

# UNDERSTANDING CO<sub>2</sub>: NORTH DAKOTA'S ROLE

## LANDOWNER FREQUENTLY ASKED QUESTIONS

In North Dakota, we take great pride in our agricultural and energy heritage—it's a core part of who we are. But now, we're facing new challenges. Federal regulations are tightening their grip on the oil, gas, biofuel, and coal industries, leading to a sharp rise in the need for capturing, using, and storing carbon dioxide (CO<sub>2</sub>) deep underground.

While there's still debate about how much CO<sub>2</sub> impacts our atmosphere, the reality is our local farmers and energy workers are under increasing regulations to produce low- or no-carbon products and energy.

For our community, navigating these changes is crucial. It's about finding the best ways to adapt, ensuring that our way of life continues while meeting these new demands.





## WHAT IS CO<sub>2</sub> AND WHAT IS CARBON CAPTURE, UTILIZATION, STORAGE, AND/OR SEQUESTRATION?

**Carbon Dioxide**, or CO<sub>2</sub>, is a non-flammable, non-explosive, naturally occurring gas. It is exhaled by humans every time you breathe; is used in hundreds of products including soda, dry ice and fire extinguishers; and is a necessary component of plant growth.

- **Carbon Capture** is the act of separating CO<sub>2</sub> molecules from the flue gas of an industrial facility (such as a power plant or ethanol plant), or directly from the atmosphere.
- **Carbon Storage**, or Sequestration, is injecting captured CO<sub>2</sub> deep underground (nearly a mile or more in North Dakota) within porous rock beds, covered by a solid rock cap.
- **Carbon Utilization** is using captured CO<sub>2</sub> for other purposes, including enhanced oil recovery (EOR).

## IS STORING CO<sub>2</sub> UNDERGROUND SAFE?

North Dakota has been at the forefront of studying and implementing CO<sub>2</sub> initiatives for more than 20 years. CO<sub>2</sub> capture, utilization and storage projects are designed to be safe for people, animals, plants, and the environment. Before a CO<sub>2</sub> storage project ever begins, scientists identify and evaluate acceptable sites to be considered.

Our unique geology is perfectly suited for safe storage of CO<sub>2</sub> nearly a mile or more below the surface, and thousands of feet below the water table.

## WILL STORING CO<sub>2</sub> UNDERGROUND BE HARMFUL TO MY GRASS, CROPS OR DRINKING WATER?

Similar to how oil reserves deep underground do not have an impact on the surface or water supply, CO<sub>2</sub> will also remain safely beneath an impervious cap rock and will not have an impact on the surface, water, soil, or plants thousands of feet above. Crops and grass can grow above these areas and animals will be able to safely graze.

## IS IT SAFE TO TRANSPORT CO<sub>2</sub> IN UNDERGROUND PIPELINES?

CO<sub>2</sub> pipelines have been operating safely in the United States for more than 50 years. Decades of data has helped us understand how CO<sub>2</sub> behaves deep underground, and how to safely transport it through pipelines. Today, millions of metric tons of CO<sub>2</sub> are safely transported across the country through 5,000+ miles of pipeline – including nearly 200 miles in North Dakota.

Pipelines are designed to safely operate under the pressures (between 1200-2200 psi) required for "dense phase" CO<sub>2</sub> transport. Before any CO<sub>2</sub> is transported, pipelines are filled with fresh water or inert gas at a pressure 125% of their maximum operating pressure to ensure structural integrity.

Pipelines and storage sites have stringent regulations, monitoring, and mitigation requirements. North Dakota prioritizes significant planning, research, training, and technology to be prepared for any unexpected scenarios.

## CO<sub>2</sub> CAPTURE AND STORAGE IN ND

- **Red Trail Energy Ethanol Plant, Richardton**  
Began operations on June 16, 2022; captures and stores up to 180,000 metric tons of CO<sub>2</sub> annually.
- **Blue Flint Ethanol, Underwood**  
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## CO<sub>2</sub> PIPELINES

- **Dakota Gas/Souris Valley Pipeline**  
Began operations in 2000. This 205-mile pipeline runs from Beulah, northwest past Tioga, and into Saskatchewan, Canada. It has been transporting up to 2 million metric tons of CO<sub>2</sub> annually for enhanced oil recovery (EOR) for nearly 25 years.
- **Denbury/ExxonMobile Pipeline**  
Began operations in 2022. The final 9 miles of this pipeline, which starts in Wyoming, delivers CO<sub>2</sub> to the Bowman area for enhanced oil recovery (EOR).



## DOES CO<sub>2</sub> EXPLODE? WHAT HAPPENS IF THERE IS A LEAK?

Unlike natural gas and liquid petroleum - which are transported through millions of miles of pipelines across the U.S. - CO<sub>2</sub> is not flammable or explosive. In the unlikely occurrence CO<sub>2</sub> escapes from a pipeline or through the surface, it will become dry ice or go back to a gaseous state. While prolonged exposure to high concentrations of CO<sub>2</sub> can cause breathing difficulty, the gas typically quickly evaporates into the air and requires little to no clean-up. In the event of a leak, pipeline systems are designed to automatically shutdown, ceasing all operations until the cause is determined and repaired, and a reporting process through North Dakota's Unified Spill Reporting System is triggered.

### **What happened in Mississippi?**

The 2020 CO<sub>2</sub> pipeline failure in Satartia, Mississippi was a "worst-case scenario," and resulted in several lessons learned.

First, the pipeline operator was cited for violating multiple regulations. When federal pipeline regulations are followed, pipelines outperform the safety standards of both rail and truck transit.

Second, the soil where the pipeline was installed was unstable, and susceptible to movement from high rainfall. The incident followed heavy rains (7.5 to 13.5 inches above average) that resulted in a landslide, rupturing the pipeline as the ground shifted.



Lastly, weather conditions, lack of wind, and the density/volume of CO<sub>2</sub> released slowed its dissipation; the operator models underestimated the potential affected area; the operator did not adequately inform emergency responders; and the pipeline did not contain pure CO<sub>2</sub>.

One misconception is that this pipeline "exploded." Rather, the pipeline experienced "explosive decompression." This happens when a pipe that carries gas or liquid breaks very quickly - like blowing up a balloon and popping it with a pin. The material escapes quickly, causing a powerful rush and noise, disturbing the ground immediately around the break point.

## WILL STORING CO<sub>2</sub> PREVENT ME FROM HARVESTING OIL OR OTHER MINERALS?

The CO<sub>2</sub> injected deep underground for dedicated permanent storage goes into layers that do not contain harvestable minerals such as oil, and does not co-mingle with oil-bearing layers. Comprehensive state regulations provide for oil and mineral exploration near CO<sub>2</sub> storage zones while keeping the CO<sub>2</sub> securely in place.

## HOW DO I BENEFIT FROM A CO<sub>2</sub> PIPELINE EASEMENT ON MY PROPERTY?

In nearly all circumstances, a company requesting land access will ask for an easement - the right to access or use a portion of private property for a specific reason, outlined in an easement agreement. Easements can be temporary (for construction); permanent (for long-term maintenance or access to a pipeline or facility); or both.

When granting an easement, the landowner retains ownership of the land and can continue to use it. Specific terms or limited restrictions can be negotiated and are defined within the agreement. Any company requesting an easement will negotiate directly with property owners for fair and just compensation for any rights being sought. Payments typically meet or exceed market value.

## HOW DO I BENEFIT FROM CO<sub>2</sub> STORAGE UNDER MY PROPERTY?

The deep underground pore space where CO<sub>2</sub> is injected also continues to be owned by the surface landowner. Landowners are paid royalties per CO<sub>2</sub> injected into their pore space, similar to oil and gas mineral rights.

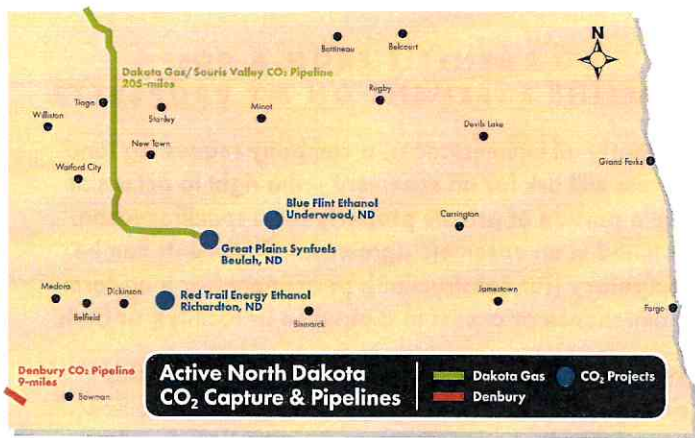
## HOW ARE LANDOWNER RIGHTS PROTECTED?

The terms "eminent domain" and "amalgamation" have gotten a lot of media attention recently. Eminent domain broadly refers to the government's ability to compensate a property owner to convert a portion of private property to public use.

Amalgamation broadly refers to the government's ability to include underground pore space owned by non-consenting landowners as part of a CO<sub>2</sub> storage facility. This can only happen when consent is given by at least 60% of the pore space owners. Like eminent domain, property owners are equitably compensated. Amalgamation of pore space is similar to the unitization of oil and gas minerals.

When it comes to CO<sub>2</sub>, the focus is **voluntary participation** and **fair compensation**. There is no intention or desire to take land ownership. It is important to understand that even if eminent domain or amalgamation were exercised, ownership of the land would still remain with the property owner and would not result in the loss of land. CO<sub>2</sub> efforts only pertain to pipeline easements or underground storage agreements and have very little impact on surface uses.





### HOW IS THIS GOOD FOR NORTH DAKOTA? WHY DO IT AT ALL?

Because of stringent federal regulations, capturing and storing CO<sub>2</sub> benefits our coal and ethanol plants by allowing them to continue operations in a low- or no-carbon market. A developing CO<sub>2</sub> industry also has the potential to benefit corn producers from increased ethanol production, provide tax and economic benefits to the state and can help extend the life of North Dakota oil fields through enhanced oil recovery.

### HOW WILL CO<sub>2</sub> PIPELINES OR UNDERGROUND STORAGE AFFECT MY PROPERTY VALUE AND INSURANCE?

Property values are typically influenced by factors such as lot size, yard space, and development potential. This tends to be consistent in new and mature neighborhoods, as well as in both urban and rural settings. Natural gas and liquid petroleum pipelines have existed near or beneath North Dakota homes for decades and have not deterred economic or residential development or values.

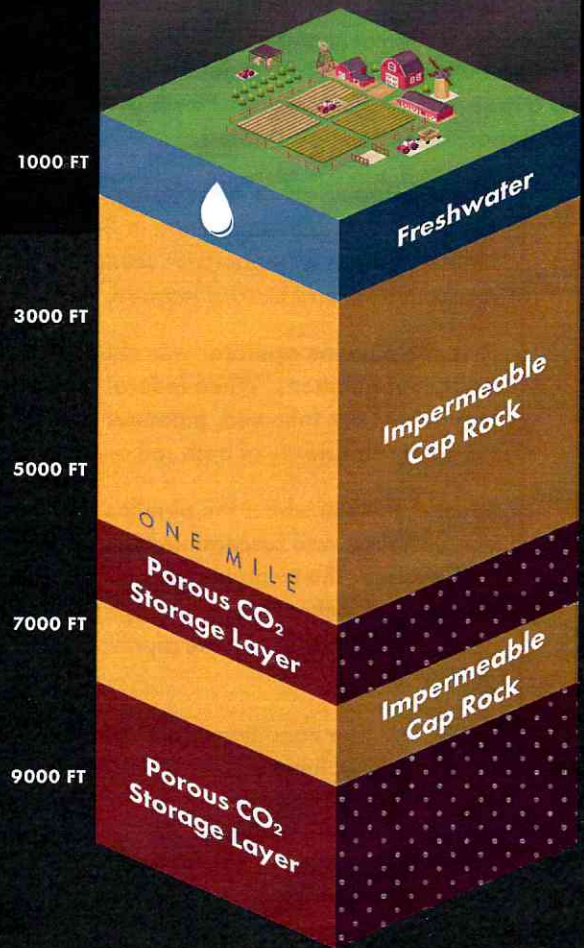
There is no precedent for landowners needing additional insurance for pipelines on their property. This is also true for CO<sub>2</sub> pipelines or underground storage. North Dakota law protects landowners from financial responsibility for damage to their property or related environmental impacts, in these instances.

In addition, CO<sub>2</sub> storage facility operators must have the proper financial instruments and ability in place to cover the cost of any necessary corrective action, injection well plugging, post-injection site care/facility closure, and emergency and remedial response before the CO<sub>2</sub> storage facility ever begins injection. These instruments are required to remain in place until the CO<sub>2</sub> storage facility is approved for closure.



## CO<sub>2</sub> STORAGE ZONES

THE RIGHT GEOLOGY FOR SAFE, PERMANENT STORAGE IN DEEP, DEEP ROCK LAYERS



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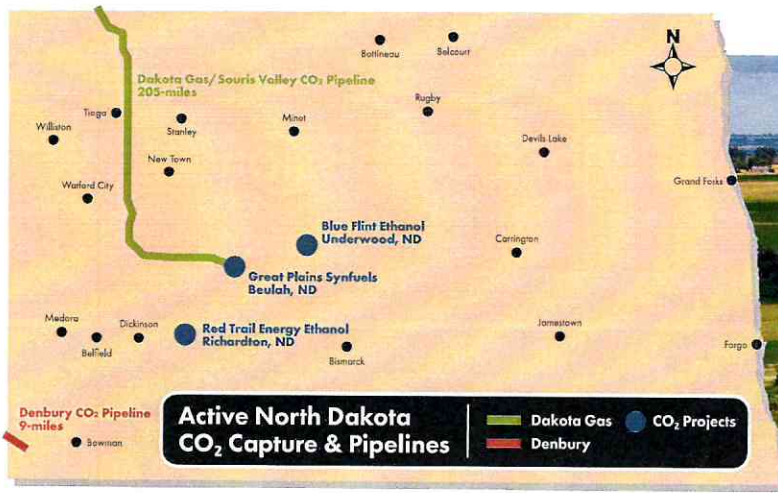
## FREQUENTLY ASKED QUESTIONS

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North Dakota is known for, and extremely proud of its agriculture and energy production. As federal regulations continue to impose stricter standards on the oil, gas, biofuel, and coal industries, the state has seen a drastic increase in demand across all energy sectors for capturing, using, and permanently storing carbon dioxide (CO<sub>2</sub>) deep underground.

While the impacts of increasing CO<sub>2</sub> levels in the atmosphere are debatable, the reality is that fossil fuel (oil, coal, gas) and ag producers are facing increased legal, regulatory, and economic pressures to produce low- or no- carbon products and energy. It is vital for the state's energy and ag industries to figure out the best way to manage these challenges.





## UNDERSTANDING CO<sub>2</sub>

### WHAT IS CARBON DIOXIDE (CO<sub>2</sub>)?

Carbon Dioxide, or CO<sub>2</sub>, is a non-flammable, non-explosive, naturally occurring gas. It is exhaled by humans every time you breathe; is used in hundreds of products including soda, dry ice and fire extinguishers; and is a necessary component of plant growth.

**CO<sub>2</sub> is not Carbon Monoxide (CO), a dangerous gas that is produced by burning of fuels in gas appliances, fireplaces, grills, and automobiles.**

### WHAT DOES CARBON CAPTURE, UTILIZATION, STORAGE, AND/OR SEQUESTRATION MEAN?

Carbon Capture is the act of separating CO<sub>2</sub> molecules from the flue gas of an industrial facility (such as a power plant or ethanol plant), or directly from the atmosphere.

Carbon Storage, or Sequestration, is injecting captured CO<sub>2</sub> deep underground (nearly a mile or more in North Dakota) within porous rock beds, covered by cap rock.

Carbon Utilization is using captured CO<sub>2</sub> for other purposes, including enhanced oil recovery (EOR).

### WHY DO WE WANT TO DO THIS, ESPECIALLY HERE IN NORTH DAKOTA?

North Dakota's unique geology is perfectly suited for the permanent, safe storage of CO<sub>2</sub> nearly a mile or more beneath the surface.

In addition to helping our coal and ethanol plants meet the increasing burden of federal regulations, a developing CO<sub>2</sub> industry has the potential to benefit corn producers from increased ethanol production, provide tax and economic benefits to the state and could extend the life of North Dakota oil fields through enhanced oil recovery.

### HAS THIS BEEN DONE BEFORE IN NORTH DAKOTA, OR ANYWHERE ELSE?

Underground CO<sub>2</sub> injection first began more than 50 years ago in western Texas. Decades of data has helped us understand how CO<sub>2</sub> behaves deep underground, and how to safely transport it through pipelines.

In the U.S. today, there are multiple operating CO<sub>2</sub> projects and more than 50 CO<sub>2</sub> pipelines spanning over 5,000 miles. North Dakota has three active CO<sub>2</sub> storage projects and nearly 200 miles of operating CO<sub>2</sub> pipeline. (see map above and descriptions below)

#### CO<sub>2</sub> CAPTURE AND STORAGE

- **Red Trail Energy Ethanol Plant, Richardton**  
Began operations on June 16, 2022, and captures and stores up to 180,000 metric tons of CO<sub>2</sub> annually.
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#### CO<sub>2</sub> PIPELINES

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# SAFETY CONCERNS

## IS IT SAFE TO STORE CO<sub>2</sub> UNDERGROUND?

CO<sub>2</sub> capture, utilization, and storage projects are designed to be safe for people, animals, and the environment. Before a CO<sub>2</sub> storage project ever begins, scientists identify and evaluate acceptable sites to be considered.

Permanent CO<sub>2</sub> storage needs porous (small spaces or holes) rock layers where CO<sub>2</sub> can be injected and stored at pressures low enough to avoid breaking the rock. This porous storage layer must also be capped by an impermeable (or solid) rock where CO<sub>2</sub> can't escape.

## DOES UNDERGROUND CO<sub>2</sub> NEGATIVELY IMPACT MY GROUNDWATER, SOIL QUALITY, GRASS, TREES, OR CROPS?

In North Dakota, CO<sub>2</sub> is stored nearly a mile or more below the surface, and thousands of feet below the water table. Similar to how oil reserves deep underground do not have an impact on the surface or water supply, CO<sub>2</sub> will also remain safely beneath an impervious cap rock and will not have an impact on the surface, water, soil, or plants thousands of feet above.

## IS IT SAFE TO TRANSPORT CO<sub>2</sub> IN UNDERGROUND PIPELINES?

Pipelines transport millions of metric tons of CO<sub>2</sub> annually across entire regions of the country. They are designed to safely operate under the pressures (between 1200-2200 psi) required for "dense phase" CO<sub>2</sub> transport. Before any CO<sub>2</sub> is transported, pipelines are filled with fresh water or an inert gas at a pressure 125% of their maximum operating pressure to ensure structural integrity.

## DOES CO<sub>2</sub> EXPLODE? WHAT HAPPENS IF CO<sub>2</sub> LEAKS?

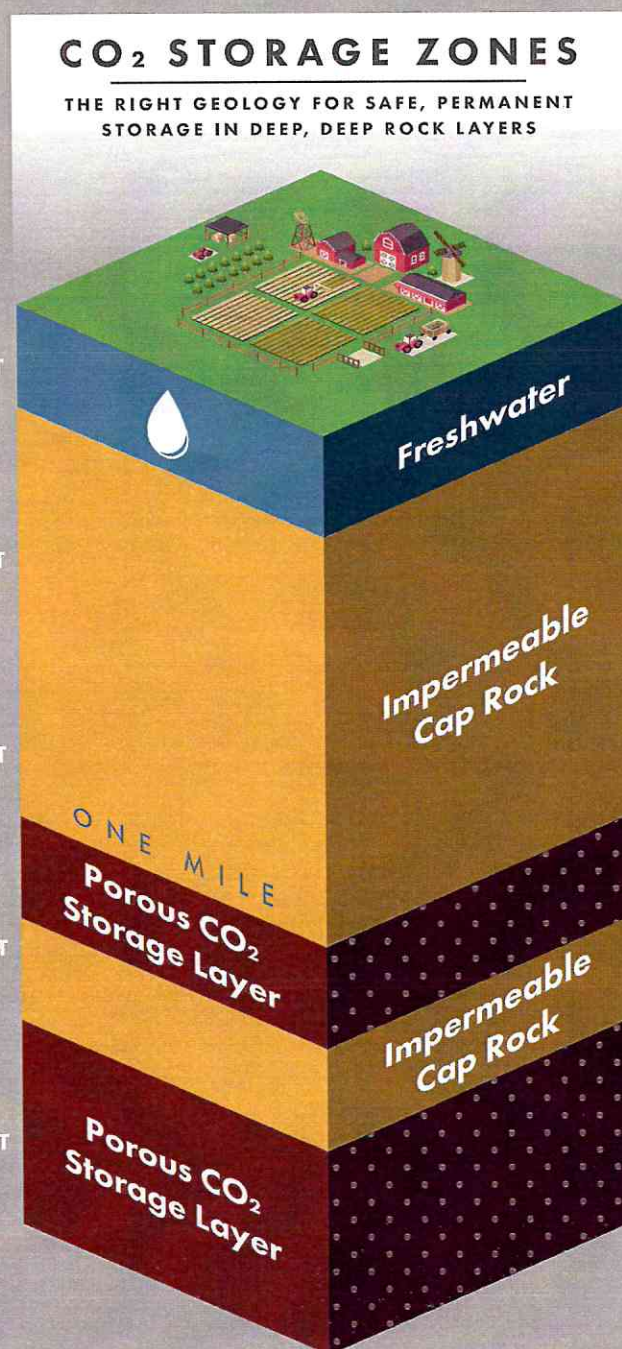
Unlike natural gas and liquid petroleum - which are transported through millions of miles of pipelines across the U.S. - CO<sub>2</sub> is not flammable or explosive.

In the unlikely occurrence CO<sub>2</sub> escapes from a pipeline or through the surface, it will become dry ice or go back to a gaseous state. While prolonged exposure to high concentrations of CO<sub>2</sub> can cause breathing difficulty, the gas will quickly evaporate into the air and requires little to no clean-up. In the event of a leak, pipeline systems are designed to automatically shutdown, ceasing all operations until the cause is determined and repaired.

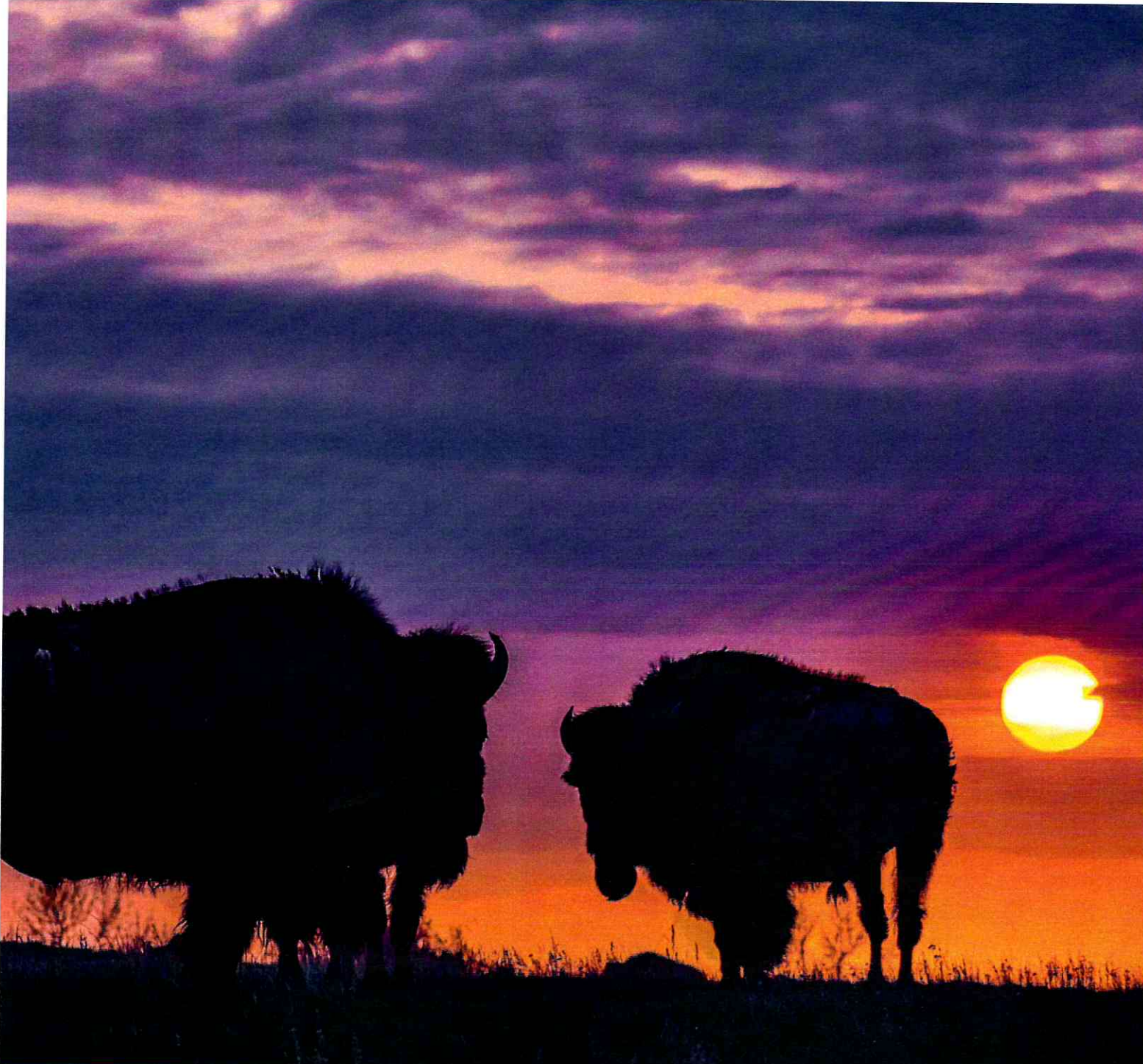
## HOW ARE UNDERGROUND CO<sub>2</sub> STORAGE SITES AND PIPELINES MONITORED?

Once injected into the ground, the movement of CO<sub>2</sub> is required to be monitored to ensure it is going where it is supposed to go, and staying where it is supposed to stay. Pipelines also have stringent regulations, monitoring, and mitigation requirements.

North Dakota prioritizes significant planning and research; intentionally planning for the what-ifs and incorporating training and state-of-the-art technology into all aspects to be able to effectively and safely handle any unexpected scenarios.







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If you're interested in learning more about CO<sub>2</sub> and North Dakota's role, visit  
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# UNDERSTANDING CO<sub>2</sub>: NORTH DAKOTA'S ROLE

## POLICY MAKER FREQUENTLY ASKED QUESTIONS

North Dakota takes great pride in our agricultural and energy heritage—it's a core part of who we are. As federal regulations are imposing stricter standards, our fossil fuel (oil, coal, gas) and ag producers are under increasing pressure to produce low- or no-carbon products and energy to remain viable. While this shift brings legal, regulatory, and economic challenges, it also creates great opportunity for North Dakota with an increase in demand across energy and ag sectors for capturing, using, and storing carbon dioxide (CO<sub>2</sub>) deep underground.

### WHAT IS CO<sub>2</sub>?

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### WHAT IS CARBON CAPTURE?

**Carbon Capture** is the act of separating CO<sub>2</sub> molecules from the flue gas of an industrial facility (such as a power plant or ethanol plant), or directly from the atmosphere. **Carbon Storage**, or **Sequestration**, is injecting captured CO<sub>2</sub> deep underground within porous rock beds, covered by a solid rock cap.





## ECONOMIC OPPORTUNITY

### POTENTIAL ECONOMIC BENEFITS OF CO<sub>2</sub> CAPTURE AND STORAGE FOR NORTH DAKOTA



Job creation in construction, operation, and maintenance of capture and storage facilities



Additional income for local farmers and landowners through easement and pore space leases



Energy sector sustainability by helping our coal and gas plants meet federal regulations



Attract investment in local infrastructure and technology development



Enhanced market for corn and ethanol producers (Ethanol plants purchase 80% of their corn from North Dakota farmers. \*)



Enhanced oil recovery to extend the life of ND oil fields and gross production tax funding

\*Source: North Dakota Ethanol Council, [www.ndethanol.org](http://www.ndethanol.org)

### HOW IS CARBON CAPTURE, STORAGE AND UTILIZATION FUNDED IN NORTH DAKOTA?

Funding for these projects comes from a mix of public and private sources. Federal grants and tax credits, state incentives, and investments from energy companies and other stakeholder contribute to financing CO<sub>2</sub> capture, storage, and utilization initiatives.

### WHAT REGULATIONS GOVERN CARBON CAPTURE AND STORAGE IN ND?

In 2018, the U.S. Environmental Protection Agency (EPA) granted North Dakota primacy (regulatory authority) of Class VI (CO<sub>2</sub> storage) injection wells within the state. As a result, North Dakota Industrial Commission's Department of Mineral Resources - Oil & Gas Division has authority over all CO<sub>2</sub> storage injection well activities. The North Dakota Public Service Commission approves the siting of transmission pipelines, including CO<sub>2</sub>, and the Pipeline Hazardous Materials Safety Administration (PHMSA) is accountable for safety in design, construction, and operation of CO<sub>2</sub> transmission pipelines.

### ARE LANDOWNER RIGHTS PROTECTED?

A company requesting land easements will negotiate directly with property owners for fair and just compensation for any rights being sought. Payments commonly meet or exceed market value, and easements are typically for very limited surface rights. When granting an easement, the landowner retains ownership of the land and is allowed to continue to use it.

In addition, the deep underground pore space where CO<sub>2</sub> is injected continues to be owned by the surface landowner. Landowners are paid royalties per CO<sub>2</sub> injected into their pore space, similar to oil and gas mineral rights.

Mineral owners may still extract oil, gas, and coal reserves. The CO<sub>2</sub> injected deep underground for storage goes into layers that do not contain commercially valuable extractable minerals. Comprehensive state regulations provide for safe oil and mineral exploration near CO<sub>2</sub> storage facilities.

North Dakota law also protects landowners from financial responsibility for damage to their property or related environmental impacts of CO<sub>2</sub> transport or storage, meaning no additional insurance coverage is needed.



## HAS THIS BEEN DONE BEFORE?

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Pipelines and storage sites have stringent regulations, monitoring, and mitigation requirements. North Dakota prioritizes significant planning and research, training, and technology into all aspects of pipeline safety to be prepared for any unexpected scenarios.

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## WHAT HAPPENED IN MISSISSIPPI?

The 2020 CO<sub>2</sub> pipeline failure in Sartoria, Mississippi was a "worst-case scenario," and resulted in several lessons learned. First, the pipeline operator was cited for violating multiple regulations. When federal pipeline regulations are followed, pipelines outperform the safety standards of both rail and truck transit.

Second, the unstable soil where the pipeline was installed was susceptible to movement from the preceding heavy rains (7.5 to 13.5 inches above average), resulting in a landslide that ruptured the pipeline as the ground shifted.

Lastly, local weather conditions, lack of wind, and the density and volume of CO<sub>2</sub> released slowed its dissipation; the pipeline operator underestimated the potential affected area; the operator did not adequately inform local emergency responders; and the pipeline did not contain pure CO<sub>2</sub>.

One misconception is that this pipeline "exploded." However, CO<sub>2</sub> is non-flammable and non-explosive. Rather, the pipeline experienced "explosive decompression." This happens when a pipe that carries gas or liquid breaks very quickly – like blowing up a balloon and popping it with a pin. The material escapes quickly, causing a powerful rush and noise, disturbing the ground immediately around the break point.

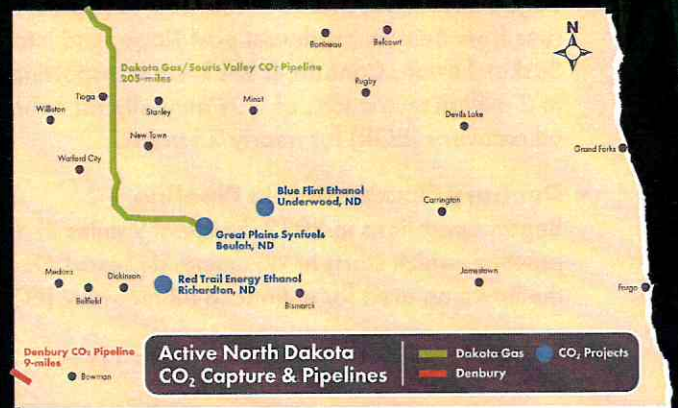
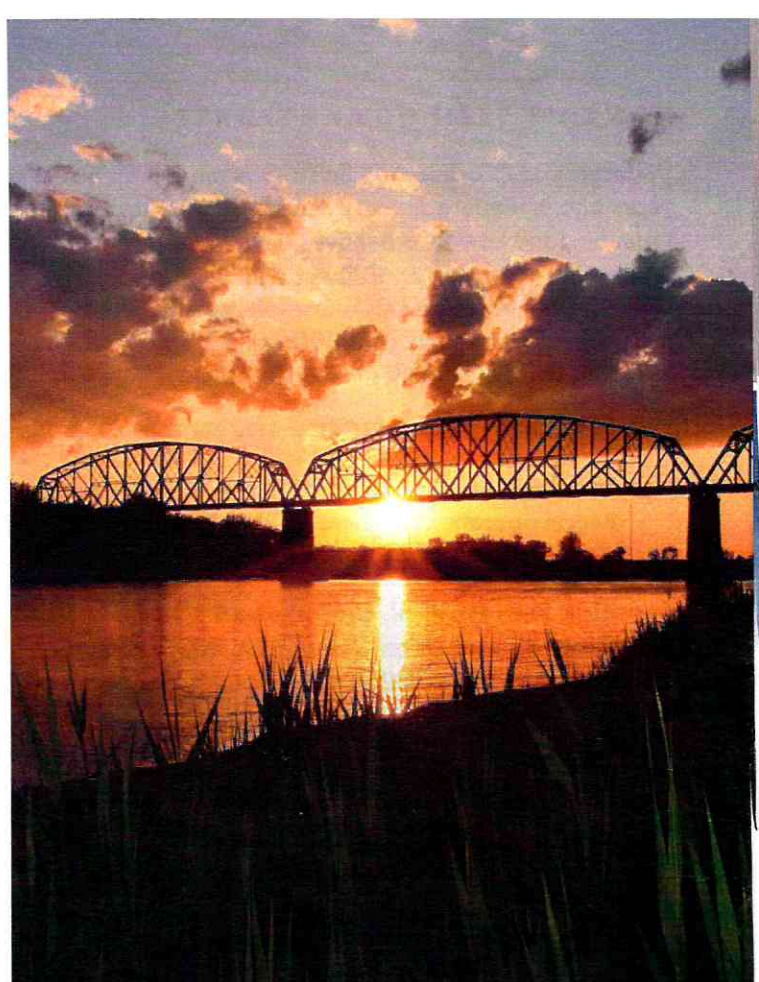
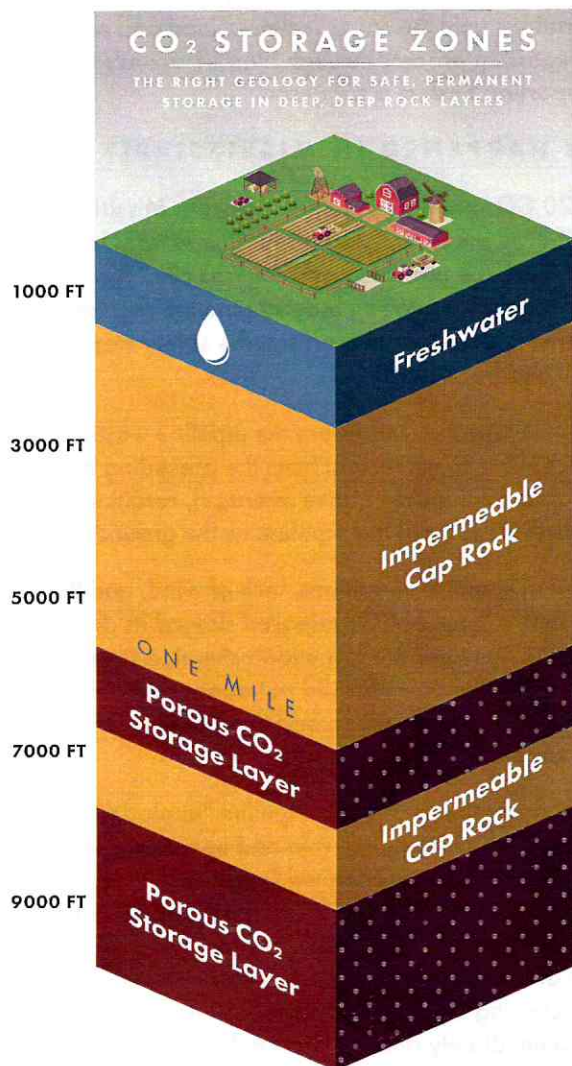


## WHAT SAFEGUARDS ARE IN PLACE?

North Dakota requires extensive review and approval of plans to operate pipelines and inject CO<sub>2</sub>, including next-level monitoring.

- Class VI well construction with surface casing/ corrosion-resistant cementing from the surface to the injection point, protecting water resources
- Multi-layer, multi-protection, multi-action 24/7/365
- Leak detection, alerts and shutoff requirements
- Deep underground and surface monitoring
- Risk assessment and mitigation
- Liability on storage facility owner, not landowner
- Post injection site care and closure monitoring for at least 10 years

CO<sub>2</sub> storage facility operators must have the proper financial instruments and ability in place to cover the cost of any necessary corrective action, injection well plugging, post-injection site care/facility closure, and emergency and remedial response before the CO<sub>2</sub> storage facility ever begins injection. These instruments are required to remain in place until the CO<sub>2</sub> storage facility is approved for closure.



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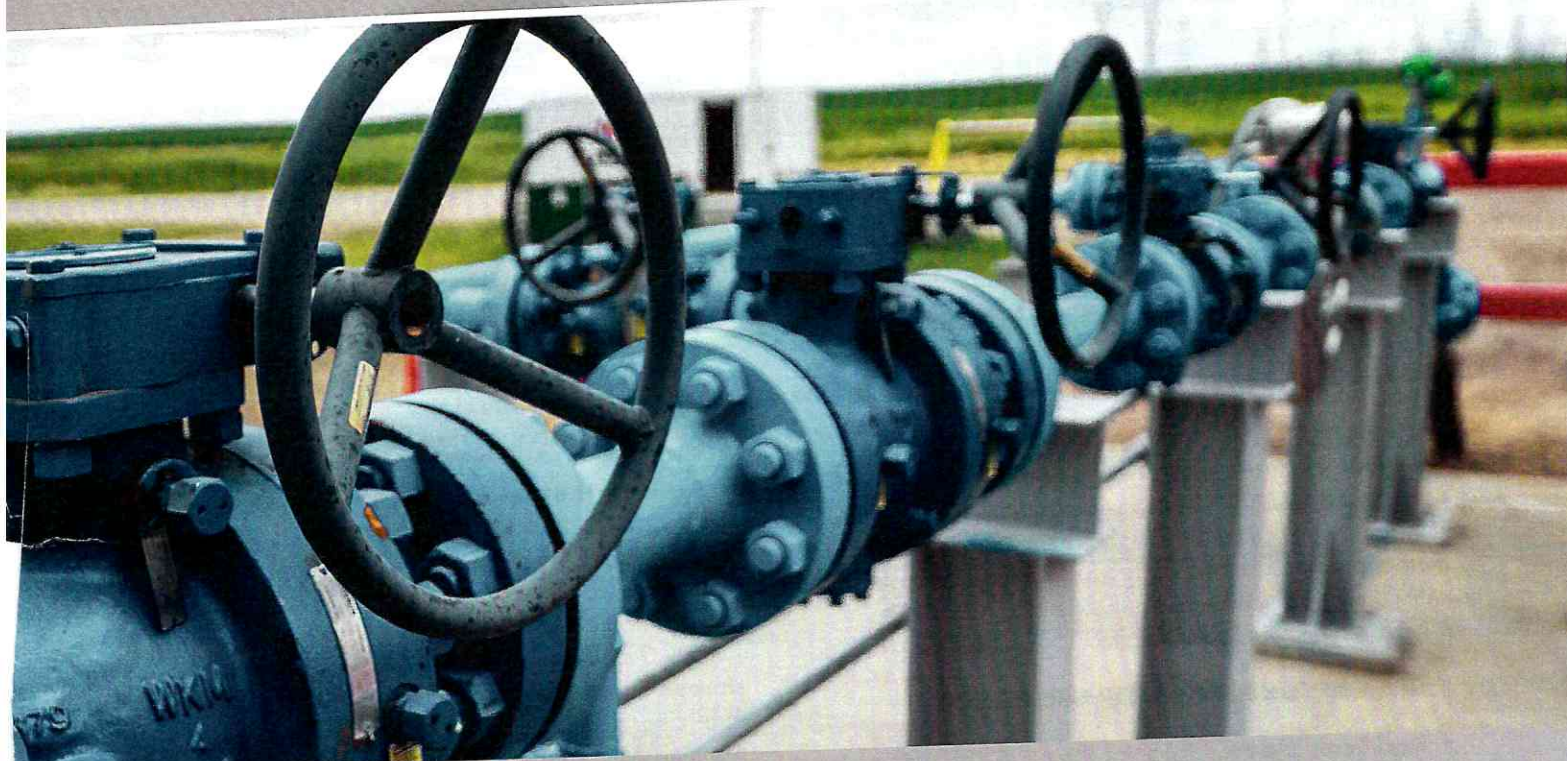
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# UNDERSTANDING CO<sub>2</sub>: NORTH DAKOTA'S ROLE

## EMERGENCY MANAGERS FREQUENTLY ASKED QUESTIONS

In North Dakota, we take great pride in our agricultural and energy heritage. As federal regulations are imposing stricter standards, our fossil fuel (oil, coal, gas) and ag producers are under increasing pressure to produce low- or no-carbon products and energy. While this shift brings challenges, it also creates great opportunity for North Dakota with an increase in demand across energy and ag sectors for capturing, using, and storing carbon dioxide (CO<sub>2</sub>) deep underground.

Our commitment to safety and responsible practices is, and continues to be, our top priority. As we navigate this shift in significant legal, regulatory, and economic conditions, our priority remains unwavering – ensuring safety and sustainability in every step we take. We are dedicated to finding the best ways to adapt, uphold our values, and continue our way of life while keeping a focus on the health and safety of our communities.





## HAS THIS BEEN DONE BEFORE?

Underground CO<sub>2</sub> injection first began more than 50 years ago in western Texas. Decades of data has helped us understand how CO<sub>2</sub> behaves deep underground, and how to safely transport it through pipelines. Today, millions of metric tons of CO<sub>2</sub> are safely transported across the country through 5,000+ miles of pipelines – including nearly 200 miles in North Dakota.

### CO<sub>2</sub> CAPTURE AND STORAGE IN ND

- **Red Trail Energy Ethanol Plant, Richardton**  
Began operations on June 16, 2022; captures and stores up to 180,000 metric tons of CO<sub>2</sub> annually.
- **Blue Flint Ethanol, Underwood**  
Began operations on October 28, 2023; captures and stores up to 220,000 metric tons of CO<sub>2</sub> annually.
- **Great Plains Synfuels Plant, Beulah**  
Began operations on February 2, 2024; captures and stores up to 2.7 million metric tons of CO<sub>2</sub> annually.

### CO<sub>2</sub> PIPELINES

- **Dakota Gas/Souris Valley Pipeline**  
Began operations in 2000. This 205-mile pipeline runs from Beulah, northwest past Tioga, and into Saskatchewan, Canada. It has been transporting up to 2 million metric tons of CO<sub>2</sub> annually for enhanced oil recovery (EOR) for nearly 25 years.
- **Denbury/ExxonMobile Pipeline**  
Began operations in 2022. The final 9 miles of this pipeline, which starts in Wyoming, delivers CO<sub>2</sub> to the Bowman area for enhanced oil recovery (EOR).

## WHAT REGULATIONS GOVERN CAPTURE AND STORAGE IN NORTH DAKOTA?

In 2018, the U.S. Environmental Protection Agency (EPA) granted North Dakota primacy (regulatory authority) of Class VI (CO<sub>2</sub> storage) injection wells within the state. As a result, North Dakota Industrial Commission's Department of Mineral Resources - Oil & Gas Division has authority over all CO<sub>2</sub> storage injection well activities. The North Dakota Public Service Commission approves the siting of transmission pipelines, including CO<sub>2</sub>, and the Pipeline Hazardous Materials Safety Administration (PHMSA) is accountable for safety in design, construction, and operation of CO<sub>2</sub> transmission pipelines.

## IS STORING CO<sub>2</sub> UNDERGROUND SAFE? IS IT HARMFUL TO CROPS OR WATER?

CO<sub>2</sub> capture, utilization and storage projects are designed to be safe for people, animals, plants, and the environment. Before a CO<sub>2</sub> storage project ever begins, scientists identify and evaluate acceptable sites based on their geological suitability to securely contain CO<sub>2</sub>. Ongoing monitoring helps detect and address any potential leaks or issues.

North Dakota's unique geology is perfectly suited for safe storage of CO<sub>2</sub> nearly a mile or more below the surface, and thousands of feet below the water table.

Similar to how oil reserves deep underground do not have an impact on the surface or water supply, CO<sub>2</sub> will also remain safely beneath an impervious cap rock and will not have an impact on the surface, water, soil, or plants thousands of feet above. Crops and grass can grow above these areas, and animals can safely graze.



## IS IT SAFE TO TRANSPORT CO<sub>2</sub> IN UNDERGROUND PIPELINES?

When federal pipeline regulations are followed, pipelines outperform the safety standards of both rail and truck transit. Pipelines are designed to safely operate under the pressures (between 1200-2200 psi) required for "dense phase" CO<sub>2</sub> transport. Before any CO<sub>2</sub> is transported, pipelines are filled with fresh water or inert gas at a pressure of 125% of their maximum operating pressure to ensure structural integrity.

Pipelines and storage sites have stringent regulations, monitoring, and mitigation requirements. North Dakota prioritizes significant planning, research, training, and technology to be prepared for any unexpected scenarios.

Local emergency responders play a crucial role in ensuring public safety near CO<sub>2</sub> pipelines. Even though a CO<sub>2</sub> pipeline leak is extremely rare, it is important that first responders have the information they need to prepare for and respond to all potential situations.

Pipeline operators are required to work closely with responders to develop and review emergency response plans and conduct regular training and drills.

## HOW DO WE KNOW CO<sub>2</sub> IS INJECTED TO THE RIGHT DEPTH OR ROCK LAYER?

A CO<sub>2</sub> injection well is constructed with a minimum of three layers of steel protection to prevent any underground discharge into the water supply.

The first layer is set below the deepest underground source of drinking water, and cemented back to the surface. The second layer is set into the injection formation nearly a mile or more below the surface, and is cemented in place. The third layer is injection tubing running from the surface to the injection zone. These casings ensure CO<sub>2</sub> only flows to the target formation, and will remain within the porous rock bed layer, covered by a solid cap rock, trapping the CO<sub>2</sub> deep underground.

## WHAT SAFEGUARDS ARE IN PLACE TO PREVENT AND IDENTIFY LEAKS?

Safety is ensured through rigorous site selection, extensive monitoring, and regulatory oversight. North Dakota requires extensive review and approval of plans to operate pipeline and storage facilities and inject CO<sub>2</sub>. All CO<sub>2</sub> storage projects must include:

- Class VI well construction with surface casing/ cementing protecting water resources, cementing from the surface to the injection point, and corrosion-resistant casing and cement
- Next-Level Monitoring: multi-layer, multi-protection, multi-action 24/7/365
- Operational monitoring for temperature and pressure changes that could indicate early anomalies
- Leak detection and alerts
- Deep underground monitoring to ensure that the CO<sub>2</sub> remains securely in the storage zone
- Surface and near surface monitoring to ensure no environmental effects
- Surface water, groundwater and soil regular testing
- Shutoff requirements
- Risk assessment and mitigation including comprehensive manuals at each site and control center with actions for various scenarios
- Liability on storage facility owner, not landowner
- Post injection site care and closure
- Continuous monitoring after injection ends, until it is demonstrated that the CO<sub>2</sub> stops moving (at least 10 years)

CO<sub>2</sub> storage facility operators must have the proper financial instruments and ability in place to cover the cost of any necessary corrective action, injection well plugging, post-injection site care/facility closure, and emergency and remedial response. These instruments must remain in place until the CO<sub>2</sub> storage facility is approved for closure.

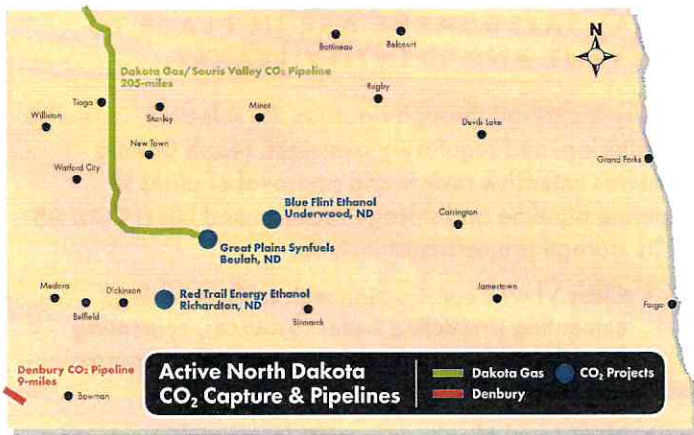


## WHAT HAPPENED WITH THE 2020 CO<sub>2</sub> PIPELINE FAILURE IN SATARTIA, MISSISSIPPI?

First, the pipeline operator was cited for violating multiple regulations. Second, the soil where the pipeline was installed was unstable, and susceptible to movement from high rainfall. The incident followed heavy rains (7.5-13.5 inches above average) that resulted in a landslide, rupturing the pipeline as the ground shifted. Lastly, weather conditions, lack of wind, and the density/volume of CO<sub>2</sub> released slowed its dissipation; the operator models underestimated the potential affected area; the operator did not adequately inform emergency responders; and the pipeline did not contain pure CO<sub>2</sub>, resulting in this "worst-case" scenario.

One misconception is that this pipeline "exploded." However, CO<sub>2</sub> is non-flammable and non-explosive. Rather, the pipeline experienced "explosive decompression." This happens when a pipe that carries gas or liquid breaks very quickly - like blowing up a balloon and popping it with a pin. The material escapes quickly, causing a powerful rush and noise, disturbing the ground immediately around the break point.





## WHAT HAPPENS IF THE CO<sub>2</sub> MIXES WITH WATER (H<sub>2</sub>O)?

While water and CO<sub>2</sub> combined may be corrosive, systems are designed to incorporate dehydration, so no free water touches the pipeline. Several additional steps are taken to ensure pipeline and equipment integrity through all conditions, including:

- Using corrosion-resistant materials
- Applying protective coatings or linings
- Using corrosion inhibiting chemicals
- Using cathodic (electrical currents) protection
- Regular monitoring and maintenance

## WHAT HAPPENS IF A LEAK IS DETECTED?

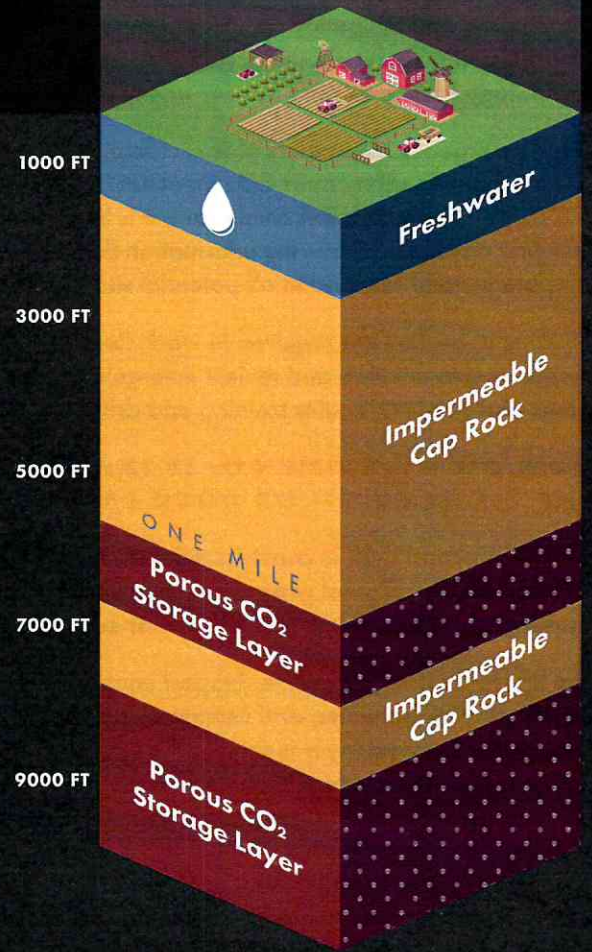
Unlike natural gas and liquid petroleum - which are transported through millions of miles of pipelines across the U.S. - CO<sub>2</sub> is not flammable or explosive. In the unlikely occurrence CO<sub>2</sub> escapes from a pipeline or through the surface, it will become dry ice or go back to a gaseous state. While prolonged exposure to high concentrations of CO<sub>2</sub> can cause breathing difficulty, the gas typically quickly evaporates into the air and requires little to no clean-up. In the event of a leak, pipeline systems are designed to automatically shutdown, ceasing all operations until the cause is determined and repaired, and a reporting process through North Dakota's Unified Spill Reporting System is triggered.

Manuals are required at every facility and call center that outline action steps and emergency protocol for any possible leak scenario.



## CO<sub>2</sub> STORAGE ZONES

THE RIGHT GEOLOGY FOR SAFE, PERMANENT STORAGE IN DEEP, DEEP ROCK LAYERS



NORTH  
**Dakota** | Industrial Commission

If you're interested in learning more about CO<sub>2</sub> and North Dakota's role, visit

**CarbonND.com**

