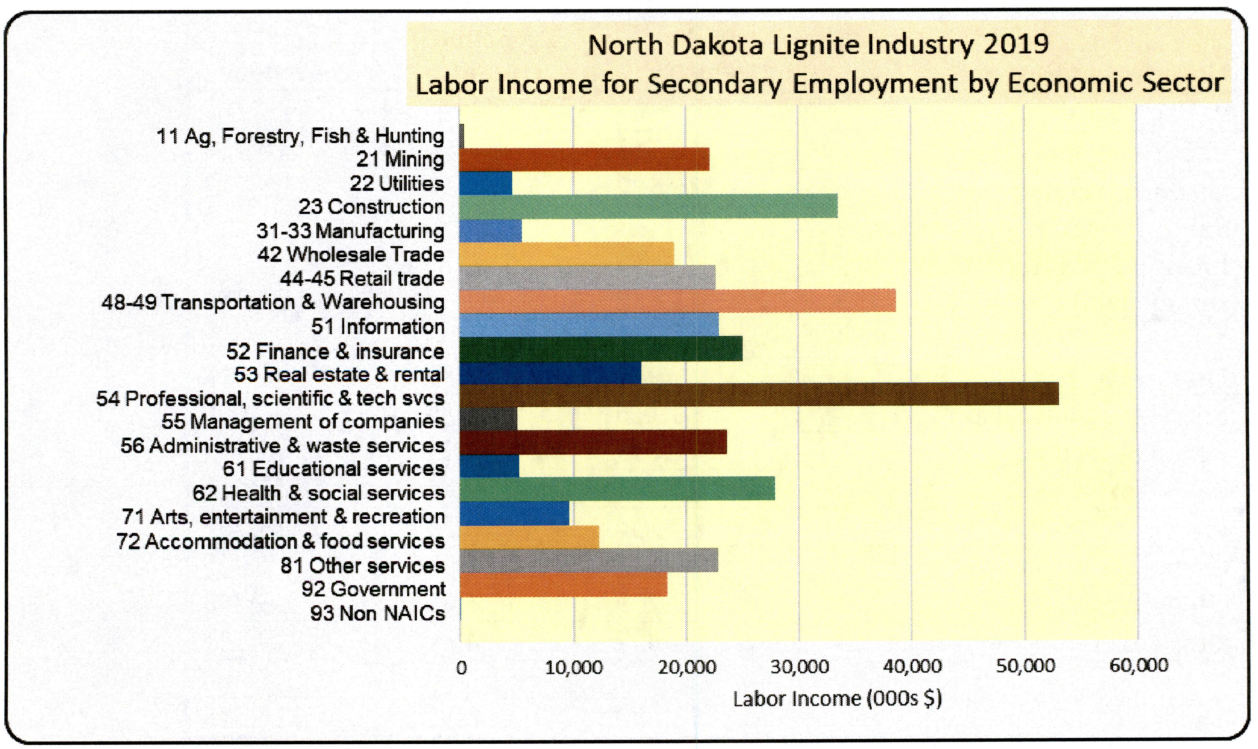

Figure 6. Gross Business Volume from Secondary Economic Activity, by Economic Sector, North Dakota Lignite Industry, 2019

Government Revenues

Government revenues are often used as a measure of how effectively an industry supports public services. In North Dakota, the most common sources of in-state public revenues are severance taxes, sales and use taxes, property taxes, and income taxes. A host of other taxes and revenue sources are often tracked in impact assessments, but have varying levels of contribution to government funds.

The lignite industry was estimated to contribute $74 million in government revenues directly from the firms in the industry. Additional tax revenues arising from secondary business activity was estimated to generate an additional $51 million in government revenues. A total of $124.5 million in state and local tax revenues were created by the Lignite Industry in North Dakota in 2019 (Table 6).

Coal conversion and coal severance taxes were estimated at $36.2 million (ND Office of State Tax Commissioner 2020). Other substantial contributions to state and local government revenues from secondary economic effects were from sales taxes ($22 million) and property taxes ($13 million).

Table 6. State and Local Government Revenues, Lignite Industry, North Dakota, 2019

Government Revenue	Paid Directly by the Industry	Collected from Indirect and Induced Economic Output	Total Collections
	000s 2019 $		
Coal Severance Tax	10,713	---	10,713
Coal Conversion Tax	25,582	---	25,582
Sales, Property, and Corporate Income taxes (reported in survey data)	22,382	---	22,382
Dividends	941	871	1,812
Social Insurance Tax	4,116	3,891	8,006
Personal Income	2,819	3,116	5,935
Sales Tax	see above	22,015	22,015
Property Tax	see above	13,557	13,557
Corporate Income	see above	1,025	1,025
Other Taxes	2,279	1,462	3,743
Non Taxes	4,857	4,891	9,747
Totals	73,689	50,829	124,518

Summary

The North Dakota Lignite Industry periodically assesses the industry's economic contribution, and this study is another installment in those ongoing efforts. The purpose of this study was to engage the industry to provide financial information on the industry's sales, employment, payroll, and expenditure profiles. Industry-based data were used with input-output analysis to estimate the additional economic activity related to business purchases and household spending.

The North Dakota Lignite Energy Council provided contacts for firms comprising the lignite industry in the state. The study had 100 percent cooperation as every firm identified for contact in the study provided financial information.

The vertically integrated industry acts to concentrate the economic footprint of mining, generation, and distribution because all the stages of electricity production are contained in the state. Unlike some coal-fired electricity plants in other regions of the country, lignite coal is mined in close proximity to generation plants. The primary export from the lignite industry is not the raw commodity of lignite, but rather electricity. North Dakota also has a coal conversion facility producing synthetic gas, fertilizer, and other chemical products from lignite coal.

The economic effects were largest in the coal conversion and generation segment of the industry. Coal mining supported 3,400 jobs, of which 1,260 were directly employed by lignite mines. Coal conversion and electricity generation supported 8,500 jobs, of which 1,900 were directly employed by the industry. About 1,200 total jobs were supported in North Dakota through the operations of electricity transmission and distribution. The industry has a total of 3,620 jobs in all segments of the industry. Direct, indirect, and induced economic effects were estimated to support a total of 13,100 jobs in the state.

Other sources of economic output from the industry include total labor income of $1 billion, $1.8 billion in value-added economic activities (contribution to GSP), and a gross business volume of $5.4 billion. The industry was directly responsible for $73 million, and indirectly responsible for another $51 million in state and local government revenues.

The industry has remained stable in the state for several decades. Data from recent economic assessments were compiled showing recent job reductions in the state have been offset with growth in labor income (Figure 7). Over the past several years, the output of coal in the state also has been relatively stable (Figure 8).

The economic footprint of the industry is considerable, and this study confirms the magnitude of economic effects in the state are similar to previous years. The industry continues to be an important driver of employment, business activity, and tax revenues.

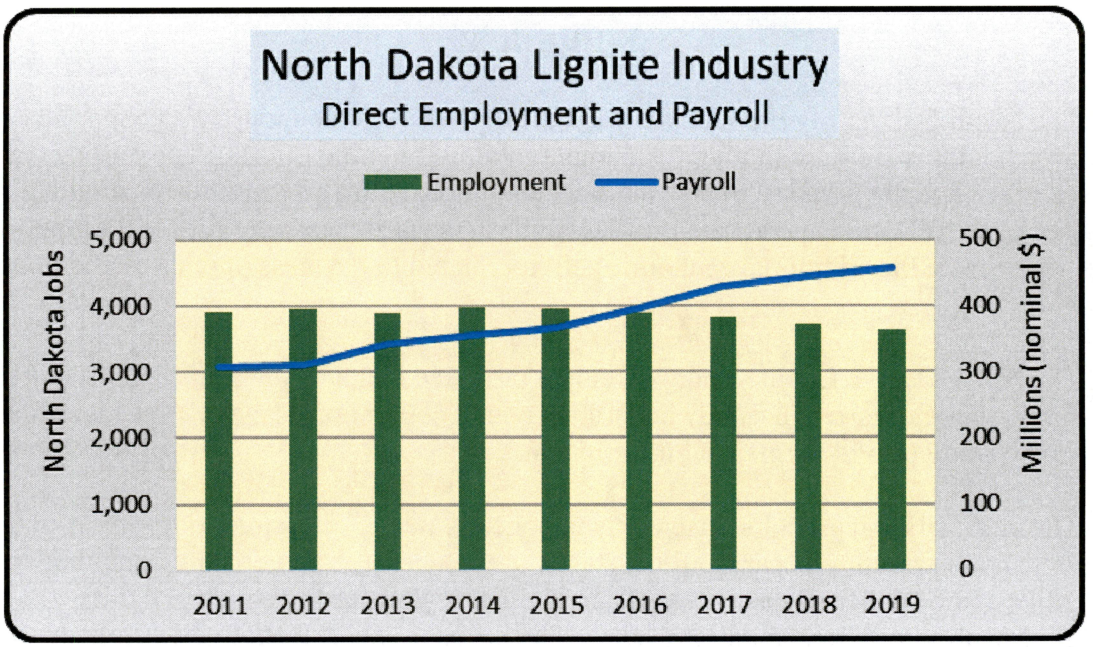

Figure 7. Employment and Employment Compensation, North Dakota Lignite Industry, 2011 through 2019

Sources: Coon et al. (various years), Bangsund and Hodur (2018).

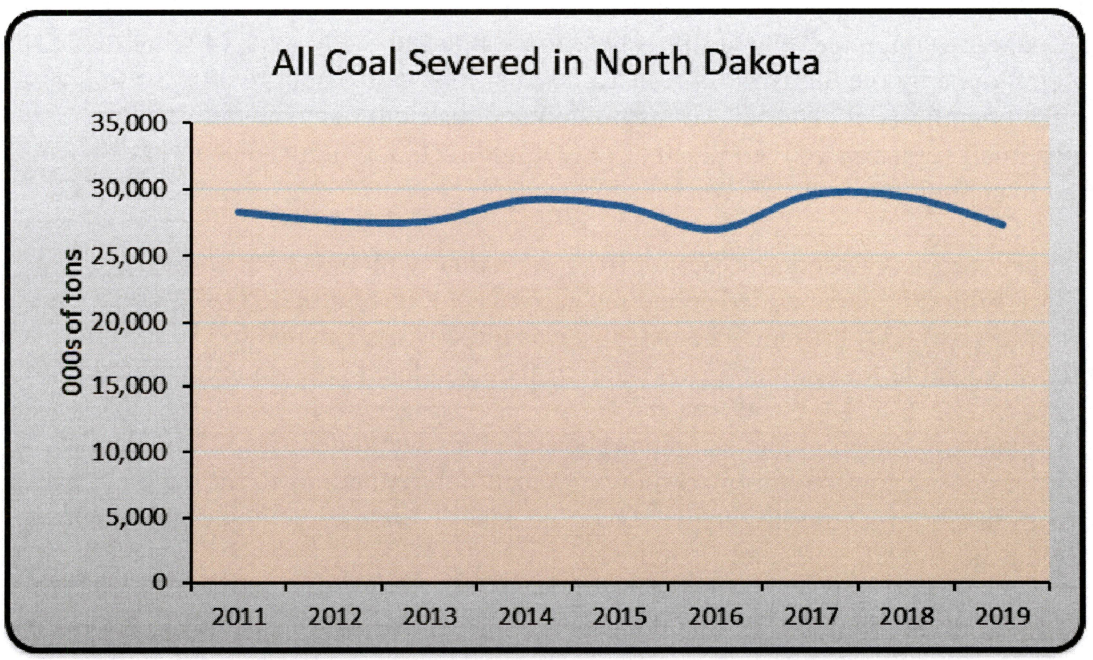

Figure 8. Coal Severed in North Dakota, 2011 through 2019

Source: North Dakota Office of State Tax Commissioner (2020).

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Appendix A

Industry Questionnaires

NDSU AGRIBUSINESS AND APPLIED ECONOMICS

Economic Contribution of North Dakota Lignite Industry

Coal Conversion

Funding for this study is provided by the **North Dakota Lignite Energy Council**

Confidentiality

This is a confidential request -- only the immediate research team has access to this information, and the information is never shared with any interests during or after the study. A confidentiality agreement can be provided upon request.

Guidelines and Instructions

Please use the following guidelines.

1. Please provide information for 2019.

2. This questionnaire is specific to the ND Synfuels Plant.

3. When information is not available, please estimate.

4. Definitions for selected expenditure items are included to help determine allocation of expenditures.

5. Please complete the survey by August 31, 2020.
   You can mail the survey in the prepaid envelope or email the questionnaire to Dean Bangsund at the address below.

Study Contacts

Dean Bangsund (701-231-7471)
d.bangsund@ndsu.edu
Dr. Nancy Hodur (701-231-8621)
nancy.hodur@ndsu.edu

Mailing Address
Dean Bangsund
Richard H. Barry Hall
Dept # 7610, PO Box 6050
North Dakota State University
Fargo, ND 58108-6050

Survey of Lignite Industry
ND Synfuels Plant

Company: _____

Contact Person: _____

Email: _____ Phone: _____

I. Revenues for 2019 for the Synfuels Plant in North Dakota (financial values can be rounded to thousands)

Sources of Revenue	Total Revenue for Operations in North Dakota
Chemicals and Fuels (such as dephenolized cresylic acid, naphtha, phenol, tar oil)	$
Fertilizers (such ammonium sulfate, anhydrous ammonia, urea)	$
NOx Emission Control (such anhydrous ammonia, diesel exhaust fluid, urea)	$
Gases (carbon dioxide, krypton and xenon, liquid nitrogen, synthetic natural gas)	$
Miscellaneous by-products	$
	$
	$

II. Employment for 2019 for the Synfuels Plant in North Dakota.

Employment	On-site Synfuels Plant Operations	Any off-site employment related to the plant
Number of full-time		
Number of part-time and seasonal		

III. Expenditures for 2019 for the Synfuels Plant in North Dakota (financial values can be rounded to thousands)

Definitions for some expense categories are appended at the end of this table. If in doubt as to where a particular expense might be placed, please write in the type of expense.

	Categories	Total Expenses for North Dakota Operations	Percentage paid to North Dakota Sources
	Example: telecommunications	$35,000	80%
Employment Compensation			
	Wages, salaries, bonuses	$	%
	Employee Benefits	$	%
Expenditures			
	Purchases of lignite coal	$	%
	Purchases of plant equipment	$	
	Contract Construction	$	%
	Communications	$	%
	Utilities	$	%
	Repairs and Maintenance (facilities and infrastructure related to the Synfuels plant)	$	%
	Insurance	$	%
	Loan interest and finance charges	$	%
	Advertising and public relations	$	%
	Fees, permits, licenses, inspections, audits, tax preparations	$	%
	Office supplies, computers, software	$	%
	Meetings, Conventions, Travel	$	%
	Training, Safety, Employee Education	$	%
	Rent and Leases (exclude Federal coal leases)	$	%
	Legal and attorney fees	$	%
	Other Expenses (please list)	$	%
		$	%
		$	%

	Categories	Total Expenses for North Dakota Operations	Percentage paid to North Dakota Sources
Taxes Paid in North Dakota (please exclude payroll taxes)			
	Coal Conversion Tax	$	100%
	Property Tax	$	100%
	Sales and Use	$	100%
	Corporate Income	$	100%
	Others (please list)	$	100%
		$	100%

Selected Definitions:

Wages and Salaries: Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Any pensions paid to retired employees. Please exclude payroll benefits.

Employee Benefits: Includes payments for health, dental, and vision insurance, retirement contributions (e.g., 401k, company pension funds) for active employees, state payroll taxes, unemployment taxes, and Workforce Safety Insurance contributions.

Contract Construction: Includes expenses for new work, additions, alterations, and remodeling to industrial facilities, public offices, warehouse, and other buildings and structures.

Communications: Includes expenditures for telephone, radio, television, satellite services, Internet service, DTN feeds, cell phones, and other communication services.

Public Utilities: Includes expenses for natural gas, electricity, water supply, sewer and garbage services.

Manufacturing: Includes expenses for on-site fabrication of equipment, machinery, and processing components and expenses for materials, structural components, equipment, machinery and other goods purchases directly from a manufacturing firm. Also includes rebuilding of machinery and equipment at a processing plant.

Taxes: Only include taxes paid in North Dakota. Do not include taxes paid in other states, or to the Federal government. Note: payroll taxes are included in employment compensation in the employee benefits category.

Miscellaneous Expenses: Please write in any expenses that do not fit with the supplied categories. If needed, those listings can be attached on another sheet of paper.

Feel free to add any supporting materials or comments that will help with the study.

Thank You for completing this questionnaire

Please return the questionnaire in the postpaid envelope or email an electronic copy to one of the study researchers.

Study results will be available in late 2020. Please contact Edie Nelson in the Department of Agribusiness and Applied Economics at North Dakota State University for more information on our departmental reports. Phone 701-231 7441, fax 701-231-7400, email: ndsu.agribusiness@ndsu.edu or visit our departmental listing of research reports on the internet at http://agecon.lib.umn.edu

NDSU AGRIBUSINESS AND APPLIED ECONOMICS

Economic Contribution of North Dakota Lignite Industry

Coal Mining Operations

Funding for this study is provided by the **North Dakota Lignite Energy Council**

Confidentiality

This is a confidential request -- only the immediate research team has access to this information, and the information is never shared with any interests during or after the study. A confidentiality agreement can be provided upon request.

Guidelines and Instructions

Please use the following guidelines.

1. Please provide information for 2019.

2. For firms with multiple locations in North Dakota, please combine all locations into one questionnaire.

3. When information is not available, please estimate.

4. Please consider Coal Mining Operations to include all activities at the mine, such as removal of over burden, coal extraction, coal beneficiation, reclamation, and any expenses for delivery of coal to power plants.

5. Definitions for selected expenditure items are included to help in determine allocation of expenditures.

6. Please complete the survey by August 31, 2020.
   Please email the questionnaire to Dean Bangsund at the address below or return via prepaid envelope (if requested).

Study Contacts

Dean Bangsund (701-231-7471)
d.bangsund@ndsu.edu
Dr. Nancy Hodur (701-231-8621)
nancy.hodur@ndsu.edu

Mailing Address
Dean Bangsund
Richard H. Barry Hall
Dept # 7610, PO Box 6050
North Dakota State University
Fargo, ND 58108-6050

Survey of Lignite Industry

Company: _____
Contact Person: _____
Email: _____
Phone: _____

I. Revenues for 2019 for mining facilities and operations in North Dakota (financial values can be rounded to thousands)

Sources of Revenue (definitions provided below)	Total Revenue
Sale of Coal	$
Sale of Other Mining Products	$
Other revenues associated with Mine Operations (please specify):	$
	$
	$
	$
	$

II. Employment for 2019 for mining facilities and operations in North Dakota.

Employment	Coal Mining Operations	
Number of full-time		
Number of part-time and seasonal		

III. Expenditures for 2019 for mine facilities and operations located in North Dakota (financial values can be rounded to thousands)

Definitions for some expense categories are appended at the end of this table. If in doubt as to where a particular expense might be placed, please write in the type of expense.

Categories	Total Expenses for North Dakota Operations	Percentage paid to North Dakota Sources
Example: Office supplies, computers, software	$35,000	80%
Employment Compensation		
Wages, salaries, bonuses	$	%
Employee Benefits	$	%
Expenditures		
Purchases of coal mining equipment	$	%
Purchases of fuel and lubrication	$	%
Contract Construction	$	%
Communications	$	%
Utilities (electricity, natural gas, water)	$	%
Repairs and Maintenance (facilities & equipment)	$	%
Manufacturing	$	%
Insurance	$	%
Loan interest and finance charges	$	%
Advertising and/or public relations	$	%
Fees, permits, licenses, inspections, audits, tax preparations	$	%
Office supplies, computers, software	$	%
Meetings, Conventions, Travel	$	%
Training, Safety, Employee Education	$	%
Rent and Leases	$	%
Legal and attorney fees	$	%
Other Expenses (please list)	$	%
	$	%
	$	%

	Other Expenses (cont.)	$	%
		$	%
		$	%
		$	%
		$	%
		$	%
		$	%
		$	%
Taxes Paid in North Dakota (please exclude payroll taxes)			
	Property Tax	$	100%
	Sales and Use	$	100%
	Corporate Income	$	100%
	Others (please list)	$	100%
		$	%

Selected Definitions:

Wages and Salaries: Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Any pensions paid to retired employees. Please exclude payroll benefits.

Employee Benefits: Includes payments for health, dental, and vision insurance, retirement contributions (e.g., 401k, company pension funds) for active employees, state payroll taxes, unemployment taxes, and Workforce Safety Insurance contributions.

Contract Construction: Includes expenses for new work, additions, alterations, and remodeling to industrial facilities, public office, warehouse, and other buildings and structures.

Communications: Includes expenditures for telephone, radio, television, satellite services, Internet service, DTN feeds, cell phones, and other communication services.

Utilities: Includes expenses for natural gas, electricity, water supply, sewer and garbage services.

Manufacturing: Includes expenses for on-site fabrication of equipment, machinery, and processing components and expenses for materials, structural components, equipment, machinery and other goods purchases directly from a manufacturing firm. Also includes rebuilding of machinery and equipment at a processing plant.

Taxes: Only include taxes paid in North Dakota. Do not include taxes paid in other states, or to the Federal government. Note: payroll taxes are included in employment compensation in the employee benefits category.

Miscellaneous Expenses: Please write in any expenses that do not fit with the supplied categories. If needed, those listings can be attached on another sheet of paper.

Feel free to add any supporting materials or comments that will help with the study.

Thank You for completing this questionnaire

Please return the questionnaire in the postpaid envelope or email an electronic copy to one of the study researchers.

Study results will be available in late 2020. Please contact Edie Nelson in the Department of Agribusiness and Applied Economics at North Dakota State University for more information on our departmental reports. Phone 701-231 7441, fax 701-231-7400, email: ndsu.agribusiness@ndsu.edu or visit our departmental listing of research reports on the internet at http://agecon.lib.umn.edu

NDSU AGRIBUSINESS AND APPLIED ECONOMICS

Economic Contribution of North Dakota Lignite Industry

Electricity Generation, Transmission, and Distribution

Funding for this study is provided by the **North Dakota Lignite Energy Council**

Confidentiality

This is a confidential request -- only the immediate research team has access to this information, and the information is never shared with any interests during or after the study. A confidentiality agreement can be provided upon request.

Guidelines and Instructions

Please use the following guidelines.

1. Please provide information for 2019.

2. For firms with multiple locations in North Dakota, please combine all locations associated with lignite-power generation, transmission, and distribution into one questionnaire.

   Note: Please do not include mining operations in this questionnaire. Coal mining is being handled separately.

3. When information is not available, please estimate.

4. Definitions for selected expenditure items are included to help determine allocation of expenditures.

5. Please complete the survey by August 31, 2020.
   You can mail the survey in the prepaid envelope or email the questionnaire to Dean Bangsund at the address below.

Study Contacts

Dean Bangsund (701-231-7471)
d.bangsund@ndsu.edu
Dr. Nancy Hodur (701-231-8621)
nancy.hodur@ndsu.edu

Mailing Address
Dean Bangsund
Richard H. Barry Hall
Dept # 7610, PO Box 6050
North Dakota State University
Fargo, ND 58108-6050

Survey of Lignite Industry

Company: _____

Contact Person: _____

Email: _____ Phone: _____

I. Revenues for 2019 for Lignite-power Generation and Transmission Operations in North Dakota (financial values can be rounded to thousands)

Sources of Revenue	Total Revenue for Operations in North Dakota
Sales of Electricity	$
Sales of Other Lignite-Energy Products (please specify)	$
	$
	$
	$
	$
	$

II. Employment for 2019 for Lignite-power Generation and Transmission Operations in North Dakota.

Employment	Electricity Generation	Electricity Distribution and Transmission
Number of full-time		
Number of part-time and seasonal		

III. Expenditures for 2019 for Lignite-power Generation and Transmission Operations in North Dakota (financial values can be rounded to thousands)

Definitions for some expense categories are appended at the end of this table. If in doubt as to where a particular expense might be placed, please write in the type of expense.

	Categories	Total Expenses for North Dakota Operations	Percentage paid to North Dakota Sources
Example: telecommunications		$35,000	80%
Employment Compensation			
	Wages, salaries, bonuses	$	%
	Employee Benefits	$	%
Expenditures			
	Purchases of lignite coal	$	%
	Purchases of electricity for distribution	$	%
	Purchases of plant equipment	$	%
	Contract Construction	$	%
	Communications	$	%
	Utilities	$	%
	Repairs and Maintenance (lignite-power plants, electricity distribution infrastructure, and all other general facilities)	$	%
	Insurance	$	%
	Loan interest and finance charges	$	%
	Advertising and public relations	$	%
	Fees, permits, licenses, inspections, audits, tax preparations	$	%
	Office supplies, computers, software	$	%
	Meetings, Conventions, Travel	$	%
	Training, Safety, Employee Education	$	%
	Rent and Leases (exclude Federal coal leases)	$	%
	Legal and attorney fees	$	%
	Other Expenses (please list)	$	%
		$	%

	Other Expenses (cont.)	$	%
		$	%
		$	%
		$	%
		$	%
		$	%
		$	%
Taxes Paid in North Dakota (please exclude payroll taxes)			
	Property Tax	$	100%
	Sales and Use	$	100%
	Corporate Income	$	100%
	Others (please list)	$	100%
		$	100%

Selected Definitions:

Wages and Salaries: Wages, salaries, and bonuses for part-time, seasonal, and full-time employees. Any pensions paid to retired employees. Please exclude payroll benefits.

Employee Benefits: Includes payments for health, dental, and vision insurance, retirement contributions (e.g., 401k, company pension funds) for active employees, state payroll taxes, unemployment taxes, and Workforce Safety Insurance contributions.

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Communications: Includes expenditures for telephone, radio, television, satellite services, Internet service, DTN feeds, cell phones, and other communication services.

Public Utilities: Includes expenses for natural gas, electricity, water supply, sewer and garbage services.

Manufacturing: Includes expenses for on-site fabrication of equipment, machinery, and processing components and expenses for materials, structural components, equipment, machinery and other goods purchases directly from a manufacturing firm. Also includes rebuilding of machinery and equipment at a processing plant.

Taxes: Only include taxes paid in North Dakota. Do not include taxes paid in other states, or to the Federal government. Note: payroll taxes are included in employment compensation in the employee benefits category.

Miscellaneous Expenses: Please write in any expenses that do not fit with the supplied categories. If needed, those listings can be attached on another sheet of paper.

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Appendix B

Economic Impact Modeling

Overview

Economic impact assessments measure the economic activity from a project, program, policy, or activity. Economic activity is categorized into direct and secondary impacts. Direct impacts are those changes in output, employment, or income that represent the initial or first-round effects of a project, program, or event. Secondary impacts result from subsequent rounds of spending and re-spending within an economy.

Direct economic impacts are usually measured as injections (or reductions) of money into a specified economy. Direct impacts therefore represent inputs into an economic model to trace linkages among sectors of an economy and calculate various forms of business activity resulting from a direct impact in an economic sector.

Input-Output Analysis

Input-output analysis is a mathematical representation of the production and consumption of goods and services within a given economy. The basic premise to input-output modeling can be traced to economic base theory, or the understanding that a given economy is comprised of both 1) economic sectors or industries which produce goods/services for export outside the economy (basic sectors) and 2) economic sectors which produce goods/services within the economy for use by those exporting industries (non-basic sector). However, most current I-O modeling platforms do not limit economic activity in non-basic sectors to be driven or determined entirely by basic sector output.

Input-output analysis is premised on the notion of inter-industry transactions, where industries use products/services from other industries to generate their output, and outputs from one industry usually represent inputs to another industry. The basis for the interdependence (linkages) within input-output analysis between consuming and producing industries forms the foundation for development of multiplier effects. Multiplier effects can then be used to estimate how initial changes in economic activity result in economy-wide changes in a given area and represent the core component of input-output analysis.

While input-output analysis is a popular methodology used by a host of different stakeholders, the methodology has a number of fundamental assumptions or limitations. Key assumptions in input-output methodologies include 1) the economy is in equilibrium, 2) any expansion or contraction is linear, constant, and fixed, 3) no price and substitution effects, and 4) no supply constraints. This means that I-O models are a static representation of an economy and do not provide for dynamic adjustments that are likely to occur in an economy, especially those relating to large, fundamental changes in the size or structure of an area's key industries.

Since I-O models are widely available and used, output from those models is often accepted without much scrutiny. Despite development and use of other modeling processes (e.g., general equilibrium models) to mitigate the limitations and shortcomings of I-O modeling, I-O analysis remains the most widely used approach to conducting economic impact and contribution assessments.

Types of Economic Evaluations

Input-Output analysis provides a tool for economists to perform ***economic impact*** and ***economic contribution*** analyses. These analyses can be applied to programs, projects, developments, industries, and other economic activities. Key macro-economic indicators such as retail trade activity, employment compensation, labor income, value-added output, total business activity, secondary economic business activity (indirect and induced), selected government tax collections, and secondary (indirect and induced) employment can be estimated using input-output analysis.

Economic impact analysis estimates the change in key economic indicators resulting from the 'new' dollars (either gained or lost) from a specific project or development within a given economy. An economic impact analysis measures the net effect of two possible situations–often these situations would be the presence or absence of some type of economic activity, development, or program. Measures of the business activity generated in secondary industries are included in economic impact figures.

Economic contribution analysis differs in that it includes all relevant revenues and expenditures in the generation of the amount of economic activity created in an economic unit. Economic contribution analyses attempt to capture all economic activity without regard to the net change or value of alternative economic activities; therefore, economic contribution assessments provide measures of the gross effects. Typically, an economic contribution analysis will show more economic activity than found in an economic impact study for the same industry or activity. Measures of the business activity generated in secondary industries are included in economic contribution figures.

Key Definitions

Direct Economic Effects: Direct economic impacts represent the first-round of payments for services, labor, and materials. Direct effects can be interpreted to represent jobs, labor income, and business activity that comprise the Agriculture Industry.

Indirect Economic Effects: Indirect economic effects arise from the additional consumption of goods and services triggered by businesses that supply inputs to firms in a given sector/industry. Indirect effects can be interpreted as the additional economic activity created through purchases by businesses.

Induced Economic Effects: Induced economic effects arise from the additional spending by households from changes in personal income associated with direct effects and indirect effects. Changes in personal income can come from payrolls of businesses that are directly impacted, changes in payroll from businesses that supply goods and services to an impacted sector (induced effects), and proprietor income resulting from a change in business volume. Induced effects measure the additional business activity that is triggered as changes in personal income are translated into the purchase of goods and services for personal consumption.

Value-added Effects: Value-added economic activity is a measure of the payment to labor and capital, and includes labor income, business taxes, and business/proprietor income

(profit). This economic effect is sometimes referred to a measure of the value that is added to purchased inputs by a business or industry, and is analogous to gross state product. The use or consumption of goods and services in the production of another good or service is not included in value-added measures.

Total Economic Output: Total output is a measure of the business activity created by summing direct economic effects, indirect economic effects, and induced economic effects. This economic measure is sometimes called gross business volume. Total output therefore represents the sum of gross receipts of all economic sectors.

Employment and Employment Compensation: Employment is perhaps one of the most important economic measures associated with impact assessments. Direct employment represents the jobs employed by the business or economic sector for which the activity or event is being modeled. I-O analysis also estimates employment associated with indirect and induced economic effects. Changes in employment compensation include wages, salaries, and employment benefits linked to changes in employment levels.

Government Revenue: Changes in revenues to state and local governments are another important measure in most contribution studies. I-O models estimate changes in selected government revenues such personal income, sales and use, corporate income, severance, and property taxes, and a variety of miscellaneous revenues such as permits, fees, licenses, and dividends. Government revenues are not generally additive to economic effects, as most government revenues are either imputed internally or directly comprise a component of an industry balance sheet.

Selection of Input-output Model

The Department of Agribusiness and Applied Economics at NDSU developed an I-O model for North Dakota back to the 1960s and it was an important economic tool examining energy development projects in the state during the 1970s. The basic data for the model came from surveys of firms and businesses in the state, and key economic statistics included a corresponding data set defining state-level net exports (economic base and export-based sales to final demand), employment productivity ratios, and tax coefficients. The model and supporting economic data were widely-used for examining economic impact and economic contribution effects in the region. Finally, maintenance and use of the North Dakota Input-output Model was suspended in 2018 as personnel and resources were no longer available to support the model. This prompted the impact assessment research team, spearheaded jointly by Dean Bangsund, Department of Agribusiness and Applied Economics, and Dr. Nancy Hodur, Director, Center for Social Research, to devise a new modeling platform.

A number of commonly used input-output models are available for conducting impact assessments for North Dakota. Publicly available models include RIMS II (Regional Input-Output Modeling System), IMPLAN (Impact Analysis for Planning), REMI (Regional Economic Models Inc.), and EMSI Analytics (Economic Modeling Specialists). There are other commercial models that are 1) not available for state-level analysis (e.g., REdyn, which combines I-O factors with CGE processes but is only used for the US national economy), 2) specialize in fiscal effects and do not provide the same degree of impact assessment as the more common I-O models (e.g., LOCI, which only examines government costs of various types of impacts), and 3) built with varying degrees of sophistication primarily targeting subject-matter issues (e.g., JEDI-NREL that examines some economic impacts of constructing and/or operating energy-based facilities).

REMI was considered the best option from an empirical capacity, but the cost of acquiring the model and subscribing to annual baseline data was prohibitive. RIMs II is inexpensive, but the analytical capacity is substantially limited, and does not have any baseline or supporting data sets. IMPLAN was chosen as the modeling system since it is supported with detailed baseline data, and cost was not prohibitive.

IMPLAN

IMPLAN modeling system is a popular input-output methodology because of its flexibility and customizability for structuring economic scenarios and ease of access to key data sets used in the modeling process (IMPLAN Group LLC 2016). IMPLAN can be structured to evaluate economic effects through a number of model operations. Those operations range from a change in sales for an entire industry to personal spending patterns for households with a specific income level. The flexibility to structure an assessment using multiple economic criteria, along with customization of baseline data, allow IMPLAN to be tailored to most economic conditions.

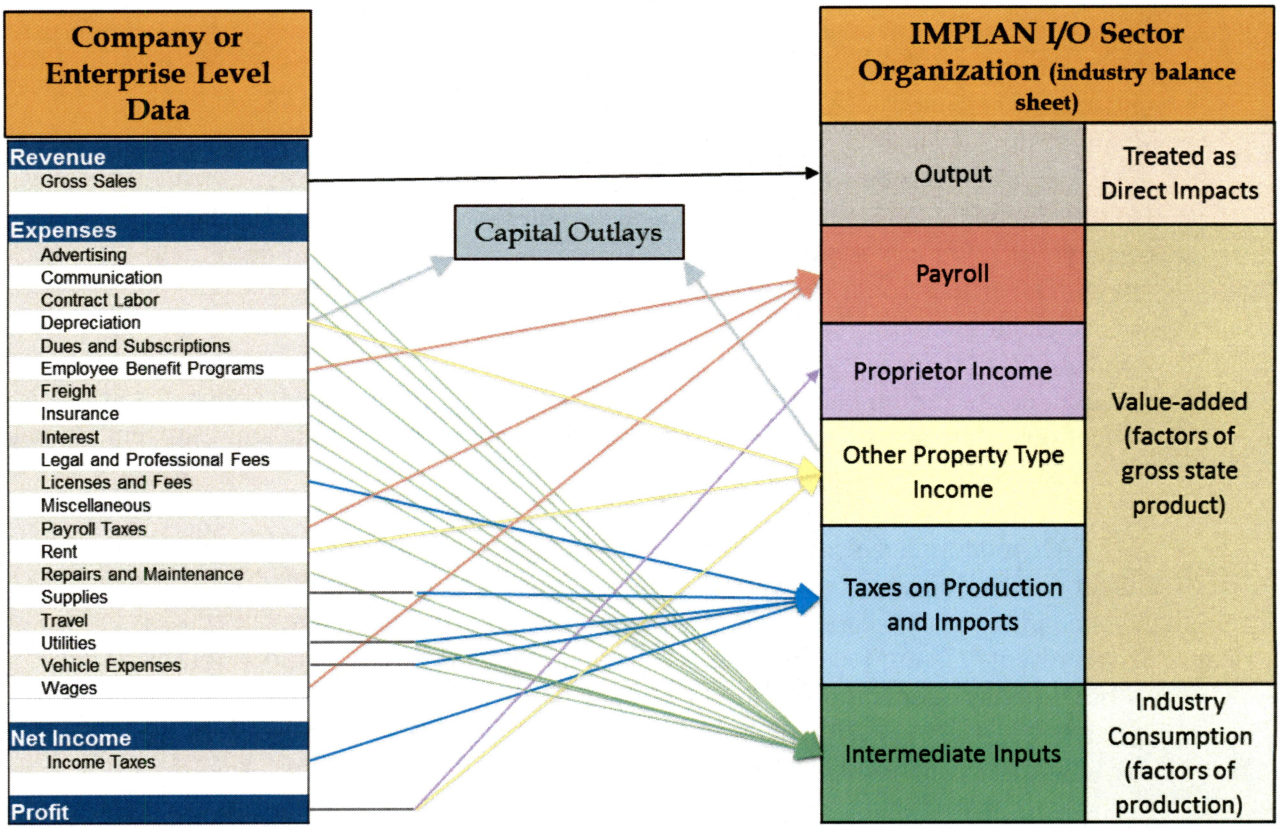
IMPLAN modeling system uses a variety of data sets to construct the I-O model. In general, those data sets begin with federal data, work through regional and state-level economic statistics, and if available, attempt to combine information for counties or other smaller geographic units. [see www.implan.com for more detail regarding data sets used to construct the model]. Some of the key data sets for IMPLAN include the following:

-) U.S. Bureau of Labor Statistics Covered Employment and Wages (ES202)
-) Bureau of Economic Analysis Benchmark I/O Accounts of the U.S. and Output Estimates
-) U.S. Census Bureau's Program and Consumer Expenditure Survey, Census Bureau County Business Patterns, Decennial Census and Population Surveys, Censuses and Surveys
-) U.S. Department of Agriculture National Agricultural Statistics Service
-) U.S. Geological Survey.
-) Information is also collected on military and non-military federal activities, railroads, personal consumption patterns based on various income levels, local and state tax collections, state and local government purchases and expenditures, and transfers among inter-institutional entities.

IMPLAN modeling system is a widely used and well-recognized source of economic data—this process is desirable because it allows for consistency and compatibility across regional, state, and sub-state economies. However, not all industries within all economies are accurately represented using federal, state, and local secondary data in combination with IMPLAN baseline data generation techniques (Downes 2012, Booz Allen Hamilton 2008). To address potential problems, IMPLAN has built flexibility into the modeling system so that local or other primary data can be substituted for default values within the model.

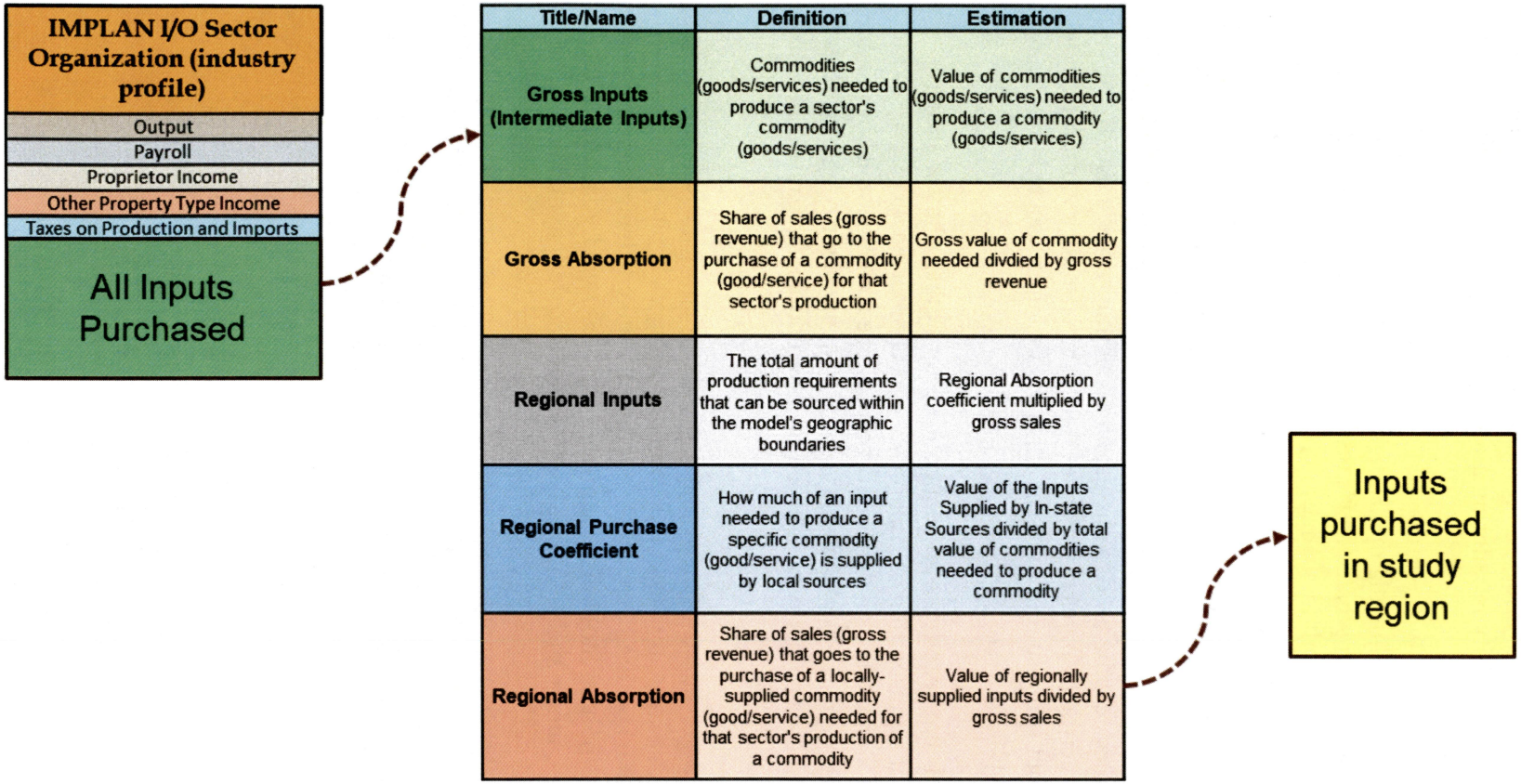
IMPLAN's Industry Structure

IMPLAN organizes financial information for industries in a manner different from traditional enterprise budgets or income statements.



General Transposition of Financial Information into IMPLAN Economic Sector Profiles

Source: DA Bangsund, Department of Agribusiness and Applied Economics, NDSU



Adjusting Gross Purchases of Inputs to Share of Inputs Purchased within a Study Region through IMPLAN Economic Sector Profiles

Source: DA Bangsund, Department of Agribusiness and Applied Economics, NDSU

IMPLAN Mapping

IMPLAN uses a variety of mechanisms, or economic triggers, to introduce a direct impact into a specified economy. Using a variety of mechanisms is one of the key attributes of the model that provide substantial flexibility in tailoring assessments to match expected economic activity.

An ***Industry Change*** represents adjusting the demand for the goods and services produced by an economic sector by varying that sector's revenue. Within this context, changes in sector gross revenues automatically result in changes in required labor, goods and services used to produce the sector's output (intermediate inputs), taxes on production and inputs (e.g., sales tax, property tax), and sector income. After setting the level of revenue change for an economic sector, IMPLAN allows custom values for employment, employment compensation, and sector income to be entered if default values are not desired.

Industry Spending Patterns can be used to change an economic sector's use of intermediate inputs without triggering changes in revenues, labor expenses or requirements, or sector income. The specific input is the sum of the total expenses that are expected to be purchased by that economic sector.

Labor Income Change is not specific to an economic sector, rather it introduces an increase in the payment for labor inputs within an economy. This approach also by-passes the need to change other aspects of an industry's balance sheet to achieve a change in labor income; however, the *Labor Income Change* requires a manual (i.e., calculated outside of the IMPLAN model) estimate of the change in direct employment based on assumptions for payroll expenses per job.

Household Income Change is used when personal spending capacity within an economy is increased, but there is not necessarily any direct link to output changes in any particular economic sector or when personal spending capacity is not directly linked changes in labor income. These types of changes in household income might be represented by income from royalties, trusts, easements, gifts, inheritances, lotteries, and social transfer payments.

Institutional Spending Patterns are used to estimate how changes in public sector revenues influence the consumption of goods and services by government entities, educational institutions, non-profits and other non-governmental organizations. *Institutional Spending Patterns* also provide options for use of household spending patterns by income levels, which can be used to approximate the consumption of goods and services by households.

IMPLAN Fiscal Analysis Methodology

IMPLAN estimates fiscal impacts by examining total government revenues from a variety of data sources. The model then estimates the share of government revenues based on the individual source of revenue (e.g., sales tax, income tax, severance tax, fees, and licenses). IMPLAN compares total government revenues, from all sources, with total industry output from all sectors in the economy. That process produces an estimate of tax revenue per unit of average industry output (e.g., gross sales, state gross product). The model does not estimate tax collections stemming from individual economic sectors or industries. Therefore, to estimate the fiscal impacts of a project, program, or activity, IMPLAN estimates the change in economy-wide business output, and then estimates the fiscal effects by multiplying that change in business output by the ratio of government revenues to economy-wide output. This process produces a direct relationship between expected new government revenues and a change in industrial or economic output.

Shortcomings and limitations of IMPLAN's fiscal impact methodology in North Dakota include.

A. IMPLANs fiscal impact methodology is locked on the premise that all government revenues are intrinsically linked to changes in economy-wide economic output. This relationship is embedded within IMPLANs default tax ratios and leads IMPLAN to generate large changes in some tax revenues even when direct causation is not contained in the economic assessment (i.e., without linking an economic impact to a specific change in a tax base or tax rate, or linking tax revenues on a per-sector basis). For some tax revenues, such as severance taxes, that methodology produces erroneous estimates. For other tax revenues, general economic output is a reasonable proxy for estimated changes in tax revenues.

B. IMPLAN's fiscal impact methodology cannot be adjusted internally to reflect state rules and stipulations affecting the specific taxes relating to unique conditions or special treatment that adjusts the tax base or tax rate.

IMPLAN Fiscal Data Sources and Treatment of Tax Data

The following discussion of data sources is provided by IMPLAN Group LLC (2018).

IMPLAN's tax impact report values are based on the existing relationships of the data found in the IMPLAN database. The sources for these data are listed below, followed by description of each data element in the tax impact report.

- **NIPA Tables.** All items in the IMPLAN data sets are ultimately controlled to the U.S. level values from the Bureau of Economic Analysis' (BEA) National Income and Product Accounts (NIPA). Section 3 of the NIPA tables covers Government Current Receipts and Expenditures.

- **Consumer Expenditure Survey (CES).** The U.S. Census Bureau through the Consumer Expenditure Survey annually conducts surveys and diary samplings of household expenditure patterns. The survey data are reported for nine different categories of household income, which we control to the NIPA's Personal Consumption Expenditure (PCE) totals (which are not split out by income category). From these data, we can establish the tax-to-income relationships for the nine different household income categories. It is based on these relationships that we can distribute many of the national-level tax data to states and state-level tax data to counties, using the number of households in each of the nine household categories in the state or county.

- **Annual Survey of State and Local Government Finances (SLGF).** The U.S. Census Bureau also collects annual State/Local Government receipts and expenditures data. These data act as preliminary controls for state-level values (subject to controlling to the national NIPA values). That data also provide the proportional split of the Tax on Production and Inputs (TOPI) value amongst the various types (sales, property, etc.). The actual value of total TOPI (at the state level) comes from the BEA's REA series.
    - The annual survey also provides local government collections by tax type. These data are used to estimate, for the total state/local tax receipts, the share of each type of tax that belongs to local government. The data for each local government is then used to apportion that local total (at the state level) to each county. Since the local total for each county is estimated, the model can distinguish between the state and local tax revenue in the tax impact report. In IMPLAN Online, the tax impact report includes 4 types of governments that compose State/Local Government:
        - State government
        - County government
        - Sub-county general government, which includes city and township governments, for example
        - Sub-county special government, which includes fire and public school districts, for example
    - IMPLAN supplements gaps in the SLGF with 5-year Census of Governments data, and supplements the SLGF state tax revenue with current-year state tax collections data from the Census.

- **Regional Economic Accounts (REA).** The Bureau of Economic Analysis collects and reports income, wealth, tax, and employment data on a regional, state and county basis. The REA data from these two tables are used to distribute the U.S. NIPA values to states and counties:
        - Table CA05 -- Personal Income by Major Source and Earnings by Industry
        - Table SA50 -- Personal Tax and Non-tax Payments

IMPLAN Tax Identification Scheme					
Description	**Employee Compens-ation**	**Proprietor Income**	**Tax on Production and Import**	**House holds**	**Corpor-ations**
State and Local Taxes					
Dividends					O
Social Ins Tax- Employee Contribution	A	C			
Social Ins Tax- Employer Contribution	B				
Tax on Production and Imports: Sales Tax			D		
Tax on Production and Imports: Property Tax			E		
Tax on Production and Imports: Motor Vehicle Lic			F		
Tax on Production and Imports: Severance Tax			G		
Tax on Production and Imports: Other Taxes			H		
Tax on Production and Imports: S/L NonTaxes			I		
Corporate Profits Tax					P
Personal Tax: Income Tax				J	
Personal Tax: NonTaxes (Fines-Fees				K	
Personal Tax: Motor Vehicle License				L	
Personal Tax: Property Taxes				M	
Personal Tax: Other Tax (Fish/Hunt)				N	
Federal Taxes					
Social Ins Tax- Employee Contribution	Q	S			
Social Ins Tax- Employer Contribution	R				
Tax on Production and Imports: Excise Taxes			T		
Tax on Production and Imports: Custom Duty			U		
Tax on Production and Imports: Fed NonTaxes			V		
Corporate Profits Tax					X
Personal Tax: Income Tax				W	
Source: IMPLAN Group LLC (2018).					

The following definitions and sources are provided by IMPLAN Group LLC (2018) and correspond with labeling in the IMPLAN Tax Identification Scheme.

A. Employee-paid portion for State/Local social insurance. This represents retirement plans and temporary disability insurance. The U.S. value comes from National Income and Products Accounts (NIPA) Table 3.6. This value is distributed to states based on each state's share of the following items from the State and Local Government Finances report (SLGF).

Employee Retirement – Local Employee Contribution;
Employee Retirement – State Employee Contribution;
Workers Compensation – Other Contributions.

These state values are distributed to counties based on each county's proportion of the state's State/Local Government Non-Education Employee Compensation. The county-level State/Local Employee Compensation figures come from U.S. Bureau of Economic Analysis. These are then split into Education vs. Non-Education using various data from the U.S. Census Bureau and the U.S. Department of Education.

B. Employer-paid portion for State/Local social insurance funds. This represents workers' compensation and temporary disability insurance. The U.S. value comes from NIPA Table 3.6. This value is distributed to states and based on each state's share of the following items from the SLGF:

Employee Retirement – From Local Government;
Employee Retirement – From State Government;
Unemployment Compensation – Contribution;
Workers Compensation – Own Contributions.

County distribution is based on county portion of state and local government non-education employee compensation from IMPLAN.

C. State/Local social insurance paid by self-employed. Self-employed individuals do not make payments to State/Local government, so this entry will always have a value of $0.

D. Sales Taxes on "Other Property Type Income" (TOPI) paid to State and Local Governments. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of Total General Sales Tax from the SLGF. State government values are then distributed to counties based on total retail output.

E. TOPI property taxes paid to State and Local Governments. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of Total Property Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

F. TOPI motor vehicle license taxes paid to State and Local Governments. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of Motor Vehicle Operator's License Tax and Motor Vehicle License Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

G. TOPI severance taxes paid to State and Local Governments. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of Severance Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

H. TOPI other taxes paid to State and Local Governments. This item consists largely of business licenses and documentary and stamp taxes. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of the following tax items from the SLGF: Corporation License; Amusement License; Other License; Documentary & Stock Transfer; Public Utility License; Alcoholic Beverage License; Occupation & Business License, NEC; and NEC. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

I. TOPI non-taxes paid to State and Local Governments. This item includes rents and royalties, special assessments, fines, settlements, and donations. The U.S. value comes from NIPA Table 3.5. The U.S. value is distributed to states based on each state's proportion of the following tax items from the SLGF: Miscellaneous – Rents; Miscellaneous – Special Assessments; Miscellaneous – Royalties; and Miscellaneous – Donations from Private Sources. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

J. Personal income tax payments to State and Local Governments. The U.S. value comes from NIPA Table 3.3. The U.S. value is distributed to states based on Individual Income Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

K. Personal non-tax payments to State and Local Governments. This item includes payments for fines and donations. The U.S. value comes from NIPA Table 3.3. The U.S. value is distributed to states based on Motor Vehicle License Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

L. Personal motor vehicle fee payments to State and Local Governments. The U.S. value comes from NIPA Table 3.4. The U.S. value is distributed to states based on Miscellaneous – Fines & Forfeits from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

M. Personal property tax payments to State and Local Governments. The U.S. value comes from NIPA Table 3.4. The U.S. value is distributed to states based on Property Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

N. Personal other tax payments to State and Local Governments. This item consists largely of hunting, fishing, and other personal licenses. The U.S. value comes from NIPA Table 3.4. The U.S. value is distributed to states based on Hunting and Fishing License Tax from the SLGF. State government values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

O. State/Local Government Dividends. This item represents net dividend payments to government by corporations from investments. The U.S. value comes from NIPA Table 3.3. The U.S. value is distributed to states based on the following items from the SLGF:

Employee Retirement – Securities – Mortgages;
Employee Retirement – Securities – Corporate Stocks;
Employee Retirement – Securities – Corporate Bonds;
Employee Retirement – Total Other Securities.

State government values are distributed to counties is based on their proportion of state Other Property Income (from IMPLAN database).

P. State/Local Government corporate profits tax. The U.S. value comes from NIPA Table 3.3. The U.S. value is distributed to states based on Corporate Net Income Tax from the SLGF. State government values are then distributed to counties is based on counties based on their proportion of the state's Other Property Income (from IMPLAN database).

Q. Employee-paid portion for Federal social insurance. This item includes social security, survivors insurance, disability insurance, hospital insurance, supplemental medical insurance, unemployment insurance, veterans' life insurance, and railroad retirement plans. The U.S. value comes from NIPA Table 3.6. The U.S. value is distributed to states and counties based on Personal Contribution for Social Insurance from the BEA's CA05 table.

R. Employer-paid portion for Federal social insurance. This item includes social security, survivors insurance, disability insurance, hospital insurance, military medical insurance, unemployment insurance, pension benefit guaranty, veterans' life insurance, and railroad retirement plans. The U.S. value comes from NIPA Table 3.6. The U.S. value is distributed to states and counties based on Personal Contribution for Social Insurance from the BEA's CA05 table.

S. Self-Employed contribution to Federal social insurance. This item includes social security, survivors insurance, disability insurance, and hospital insurance. The U.S. value comes from NIPA Table 3.6. The U.S. value is distributed to states and counties based on Personal Contribution for Social Insurance from the BEA's CA05 table.

T. TOPI Federal Excise Taxes. This item includes federally levied excise taxes on alcohol, tobacco, telephones, coal, fuels, air transportation, vehicles, etc. The U.S. value comes from NIPA Table 3.2. The U.S. value is distributed to states and counties based on IMPLAN estimates of total TOPI for all industries in relationship to U.S. total TOPI.

U. TOPI Federal Custom Duties. These are gross collections less refunds. The U.S. value comes from NIPA Table 3.2. The U.S. value is distributed to states and counties based on IMPLAN estimates of total TOPI for all industries in relationship to US total TOPI.

V. TOPI Federal Non-taxes. This item includes rents and royalties4. The U.S. value comes from NIPA Table 3.2. The U.S. value is distributed to states and counties based on IMPLAN estimates of total TOPI for all industries in relationship to U.S. total TOPI.

W. Personal Income taxes paid to the Federal Government. These are taxes paid through withholding, declarations and final settlement less refunds. The U.S. value comes from NIPA Table 3.2. The same value can also be found in NIPA Table 3.4. The U.S. value is distributed to states based on each state's value of "Federal government: Individual Income taxes (net of refunds)" from the BEA's SA50 table. State values are then distributed to counties based on total Personal Income from the BEA's CA05 table.

X. Federal Corporate profits tax. The U.S. value comes from NIPA Table 3.2. The U.S. value is distributed to states and counties based on their proportion of U.S. Other Property Income (from IMPLAN database).

Definition of Government Revenues Produced by IMPLAN	
Government Level	**Definition**
State and Local Government Revenues	
Dividends	State and Local government dividends represents dividend payments to government by corporations from investments.
Social Insurance Taxes: Employee Contribution	The social insurance contributions paid by state employees towards State sponsored pensions, in lieu of social security.
Social Insurance Taxes: Employer Contribution	The social insurance contributions paid by the State towards State sponsored pensions, in lieu of social security.
Indirect Business Tax: Sales Tax	Sales taxes paid to State and Local government.
Indirect Business Tax: Property Tax	Real estate based property taxes paid by firms to State and Local governments. Because of the special situation encountered with Sector 361, this includes payments of property taxes made on homes.
Indirect Business Tax: Motor Vehicle	Motor vehicle license taxes paid by firms to State and Local governments.
Indirect Business Tax: Severance Tax	Taxes imposed by a State on the extraction of natural resources.
Indirect Business Tax: Other Taxes	Other taxes paid to State and Local governments include business licenses, documentary and stamp taxes.
Indirect Business Tax: S/L Non-taxes	IBT state and local non-tax payments include fines (such as parking and speeding tickets), fees (State and County park passes or day fees) and donated funds.
Corporate Profits Tax	Corporate profits taxes paid to State and Local governments.
Personal Tax: Income Tax	Income taxes paid by individuals to State and Local Government through withholding, declarations and final settlement, less refunds.
Personal Tax: Non-taxes (fines and fees)	Household personal nontax payments to State and Local governments include fines, donations, passport and immigration fees, and migratory bird-hunting stamps.
Personal Tax: Motor Vehicle Licenses	Household personal motor vehicle fee payments to State and Local governments.
Personal Tax: Property Taxes	Household personal property tax payments to State and Local governments. Dividend, interest, and rental income of persons with capital consumption adjustment are sometimes referred to as property income.
Personal Tax: Other Tax (Fishing/Hunting)	Other taxes consist of miscellaneous fees and licenses (such as hunting and fishing licenses, marriage licenses, registration of pleasure boats, and licenses for pets) to State and Local governments.

Federal Government Revenues	
Social Insurance Taxes: Employee Contribution	The employee paid portion for Federal social insurance. These contributions include payments by employees, the self-employed, and other individuals who participate in the following government programs: Old-age, survivors, and disability insurance (social security, FICA); hospital insurance; supplementary medical insurance; unemployment insurance; railroad retirement; veterans life insurance; and temporary disability insurance.
Social Insurance Taxes: Employer Contribution	The employer paid portion for Federal social insurance. This includes social security, unemployment insurance, medical and retirement plans.
Indirect Business Tax: Excise Taxes	Includes Federally levied excise taxes on alcohol, tobacco, telephones, coal, fuels, air transportation, vehicles, etc.
Indirect Business Tax: Custom Duty	Custom duties are gross collections net refunds.
Indirect Business Tax: Non-Taxes	IBT Federal non-tax payments include petroleum royalties, fines, regulatory fees, forfeitures and donated funds.
Corporate Profits Tax:	Corporate profits taxes paid to Federal governments.
Personal Tax: Income Tax	Income taxes paid by individual to the Federal Government through withholding, declarations and final settlement, less refunds.
Source: IMPLAN Group LLC (2018).	

Appendix C

Adjustments to IMPLAN Baseline Data

IMPLAN Customization

For sake of brevity, industry financial data that has been collected from the Lignite Industry through surveys conducted by the Department of Agribusiness and Applied Economics at North Dakota State University is labeled as 'survey data.'

The comparison of IMPLAN's baseline data to survey data began with using IMPLAN to estimate the potential economic impacts of CO2 Enhanced Oil Recovery (EOR) development in North Dakota, as part of two studies at the Energy & Environmental Research Center, University of North Dakota (Energy & Environmental Research Center 2018a, 2018b). Those efforts revealed the need to substantially change several key elements within the industry.

IMPLAN's baseline data on lignite mining and coal-fired electricity generation in the state was found to not match the industry's structural arrangement consistent with mine-to-mouth operations. IMPLAN's estimates of coal exports from ND suggested a high percentage of the lignite mined in the state was exported. This is obviously erroneous. Using state data that tracks coal tonnage severed in the state, combined with Energy Information Association (EIA) information on coal prices, revealed that gross sales from coal mining within IMPLAN were also not consistent with actual industry output from 2010 through 2017. In 2015 IMPLAN was suggesting coal mining was two times larger than what in-state data suggested.

Further, when the sector linkages between electricity generation from fossil fuels (IMPLAN sector 42) and coal mining were evaluated, IMPLAN sector 42 was only consuming 20 percent of the lignite coal mined (on a dollar basis). Purchases of natural gas by IMPLAN sector 42 were larger monetarily than purchases of coal – again, both of these conditions are obviously erroneous. North Dakota has little electricity generation from natural gas and nearly all lignite mined in ND is consumed in ND. IMPLAN's baseline data did not represent the ND Lignite Industry. Due to the data sources and processes employed by IMPLAN in development of the North Dakota economy baseline data, it is postulated that the underlying data used to build the lignite industry inside IMPLAN reflected industry conditions prevalent in other parts of the country.

IMPLAN was modified to more accurately represent the lignite industry by adjusting gross sales, changing the linkages between industry-related sectors, refining the industry's production function and regional absorption of intermediate inputs. Essentially, those economic sectors were re-built to reflect the state's mine-to-mouth operations.

The following discussions highlight the process that was used to re-calibrate IMPLAN's lignite sectors using survey data, and other secondary data from state sources.

1) Align Data to Common Economic Sectors

Survey data from NDSU's previous economic assessments of the Lignite Industry were obtained from individual firms, which collectively represent all lignite-based activities in the state. NDSU economic contribution analyses for lignite-based activities in ND have consistently considered those activities to be one economic unit (sector). By contrast, IMPLAN divides

lignite-based activities into three economic sectors, which include Sector 22 Coal Mining, Sector 42 Electricity Generation from Fossil Fuels, and Sector 49 Electricity Transmission and Distribution. Data from individual firms were grouped based on the operation of mines, generation of electricity, and/or the wholesale distribution of electricity. Rather than aggregating IMPLAN data to consolidate three economic sectors into one sector, firm-level data from survey data were compiled to align with the three IMPLAN sectors.

2) Organize IMPLAN and Survey Expenditure Data using Common Economic Definitions

A process was created that facilitated direct groupings and comparisons of economic data based on IMPLAN's economic sectors and commodity codes and North American Industrial Classification System codes (NAICS). IMPLAN data is organized with a unique economic classification system and survey data are largely based on loosely defined areas associated with NAICS codes. IMPLAN default economic data were aligned based on NAICS codes and survey data was correspondingly aligned to NAICS codes. That process allowed direct comparison of economic data from IMPLAN and NDSU surveys.

The amount and type of intermediate expenditures for each of the three economic sectors were evaluated. The listing of "intermediate inputs" within IMPLAN represents all the goods and services consumed in the production of a commodity (i.e., a good or service). Intermediate inputs are sometimes referred to as an industry production function. The importance of having accurate spending patterns is fundamental to generating realistic economic impacts for any activity, policy, program, or event.

3) Adjusting Gross Inputs and Regional Inputs for IMPLAN sectors

A modeling process was developed to align survey expenditure data with IMPLAN industry production functions. IMPLAN's intermediate inputs are first identified as gross inputs, which represent the total amount of the good or service used by that economic sector within the defined study area. The amount of the good or service purchased within the study area (i.e., purchases from local sources) is called regional inputs. Survey data was used to estimate regional inputs for the firms comprising the lignite industry.

The process of changing the level of regional inputs within IMPLANs production functions to more closely represent survey data required proportional adjustments to each regional input that was grouped into any of the 2-digit NAICS codes. For example, expenditures for communications (2-digit NAICS code 51) for intermediate inputs for IMPLAN Sector XYZ may contain $30 for internet, $50 phone, and $20 for data processing, for a total of $100. However, if total regional inputs for communications should more closely approach $200, then a new allocation of regional expenditures among the production function for Sector XYZ would be $60 for internet, $100 phone, and $40 for data processing.

Several additional adjustments were performed to re-align and retain IMPLAN's estimate of total purchases of intermediate inputs. For example, IMPLAN Sector 42 contains substantial gross inputs for natural gas, which is reflective of the types of inputs used for electricity generation from fossil fuels found across a more diverse set of industry enterprises at the national or multi-

state level. As a top-down model, many of those national and multi-state characteristics are retained as part of the model building process to form state and sub-state industries. However, because IMPLAN's data (or more precisely the choice to not custom develop a local industry from only local data sources) does not specifically match the operational characteristics of coal-fired electricity generational for ND, expenses such as natural gas, were substantially reduced from default levels found within IMPLAN's industry production function. The Electricity Generation from Fossil Fuels[1] sector in ND is primarily mine-to-mouth, and as such, lignite coal is the source of fossil fuel for the sector.

A key adjustment in the IMPLAN model included adjusting the source of coal purchases for all economic sectors that contain coal as a commodity in their intermediate inputs. Since the coefficients for acquisition of coal from IMPLAN sector 42 were set to equal the value of sales from IMPLAN sector 22, that would, by default, exhaust the in-state supply of coal. Therefore, to avoid distortions in the model and to balance the supply of coal with the demand for coal in ND, all other purchases of coal within IMPLAN would need to be made from out-of-state sources (imports). Regional purchase coefficients for coal were set to zero for all economic sectors except sector 42.

4) Adjusting Employment and Employment Compensation

IMPLAN combines wages and salaries and employee benefits into 'employment compensation'. Survey data for wages, salaries and employee benefits were combined to be consistent with the IMPLAN modeling system. Both the level of employment and employment compensation were adjusted within IMPLAN to match survey data. In some economic sectors, proprietor income and proprietors employed are present and would need to be treated separately; however, those conditions are not present in any substantive capacity in IMPLAN sectors 22, 42, and 49.

5) Summary

-) Reconcile financial data collected from the industry to existing data within IMPLAN
-) Adjust mix of gross inputs and in-state inputs for lignite industry
-) Adjust industry employment and compensation
-) Examine and adjust coal mining output to coincide with input usage by electricity generation from fossil fuels (properly construct mine-to-mouth economic linkages)
-) Adjust economic linkages within the model to force coal consumption for other sectors to be supply by imports (out-of-state sources)
-) Industry balance sheets for Sectors 22, 42, and 49 represent various levels of customization (i.e., sales, employment, employment compensation, proprietor's income, other property-type income, taxes on production and inputs, and intermediate inputs)
-) At various stages of modification, IMPLAN requires the model to be recompiled. The end result is a customized model where multipliers are re-estimated after changes are made to baseline data.

[1] IMPLAN does not have a sector for electricity generation specifically from coal.

Development and Comparison of Survey Data to Default IMPLAN Industry Profile, North Dakota Lignite Industry, 2019						
IMPLAN Economic Sector	**Gross Sales**	**Total Intermediate Inputs**	**In-state Purchase of Inputs**	**Gross Absorption**	**Regional Purchase Coefficient**	**Regional Absorption**
IMPLAN Sector 22 Coal Mining						
2018 IMPLAN State Model Data	$486,327,026	$208,106,836	$114,821,732	0.427915	0.551744	0.236100
2019 NDSU Study Data	$510,936,815	$277,283,600	$197,035,927	0.542696	0.710594	0.385637
IMPLAN Sector 42 Electricity Generation						
2018 IMPLAN State Model Data	$1,369,964,844	$904,313,359	$677,388,691	0.660100	0.749064	0.494457
2019 NDSU Study Data	$1,730,070,591	$1,401,764,585	$746,326,366	0.833791	0.679822	0.566829
IMPLAN Sector 49 Electricity Transmission and Distribution (in-state purchases and absorption coefficients are net of electricity purchases)						
2018 IMPLAN State Model Default Data	$1,883,224,976	$1,279,189,344	$214,198,678	0.679255	0.167449	0.113740
2019 NDSU Study Data	$1,299,858,366	$1,034,232,618	$159,233,795.46	0.603663	0.153963	0.092942

Good Morning, Commissioners and staff.

For the record, my name is Dave Nehring, and I am here as a ratepayer and a taxpayer.

Over the last few years in North Dakota, we have heard the term "all of the above" when it comes to energy generation, and "all of the above" has been an accepted practice. Well, with the fact that the market penetration of intermittent energy has reached or exceeded 30 percent of the total generation in the state, and that the negative impacts on our reliability, our rates, and our state's economy, "All of the above" is becoming "Some of the above displacing some of the other above".

Based on the direct quotes taken from Orsted's website, and the white paper included on it, their plan is to not consider their wind and solar portfolios as a percentage of a balanced portfolio, but rather to completely displace all fossil fuel generation by 2025.

Let's consider some of the impacts of this:

I'd like to offer some direct comparisons of jobs, income and state revenues, based all in North Dakota, and broken down per 1000 MW of generation.

Direct jobs for coal per 1000 MW – 975 Direct jobs for wind per 1000 MW – 45.3 Factor of 21.5

Indirect jobs for coal per 1000 MW – 2525 Indirect jobs for wind per 1000 MW – 121.3 Factor of 20.8

Labor income for coal per 1000 MW – $255.5M Labor income for wind per 1000 MW - $14M Factor of 18.25

State and local revenues for coal per 1000 MW - $32.5M State and local revenues for wind per 1000 MW - $2.56M Factor of 12.7

Gross business volume for coal per 1000 MW - $1.425B Gross business volume for wind per 1000 MW - $58.25M Factor of 24.36

Now, let's consider the increase in electrical rates to our consumers – in a recent article titled "Electricity Prices soaring in top wind power states" the top ten wind power states had increases in electricity prices that rose at least five times faster

than the national average. And in an Xcel Energy presentation to the Midwest Governors Association, they stated that costs for electricity increase steeply over 60% penetration of intermittent sources, and that the transmission buildout would necessarily be 8 times the current transmission.

Finally, we've seen firsthand the impact of too much intermittent generation – we experienced it in Feb 2021, with the Texas event, causing supply shortages, and triggering blackouts all the way to ND.

Mark P. Mills, in his testimony before the ND House Finance and Taxation hearing on HB1458, offered the following facts:

He quotes Arthur C Clarke, stating "On the first year of the 21st century, the National Academy of Sciences published a list of the most important inventions of the previous 100 years: Number 1 was the electric grid." In the afterword, Clarke wrote about how easy it is for us to take historical accomplishments "so completely for granted" and that the "harnessing and taming of electricity, first for communications and then for power, is the event that divides our age from all those that have gone before".

Unlike the modern era, economic and social progress had been hobbled by the episodic nature of energy availability. In our date-centric, increasingly electrified society, always available power is more vital than ever. That's why more than 90% of America's electricity comes from sources that can operate whenever needed.

For hydrocarbon-based systems in particular, availability is achieved by storing fuel. On average, energy and electricity supply chains store about 1 to 2 months' worth of demand at any given time. And it costs less than $1 a barrel to store oil or natural gas for a couple of months – storing coal is even cheaper. To store an equivalent amount of energy in today's batteries costs roughly $200. Even that understates the real costs of storing wind energy because one also needs to build excess capacity to meet both peak demand and have enough extra to have a surplus to store for later.

In closing, the consequences of having a small share percent of America's electricity supplied by intermittent power has been compensated for by the

availability of conventional generation. That cover evaporates as the share of intermittent power rises and as "free" backup from power plants in neighboring states disappear as they too pursue the same path.