Clean Sustainable Energy Program 2023 - 2025 Report

NOVEMBER 2024

NORTH Dakota | Industrial Commission

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Contents

Background

Creation

The North Dakota Clean Sustainable Energy Authority (CSEA) was created by the 2021 Legislature's enactment of HB 1452. The purpose of CSEA was to support the research and development of large-scale projects and technologies that advance energy production while reducing environmental impacts and diversifying the state's economy.

CSEA was modeled after existing research and development programs under the North Dakota Industrial Commission (see Figure 1) and was designed to complement them.

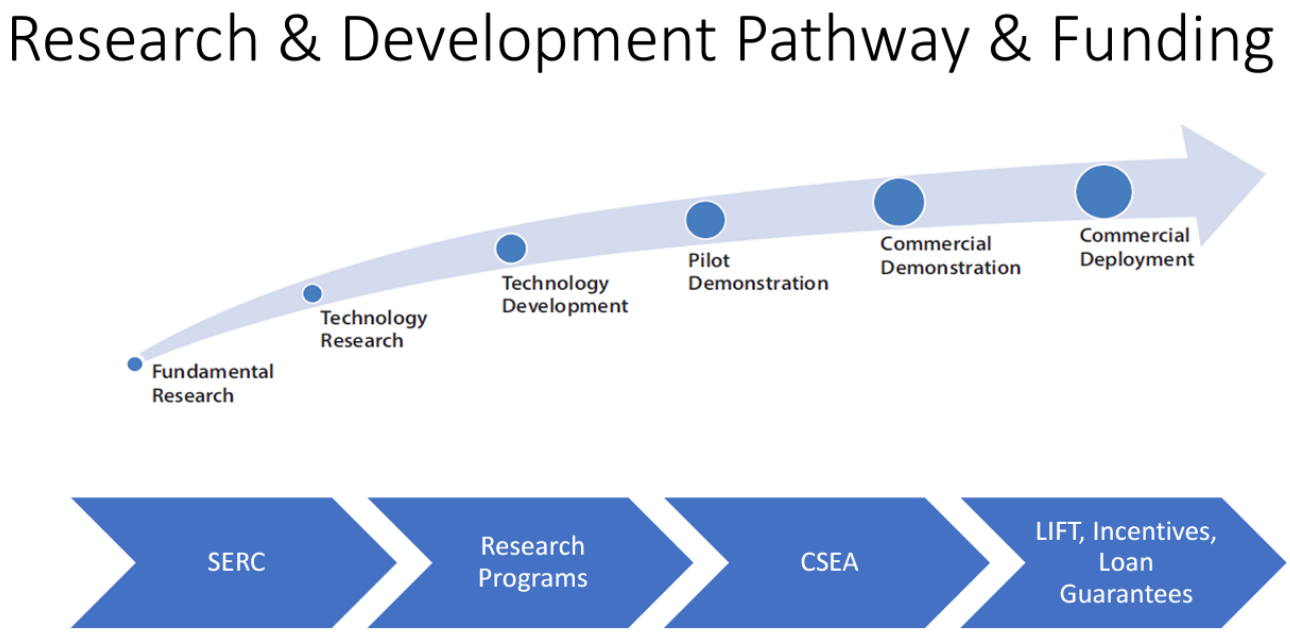

Figure 1: Research and Development Pathway, developed by Al Anderson, former CSEA Director. The State Energy Research Center (SERC), first funded in 2019, was intended to fund early-stage and on-demand research projects. Most of the Industrial Commission's existing research councils funded applied research and technology development. Commercial deployment was funded by programs such as LIFT, BND loans, etc. Funding for engineering and commercial demonstration was lacking, which is the role CSEA now plays.

At the time of CSEA's creation, topics of focus for the state included:

- Recovery from the COVID-19 pandemic and subsequent energy price shocks
- Environmental, Social, and Corporate Governance (ESG) criteria presenting significant market hurdles for agriculture and energy
- Increased frequency of electric grid emergency events, including the aftermath of 2021 Winter Storm Uri
- Protecting our state's jobs and oil and gas revenues

"Regarding the definition of sustainable, you'll see words like energy and national security, affordability, reliability and resilience…These [recent electric grid emergency] events make it clear, that as policy makers we must support developing technologies that ensure this scenario doesn't happen in North Dakota." **-Rep. Glenn Bosch, during testimony in support of HB 1452, March 19, 2021**

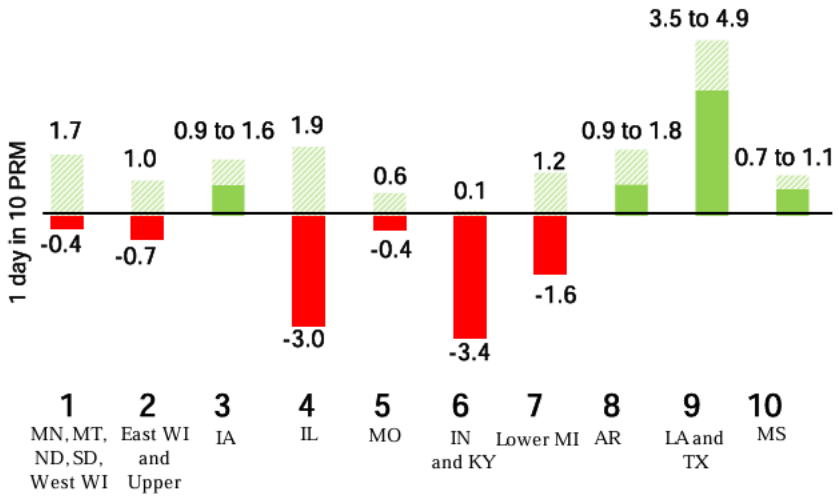

Figure 2: MISO Electric Load Capacity Forecast, 2020. MISO was forecasting resource deficits across 6 of its 10 zones, including North Dakota.

HB 1452 ultimately passed the Senate 41-6 and the House 76-12. In addition to a general fund appropriation of **$25 million for the purpose of providing grants**, CSEA was also provided with a **$250 million line-of-credit** from the Bank of North Dakota (BND) for providing long-term, low-interest loans to projects.

2021 Special Legislative Session Hydrogen Grants

In November 2021, Governor Burgum called for a special session of the North Dakota Legislative Assembly, which purposes included appropriation of federal dollars approved under the American Rescue Plan Act (ARPA). These dollars were required to be contracted by December 31, 2024 and spent by December 31, 2026.

During the special session, the Governor recommended using $25 million of ARPA dollars for CSEA projects.

During the summer of 2021, significant interest was shown toward the development of hydrogen projects. Firstly, a $500,000 appropriation to fund a “hydrogen roadmap” was added to the Industrial Commission’s budget during the 2021 regular legislative session. While this work was underway, Bakken Energy announced a partnership with Mitsubishi to purchase the Great Plains Synfuels Plant and convert it to hydrogen production. Crucial to their efforts was obtaining federal matching dollars from the Department of Energy (DOE). In November 2021, the Infrastructure Investment and Jobs Act (IIJA) was signed, which included $7 billion for investments in hydrogen hubs across the country.

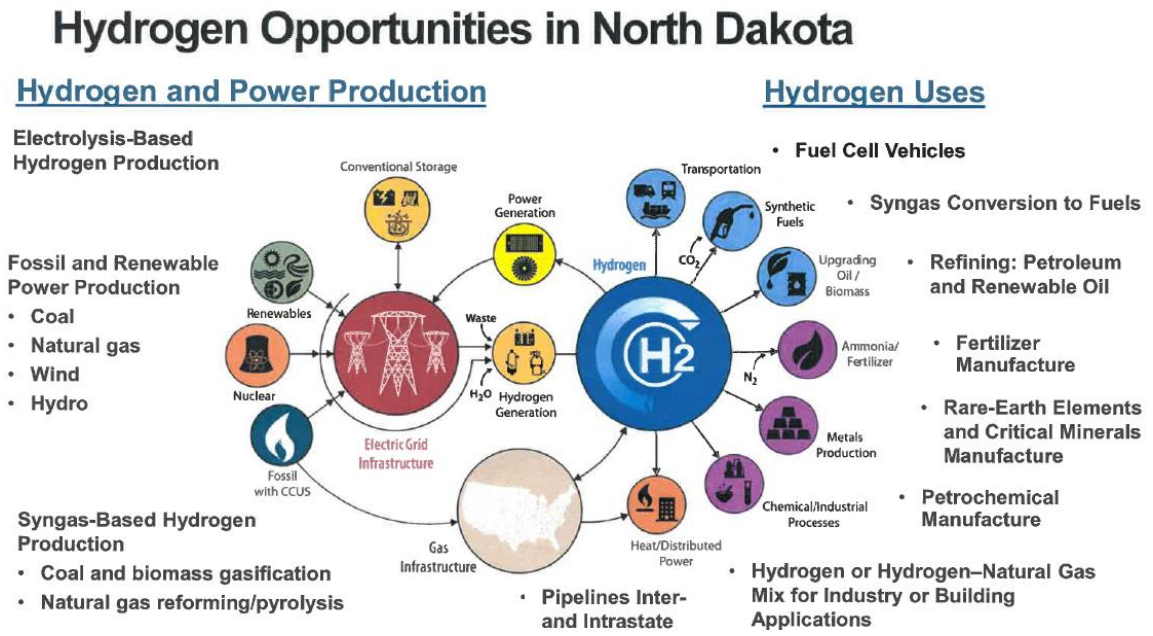

Figure 3: Hydrogen Opportunities, from EERC Legislative Road Map Report, 2022

At the end of the 2021 special session, SB 2345 included **$20 million** for CSEA "for the purpose of providing **hydrogen development grants**".

2023 Legislative Session

During the 2023 legislative session, $50 million was requested for grants and an additional $250 million was requested for loans.

On January 26th, 2023, Bakken Energy announced that its plans to acquire the Great Plains Synfuels Plant were ceased, and it would no longer be moving forward with the project. Citing shifting markets, including an increase in natural gas prices as well as in increase in the 45q carbon capture tax credit, Basin Electric declined to sell the plant. In December 2021, Bakken Energy had received a $10 million grant from the hydrogen ARPA funds as well as an $80 million loan. At the time of Bakken's announcement, they had spent $4,763,929.12 of their grant funds, and had not drawn on their loan, leaving $5,236,070.88 in remaining ARPA funds.

During the 2023 legislative session, topics of focus related to CSEA were:

- Deteriorating outlook for electric grid reliability
- Need for natural gas takeaway capacity by 2027 in order to maintain oil production and thus maintain state tax revenues
- Continued market pressures and ESG concerns
- Discrimination against fossil fuels, i.e. in insurance markets
- Concern with large volume of proposed federal rules and policies in other states (for example, state of Minnesota's carbon-free standard) and their impacts on North Dakota's economy and grid reliability

...accredited capacity is declining due to the rapid pace of retirements of controllable resources

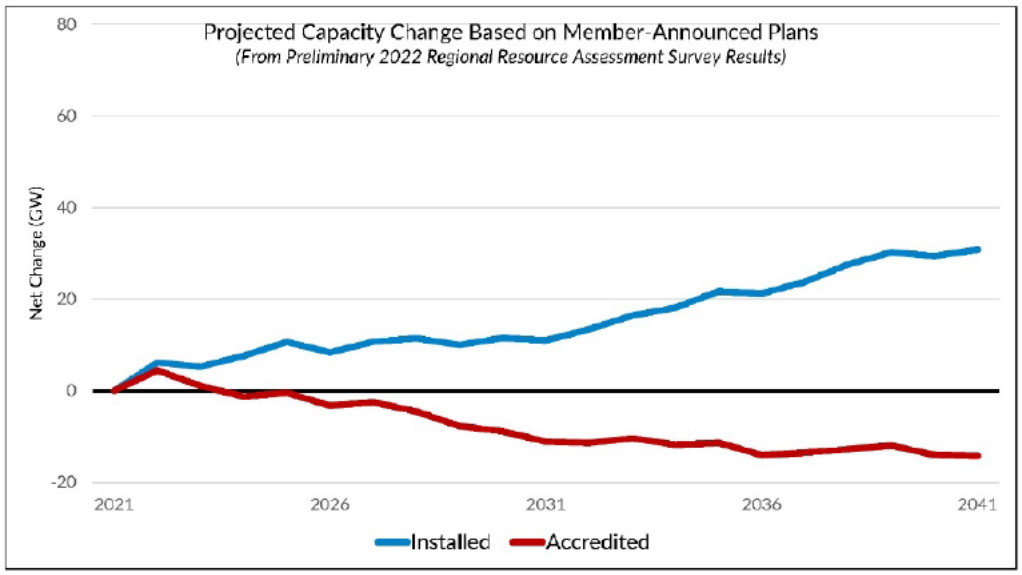

Figure 4: MISO electric installed vs. accredited capacity forecast, updated in 2022. This forecast showed an alarming trend of baseload retirements by late 2025.

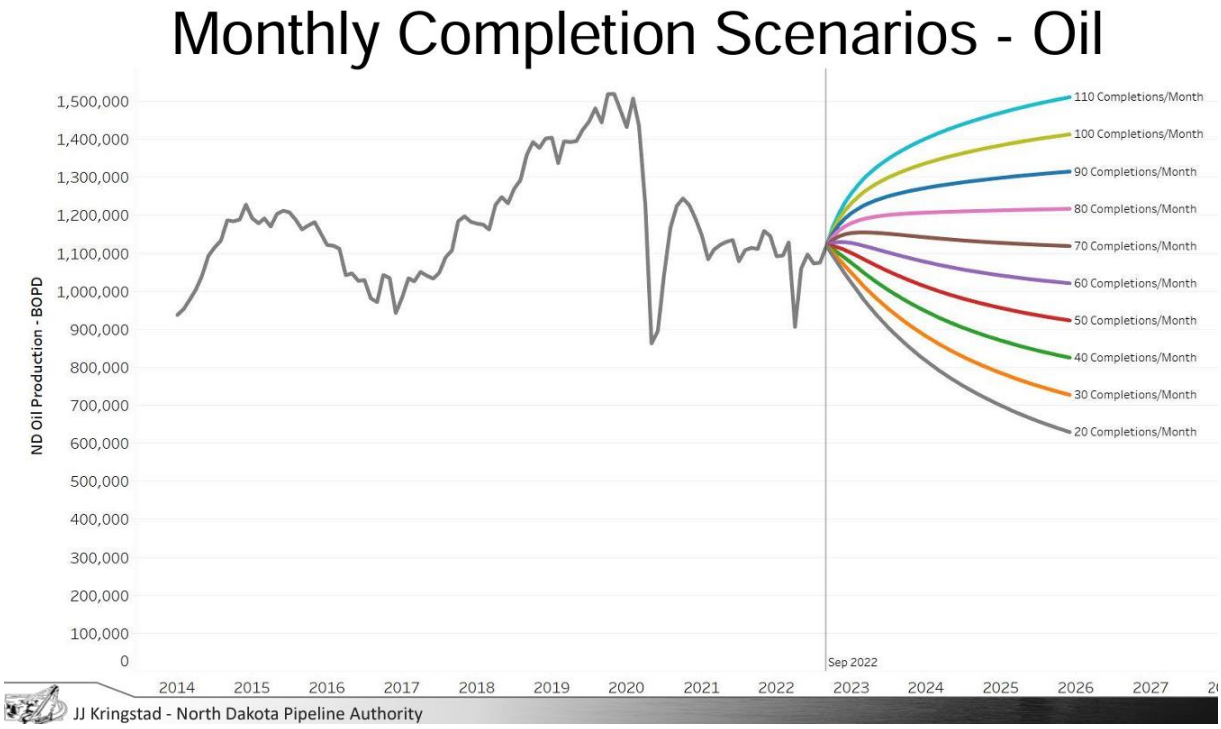

Figure 5: During the 2023 session, Justin Kringstad projected that between 70-80 well completions per month would be needed to maintain oil production and therefore maintain state tax revenues

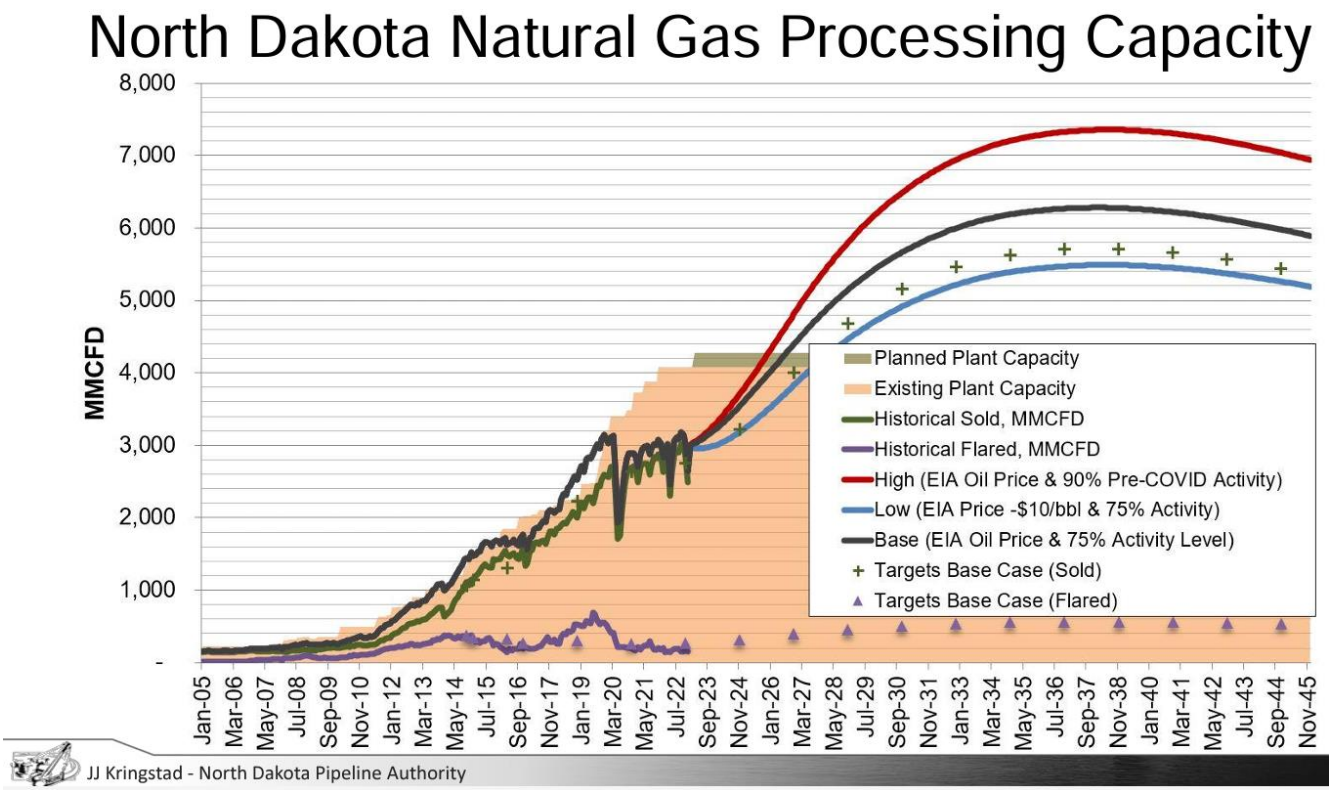

Figure 6: During the 2023 session, Justin Kringstad projected that we would need additional natural gas takeaway capacity between 2026-2027. Without additional takeaway capacity, companies would scale back production and therefore state tax revenues would be reduced

At the end of the 2023 legislative session, HB 1014 appropriated **$30 million for new grants** and authorized an additional **$250 million for loans**. To achieve the new loan-making authority, the legislature used $30 million from SIIF to repay a portion of the existing BND line-of-credit, extended the existing line-of-credit from $250 million to $390 million, and Bakken Energy's $80 million loan was de-committed.

2023 Special Legislative Session Fertilizer Loan

During the 2023 Special Legislative Session, HB 1546 directed CSEA to issue a loan of up to **$125 million** for a fertilizer development project. The project was required to use "hydrogen produced by the electrolysis of water". CSEA was directed to forgive the loan "upon completion of the construction" of the facility, and to request an appropriation from SIIF to repay the loan.

On January 23, 2024, the CSEA voted to award $75 million to Prairie Horizon and $50 million to NextEra, contingent upon their acceptance of the loan terms. 40% of the award was due upon final completion of construction, and 60% was due once the facility began selling up to 75% of its nameplate capacity.

Prairie Horizon declined the award, citing economic disadvantages with the electrolysis technology required within the incentive program parameters. NextEra accepted the parameters and received the entire $125 million award.

2025 Outlook: Purpose and Need for Continued CSEA Investment

As of November 2024, the outlook for electric grid reliability continues to deteriorate. Concerns with baseload power plant retirements nationwide remain. Federal rulemaking has exacerbated an already challenged grid, while simultaneously incentivizing an increased demand for power, i.e. with electric vehicles.

"In the view of MISO, several other grid operators, and numerous utilities and states, ***the U.S. EPA has issued a number of rules that could threaten reliability in the MISO region and beyond."*** *–MISO, February 2024*

"SPP is concerned that…the compliance time frame ***will have deleterious impacts…SPP's ability to maintain regional reliability will be directly impacted."*** *–SPP, April 2024*

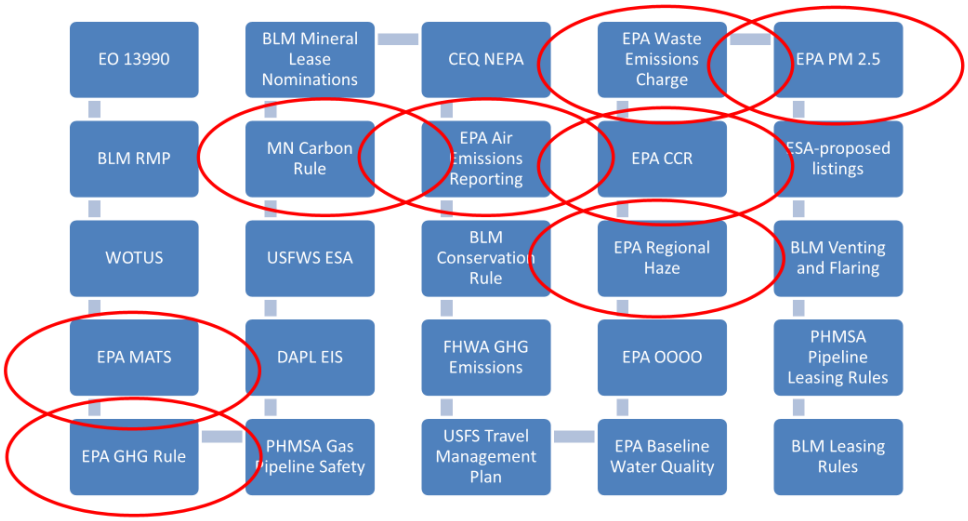

Figure 7: In response to federal rulemaking, both MISO and SPP issued formal statements in opposition, citing concerns for grid reliability. The organizations are normally hesitant to issue such statements due to their diverse stakeholder groups. The action of the organizations issuing such statements reveals the urgency of the situation.

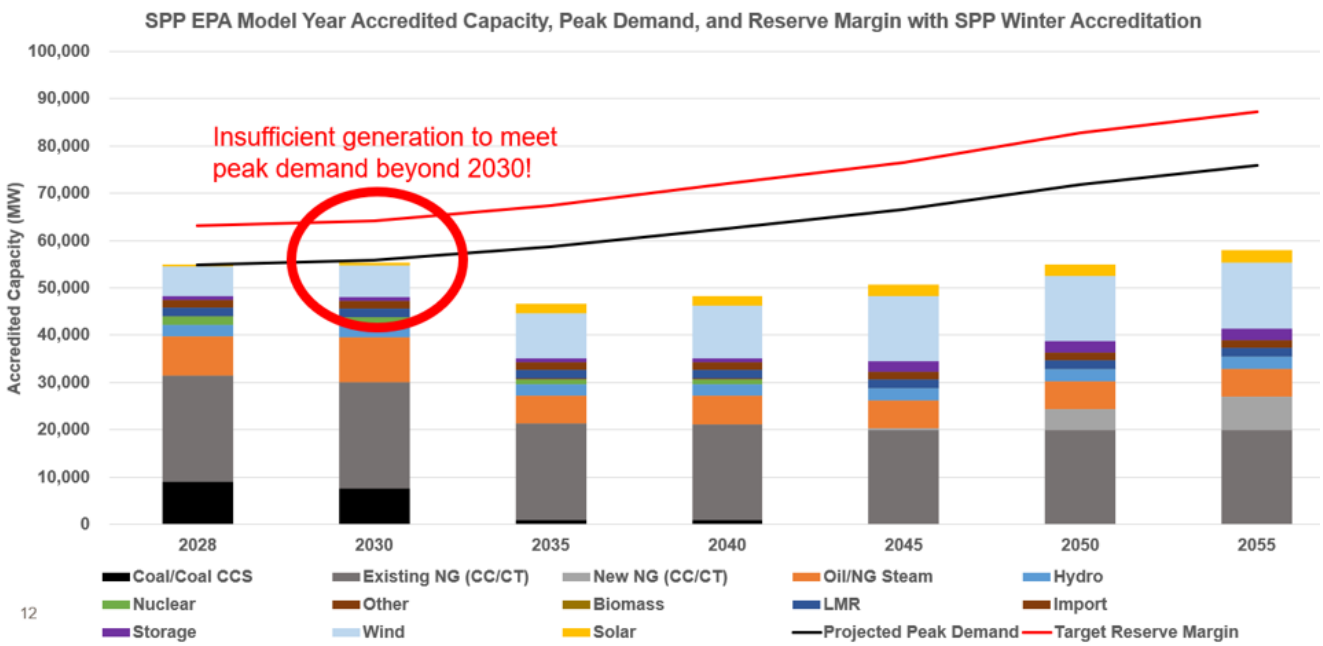

Figure 8: The North Dakota Transmission Authority modeled the impact of recent federal rulemaking on the electric grid. The results were shocking, revealing that by 2030, generation would be insufficient to meet peak demand, resulting in more hours with blackouts than without and over $83 billion of damages to the American economy!

Additionally, advancements in artificial intelligence are contributing to a significant demand for computing power and data centers, and thus an increase in demand for power. In North Dakota alone, projects totaling over 10 GW of power demand have expressed interest in locating here, requiring over twice the total power output of our state's existing coal fleet!

Future uses of CSEA would likely include:

- Data center development, using natural gas in-state, thus allowing for more oil production, reducing or preventing flaring, and potentially including carbon-capture
- Salt cavern development, which could provide for strategic propane reserves, natural gas storage, or petro-chemical development
- Continued investment in de-carbonizing our state's baseload coal fleet, especially in light of EPA's recent carbon rule
- Continued investment in low-carbon manufacturing

How CSEA Works

NDCC 54-63.1 outlines the authorities and processes for CSEA. Applicants are eligible to apply for either grants or loans. All applications undergo an economic feasibility review by the Bank of North Dakota as well as an independent technical review. Applications are then forwarded to a non-voting technical review committee, which meets in public to review applications. The CSEA then meets in public to review each application, and applicants are given the opportunity to present to the authority. The CSEA votes to make a recommendation to the Industrial Commission, which is the ultimate authority for approving or denying projects.

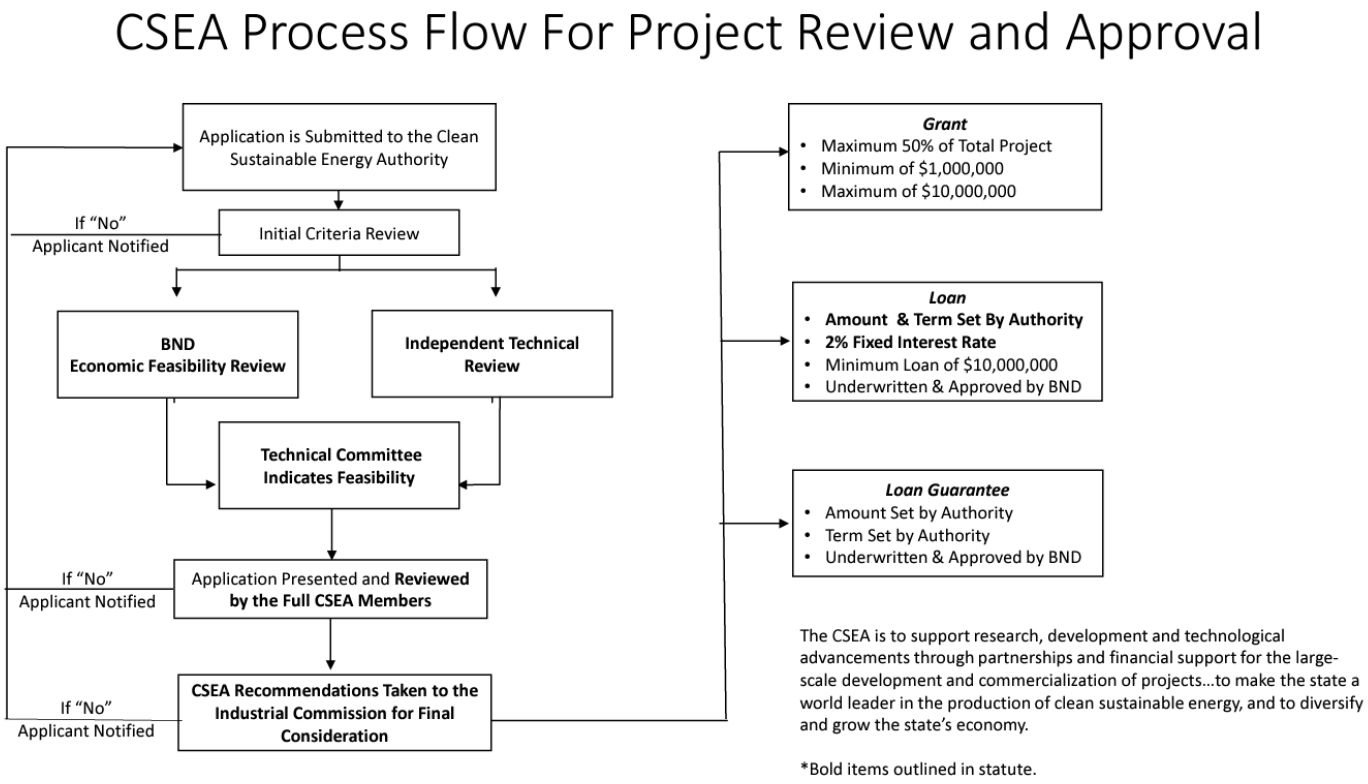

Figure 9: CSEA Process Flow Diagram

Current Status

As of November 2024, the CSEA Fund cash balance is **$34,611,686.66**. The portion of the cash balance that is committed is **$31,228,306.90**, of which $30,311,989.47 is outstanding commitments to grant projects and the remainder consists of administrative costs and other outstanding expenses. **$3,383,379.76** of uncommitted dollars remain in the fund. $3,300,000 of these funds were de-committed from project C-05-13 in October 2024.

During the 2023-2025 biennium, the fund received an appropriation of $30,000,000, with income coming from the SIIF. The fund also received $72,372.61 in interest payments.

Figure 10: As of November 2024, the uncommitted balance of the CSEA Fund is $3,383,379.76. Most of these dollars were only recently made available in October 2024, when project C-05-13 declined their award and turned back their funding.

Cumulatively, the fund has received $65 million in income from state and federal appropriations. 20 projects have been approved, with 20 currently active, 10 grants and 10 loans. Since CSEA's inception, $64.5 million has been approved for grants and

$545.5 million for loans. $6.2 billion in non-state match has been committed toward these projects.

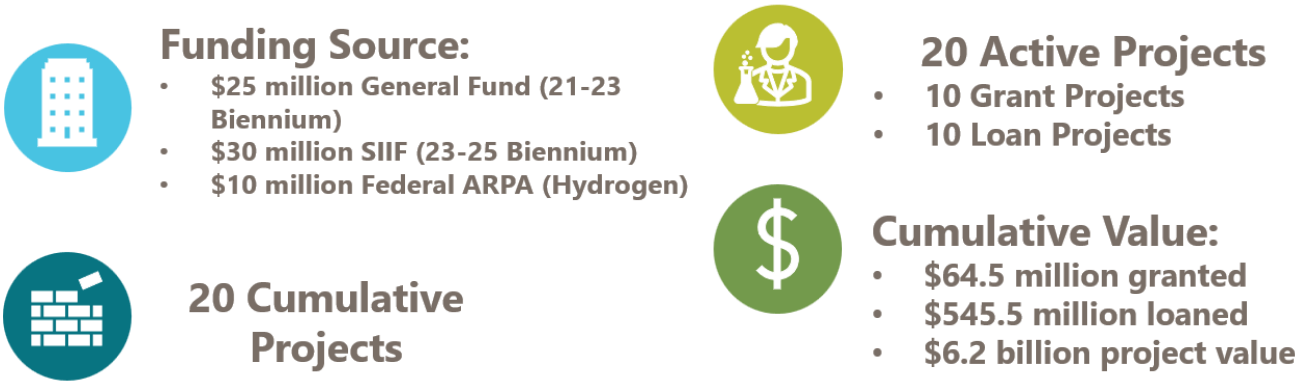

Figure 11: CSEA key statistics since inception of the program.

Project Updates

Summary of CSEA Grant Projects

Project	Applicant	Remaining Commitment	Projected End Date	Notes
C-01-01 Dakota H_2 Hub	Bakken Energy	$0	2023	Returned commitment of $5,236,070.88
C-01-02 GTL FEL-2	Cerilon	$0	2023	Completed Front-End Loading Stage 2
C-01-03 Produced Water	Wellspring Hydro	$0	2023	Completed Front-End Loading Stage 2
C-01-04 Blue Flint Carbon Capture	Midwest Ag Energy	$0	2024	Completed Carbon Capture at Blue Flint Ethanol
C-01-05 Coal Creek CCUS Design	EERC	$ 1,582,099.63	2025	Engineering progress, including process-flow
C-02-06 Engine Carbon Capture	Enerplus	$ 1,000,000.00	TBD	Project remains un-committed, evaluating contract
C-03-07 Liberty H_2 Hub	EERC	$0	2024	Returned commitment of $6,836,638.60
C-03-08 Project Phoenix	Newlight	$ 771,604.33	2024	FEED 97% complete
C-03-09 Geothermal Power	Enerplus	$ 948,249.00	2026	Pilot project installed on well pad, results expected early 2025
C-04-10 Farm Traceability Dashboard	Bushel	$ 3,415,090.12	2026	Progress toward software development
C-04-11 Produced Water 2	Wellspring Hydro	$ 4,862,898.40	2025	Progress toward FEL-3
C-05-12 Green Pig Iron	Scranton Metals	$ 5,959,594.99	2025	Mineral testing 85% complete, rewgulatory 50% complete
C-05-13 Marathon Renewable Fuels	EERC	$0	2024	De-committed award
C-05-14 Lithium Battery Manufacturing	Dakota Lithium	$ 1,828,646.17	2028	Secured manufacuturing facility and equipment, initial material testing favorable
C-05-15 GTL FEL-3	Cerilon	$ 9,500,000.00	2026	Pending BND Loan Draw

C-01-01: Bakken Energy Dakota H_2 Hub (ARPA Grant and Loan)

The Great Plains Hydrogen Hub project, led by Bakken Energy LLC, aimed to transition the Great Plains Synfuels Plant from coal-based synthetic natural gas production to hydrogen and ammonia production using natural gas as a feedstock. This project received a $10 million grant from ARPA funds and an $80 million loan. The project included three main subprojects:

- Redeveloping the plant with hydrogen production capabilities and carbon capture
- Re-purposing an existing CO_2 pipeline for natural gas transport
- Establishing CO_2 sequestration facilities through partnerships and proprietary development

Accomplished tasks for this project included:

- Plant scanning for 3D modeling
- Adjusting utility requirements
- Feasibility studies on new electrical systems, cogeneration (COGEN) options, and cooling water integration.

The project team finalized several preliminary designs, issued reports for review, and updated capital cost estimates based on the selection of a preferred autothermal reformer (ATR) licensor, which would streamline hydrogen production. Notably, Bakken planned to initially use hydrogen-fired co-generation to avoid CO_2 emissions and reduce initial capital outlays, with a later transition to natural gas-fired co-generation with carbon capture as hydrogen demand increased. The team also evaluated the potential impact of the Inflation Reduction Act (IRA) on project costs and timelines.

Ultimately, the project team was not successful in negotiating a sale of the Great Plains Synfuels Plant from Basin Electric, citing favorable coal-gasification economics and challenging hydrogen markets. The project ultimately de-committed **$5,236,070.88** in ARPA funds, and de-committed its entire $80 million loan.

C-01-02: Cerilon GTL FEL-2 (Grant and Loan)

The Cerilon GTL ND Phase 1 project, led by Cerilon GTL ND Inc., was designed to convert North Dakota's excess natural gas into synthetic products like ultra-low sulfur diesel and Group III+ base oils, helping reduce natural gas flaring in the region. This project received a **$7 million grant** and a **$40 million loan**.

In its FEL-2 phase, the project focused on Front-End Loading (FEL) Stage 2, which involves preliminary design and feasibility work to establish technical and economic viability before detailed engineering begins. Specifically, the FEL-2 phase included securing land, advancing environmental studies, and preliminary engineering tasks like syngas production and Fischer-Tropsch synthesis evaluations. Carbon capture and sequestration plans were also developed, aiming to reduce emissions by storing captured CO_2 underground. Environmental permitting and assessments were

conducted, with the site selected to be close to pipelines and transport infrastructure, as well as suitable geology for CO_2 storage.

Figure 12: Preliminary Site Layout

The project team engaged local stakeholders, officials, and potential business partners, projecting economic impacts from job creation and infrastructure investments. The team also drafted offtake agreements with companies for the sale of the facility's products. Planned next steps included the transition to FEL-3, or Front-End Engineering and Design (FEED), which involves more detailed design and final cost estimates to support a potential Final Investment Decision (FID) by 2025. However, the project's continuation depended on further financing and regulatory approvals, as well as securing additional commercial agreements.

C-01-03: Wellspring Hydro Produced Water (Grant)

The Wellspring Hydro project focused on converting produced water from the Bakken oil fields in North Dakota into valuable products, including salt for chlor-alkali production and lithium. The project received a **$1 million grant.**

This project advanced through its FEL-3 (Front-End Loading Stage 3) phase, where it completed detailed engineering designs, feasibility studies, and market assessments. Wellspring Hydro's process aimed to repurpose produced water into a sustainable resource, with additional goals to reduce waste and emissions. The FEL-3 phase also included pilot testing with engineering consultants and subject matter experts to validate the quality of recovered salts and initial lithium extraction processes, with support from Prairie Lithium. An analysis was conducted to compare the project's environmental and operational impact with conventional chlor-alkali facilities, which are typically subject to strict environmental regulations.

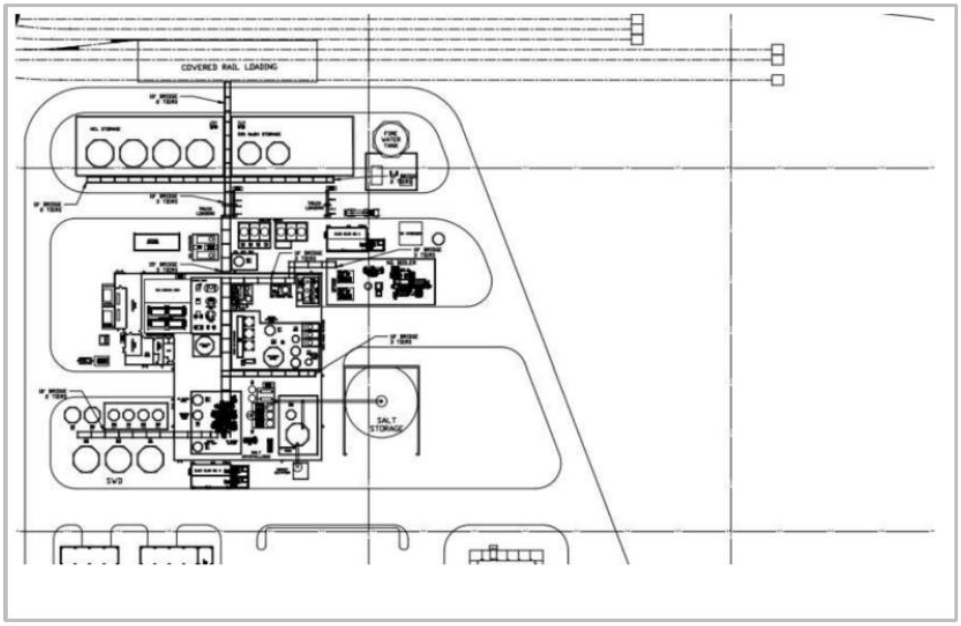

Figure 13: Preliminary Plant Layout

The project progressed toward final engineering and permitting steps, supported by various engineering and consulting firms. Wellspring Hydro collaborated with DEQ (Department of Environmental Quality) and NDIC (North Dakota Industrial Commission) to advance the permitting process, including discussions for a saltwater disposal well. The company completed market research to evaluate economic and environmental benefits, highlighting potential competitive advantages over other chlor-alkali facilities. The project was estimated to reduce environmental impacts associated with produced water disposal and promote resource sustainability in North

Dakota. Wellspring Hydro planned to continue with the permitting, patenting, and engineering validation stages, with additional design refinements expected to improve project viability and attract investor interest.

C-01-04: Midwest Ag Energy Carbon Capture (Grant and Loan)

This project involved the development and implementation of a commercial-scale carbon capture and sequestration project by Midwest Ag Energy Group in McLean County, North Dakota. The project received a **$3 million grant** and a **$100 million loan**.

The project involved the construction of a Capture Compression & Dehydration Facility (CCDF), an injection well (MAG 1), a monitoring well (MAG 2), and a CO_2 transport line. With necessary regulatory approvals obtained, including a Class VI permit from the North Dakota Department of Mineral Resources and EPA's Monitoring, Reporting, and Verification (MRV) Plan, the project aimed to capture CO_2 emissions from the Blue Flint Ethanol facility and store them securely underground. The successful execution of the project demonstrated that CO_2 emissions could be managed effectively, supporting regional sustainability by enhancing the economic feasibility of ethanol production.

Figure 14: Photo of Completed Carbon Capture Facility

The project was marked by multiple operational challenges such as delays due to equipment issues and weather conditions. Despite these, Midwest Ag Energy completed the project by October 2023, achieving all performance metrics, including environmental baseline monitoring and pipeline installation. The first CO_2 injection occurred in late October 2023, and by early 2024, the system had proven its operational reliability. The initiative reduced the carbon intensity of ethanol production, contributing to sustainable energy practices and encouraging similar CCS projects in the region. This pioneering work not only met its carbon reduction goals but also positioned the company as a leader in innovative energy solutions, influencing potential future CCS projects and receiving support for further large-scale initiatives, including a $38 million DOE grant for related endeavors.

C-01-05: EERC Coal Creek CCUS Design (Grant)

This project involves the front-end engineering and design (FEED) for a CO_2 capture project at Coal Creek Station, North Dakota's largest lignite power plant. The project received a **$7 million grant**.

Key project partners include Rainbow Energy Center as the operator, Mitsubishi Heavy Industries as the technology provider, and Burns & McDonnell handling engineering aspects. The design emphasizes a dual-train CO_2 capture system, capturing 95% of emissions from two boiler units. Challenges such as the need for equipment redundancy, integration of steam cycle with existing turbines, and adaptation to cold weather performance were addressed. Engineering tasks completed to date include the development of detailed process flow diagrams, piping, and instrumentation designs, with significant progress in preparing permit strategies and cost estimation processes.

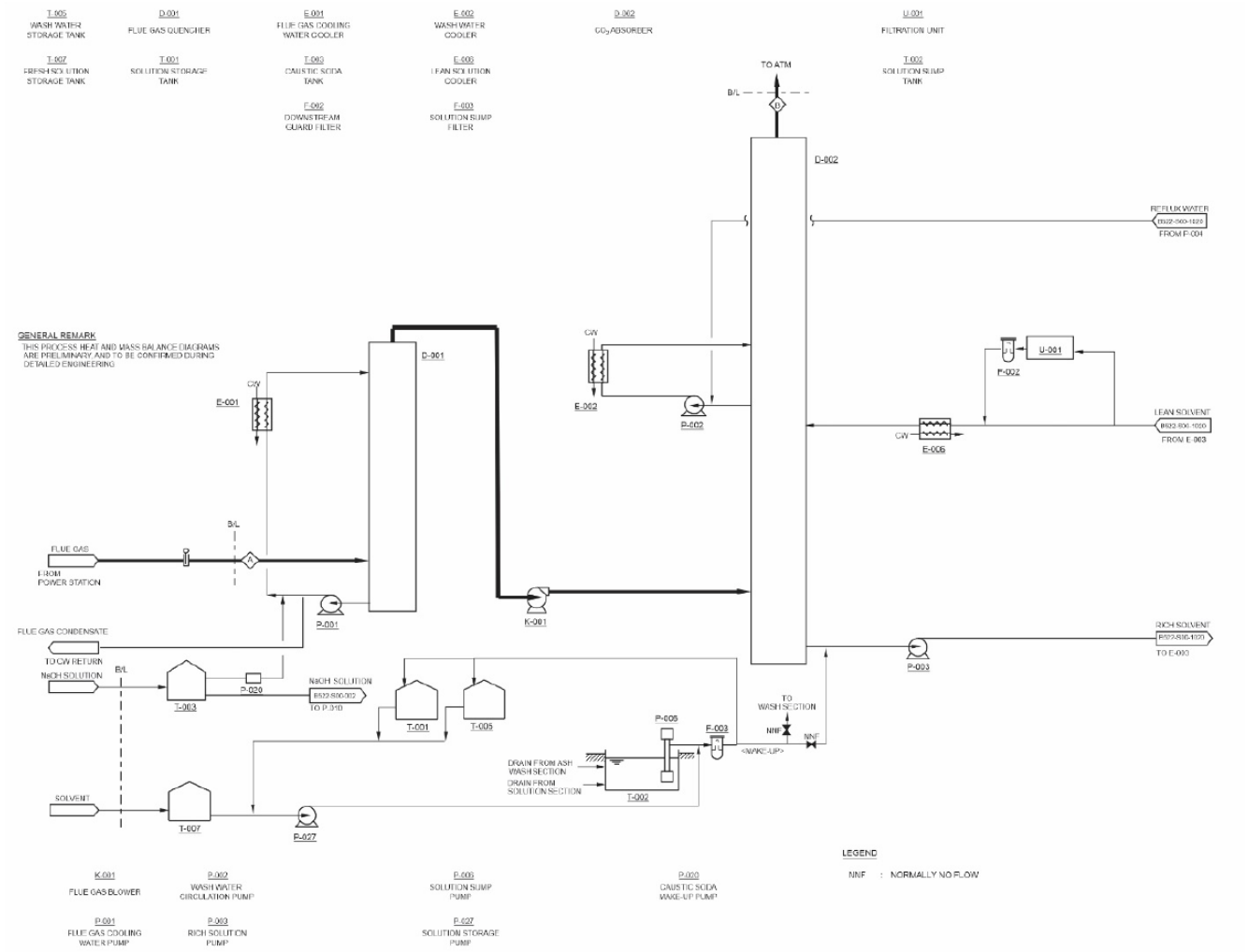

Figure 15: Process Flow Diagram for Coal Creek Carbon Capture System

Progress was made despite initial delays due to financial constraints linked to the ownership change of Coal Creek Station, completed in May 2022. The project has reached near-completion of its FEED phase, with essential documentation such as the Basic Engineering Design Data (BEDD) undergoing continuous updates to reflect evolving design and operational requirements. A major finding was the need for equipment redundancy (e.g., additional compressors) to ensure operational reliability. The integration of CO_2 capture with existing turbines revealed the necessity for modifications to handle various steam extraction scenarios. Permitting strategies, involving air and water discharge considerations, have now been developed, alongside a comprehensive cost-estimation framework, incorporating inputs from vendor bids and engineering assessments.

C-01-J: Valence Flare Gas Capture (Loan)

Valence Natural Gas Solutions LLC pursued a project to scale its Flare Gas Capture (FGC) technology in North Dakota, with the aim of reducing gas flaring and providing mobile natural gas solutions. This project received a **$15 million loan**.

This effort included the expansion of its Standard FGC units (4.0 MMCFD) and development of Micro FGC units (1.0 MMCFD) to capture stranded flare gas across the state. In 2022, Valence successfully deployed its second Standard FGC unit and began fabrication of additional units. Meanwhile, Valence advanced the Micro FGC units, completing design, ordering long-lead items, and beginning fabrication and assembly. The company also bolstered its CNG transport capabilities, growing its fleet by deploying 10 new transport trailers. By the end of the reporting period, Valence had captured 1.7 billion cubic feet of flare gas, reducing CO_2 emissions by over 155,000 tons, while providing cost savings to producers who used CNG to displace diesel. This expansion led to 26 new hires, contributing to Valence's increased staffing.

Figure 16: Valence Unit in Operation in North Dakota, 2022.

Valence encountered several challenges, particularly supply chain disruptions that extended equipment lead times and delayed the deployment of Micro FGC units. Labor shortages and rising wages also impacted the pace of hiring for skilled roles, including truck drivers and gas plant operators. Despite these setbacks, the company adapted by re-designing some system components for field installation and securing rental options for essential equipment to maintain deployment schedules. Lessons learned included the importance of timing in FGC unit availability to align with customer needs, and the rising incidence of H_2S in some customer locations, prompting adjustments in their technology.

To date, the State of North Dakota has received over **$30 million** in additional tax revenue due to the volume of gas captured by Valence's CSEA project.

C-02-06: Enerplus Carbon Capture (Grant)

In 2022, Enerplus received a $1 million grant to evaluate and test industrial scale carbon capture from natural gas power generators. Supply chain limitations along with delays in securing additional funding have delayed the pilot project. Additionally, in 2024 Chord Energy announced its acquisition of Enerplus's assets in North Dakota. To date, Enerplus has not signed a contract to execute a grant agreement. NDIC staff remain in discussions with its successor to determine if the project will proceed. To date, no funds have been expended.

C-02-I: Minnkota Project Tundra (Loan)

In 2022, Minnkota Power Cooperative received a **$15 million loan** to advance Project Tundra, a large carbon capture project at its Milton R. Young lignite-fired power plant. In 2023, Minnkota received an additional **$150 million loan**. Minnkota continues progress toward Project Tundra development as of November 2024.

C-03-07: EERC Liberty H_2 Hub (ARPA Grant)

The Liberty H_2 Hub project, led by the Energy & Environmental Research Center (EERC), aimed to develop a comprehensive front-end engineering and design (FEED) study supporting large-scale clean hydrogen (H_2) production, transport, and storage at the Prairie Horizon facility in southwest North Dakota. The project received a **$10 million ARPA grant**.

Involving stakeholders like MPLX and TC Energy, the project sought to produce clean hydrogen at a rate of 190 tons per day using autothermal reforming (ATR) combined with carbon capture and storage (CCS). The FEED study also included geologic storage considerations for both hydrogen and CO_2, logistics infrastructure for pipelines, and clean ammonia production to leverage market opportunities. Progress toward project tasks included adjustments to scope, such as increased ATR capacity and removal of electrolysis, along with the advancement of technology licensor selection and engineering design updates.

Challenges emerged in subsurface storage design, requiring comprehensive assessments of potential hydrogen and CO_2 storage sites west of Dickinson, ND. The EERC screened formations, analyzed well logs and seismic data, and initiated plans for drilling a stratigraphic test well to gather data crucial for subsurface characterization. Efforts included landowner engagement efforts for pipeline routes and survey permissions, with an emphasis on voluntary participation. Progress was also made on permitting strategies, despite a change in the consulting firm handling this scope. Expenditures and budget tracking were detailed, showing significant investment in labor, administrative efforts, and subcontracting services.

In 2024, MPLX and TC Energy decided to halt further spend on the project, citing premature hydrogen markets. A total of **$6,836,638.60** was de-committed.

C-03-08: Newlight Project Phoenix (Grant and Loan)

Newlight Technologies' Project Phoenix aimed to develop a large-scale facility in North Dakota for producing AirCarbon®, a biodegradable, carbon-negative biopolymer derived from renewable natural gas (RNG). The project received a **$4,185,625 grant** and a **$30 million loan**.

This project followed Phase 1 feasibility studies, which confirmed that constructing such a plant in the state was viable, although it presented challenges due to local climate and logistical considerations. The Front-End Engineering and Design (FEED) phase was conducted in partnership with Burns & McDonnell and reached 97% completion, with the final deliverables expected by the end of 2024. Progress included optimizing the site layout to reduce construction costs, enhancing system efficiency by adjusting equipment sizing, and exploring options for wastewater reuse as crop fertilizer. Site development efforts involved assessing multiple land plots at Marley Crossing, initiating utility tie-in plans, and negotiating with potential partners to ensure timely infrastructure delivery.

Figure 17: AirCarbon® Manufacturing Facility

Despite notable progress, the project encountered delays, such as a late start to Process Hazard Analysis (PHA) documentation, pushing the timeline for some material take-offs. Utility partnerships and site selection were underway, with Newlight engaging local providers and analyzing groundwater for potential use. The project focused on securing competitive bids for equipment and advancing engineering in various scopes, including process, mechanical, piping, and electrical engineering, as well as civil design. Permitting and technical challenges were managed with assistance from Barr Engineering, ensuring critical path items were addressed. Future efforts will involve finalizing site negotiations, mitigating identified risks, and preparing for subsequent phases that would involve state and local support.

C-03-09: Enerplus Geothermal (Grant)

This project involved the replacement of conventional water coolers with geothermal power production skids, enhancing operational energy efficiency and sustainability. This project received a **$1,098,500 grant**.

Traditionally, water cooling has been managed by large coolers to prepare produced water for third-party gathering lines, but Enerplus sought to integrate geothermal technology that utilizes the Organic Rankine Cycle to convert waste heat from water cooling into on-site power. This power would help offset the energy demands typically met by line power or on-site natural gas generators. The plan included deploying these geothermal skids at well sites during initial production phases when water temperatures and flow rates are highest, thereby maximizing both cooling efficiency and power generation.

Phase 1 of the project included the engineering, design and leasing of a geothermal skid for initial testing at the Devils Canyon Pad in North Dakota. By the end of the second quarter of 2024, the geothermal skid was installed and prepared for operation. The results from these operations, including temperature, flow rates, and power output data, were planned for analysis and subsequent reporting in early 2025.

C-04-10: Bushel Farm Traceability Dashboard (Grant)

Bushel Inc. embarked on a project to develop a grain traceability dashboard that facilitates farm data sharing and reporting across all producers utilizing the Bushel Farm platform. This project received a **$3.5 million grant**.

During the second quarter of 2024, significant progress was made in three key areas: infrastructure development, security enhancements, and partner outreach for integration into carbon and environmental, social, and governance (ESG) programs. The team modernized application processing and storage systems in preparation for increased demand and incorporated single sign-on (SSO) capabilities to streamline data linking essential for carbon programs. Security measures were also strengthened to meet SOC2 compliance standards. Concurrently, Bushel engaged with partners to align carbon modeling efforts with regulatory compliance, including preparatory work for 45Z compliance audits and governance.

Deliverables during this period included creating a commercial/advisor view to allow data aggregation and reporting by field representatives or program managers, establishing advisor access for data sharing, and developing a Kubernetes-based infrastructure alongside a Google Cloud Build migration from AWS. Challenges faced included delays in 45Z legislation, which impacted commercialization efforts and the standardization of their model. Lessons learned highlighted the importance of direct producer engagement to scale programs effectively and the necessity of third-party involvement to ensure tax credit claims related to ESG activities are verified and auditable.

C-04-11: Wellspring Hydro Produced Water 2 (Grant and Loan)

Wellspring Hydro continued a project to harness produced water as a sustainable feedstock for clean energy and commercial products. The project received a **$5 million grant** and a **$2.5 million loan**.

This project aims to produce lithium via extraction from oilfield produced water. The project's primary objectives included field validation to demonstrate technical and commercial feasibility, obtaining performance guarantees from technology providers, and completing initial detailed designs to secure technology vendors and plan for the procurement of critical equipment. Progress in this initial phase involved collaborations with Alfa Laval on designing a salt crystallizer and setting up field validation protocols for small-scale pilot tests. Independent preparations for field analysis were also carried out to accelerate preliminary feedback and support future pilots.

During the reporting period, Wellspring Hydro completed FEL-3.1 and FEL-3.2 stages, refining the project's design and capital budget. These advancements enhanced the project's efficiency and allowed for capital allocation strategies with input from construction vendors. Meetings with regulatory bodies such as the North Dakota Department of Environmental Quality (DEQ) and the North Dakota Industrial Commission (NDIC) were also conducted to align permitting processes for the facility and saltwater disposal (SWD) well. Furthermore, a comprehensive market report with partner Nex-Chlor was completed to assess local supply, demand, and sustainability comparisons, aiding strategic planning. Deliverables related to detailed design completion and specialized equipment procurement were noted for further updates in future reports.

C-04-F: Rainbow Energy Coal Ash Recycling (Loan)

Rainbow Energy Center's project, titled "Lignite Combustion Product Enhancements," aimed to optimize the use of coal combustion residuals at Coal Creek Station. The project received a **$42.5 million loan**.

The project is focused on establishing commercial facilities capable of processing bottom ash and flue gas desulfurization (FGD) materials into high-grade commodities for regional markets, thus moving away from traditional storage in solid waste facilities. The initiative is designed to support environmental and economic objectives by reducing waste, lowering CO_2 emissions, and supporting the state's carbon neutrality goals by 2030. Key tasks involve detailed engineering, design, and construction of drying and grinding facilities for bottom ash and processing facilities for FGD materials, leveraging expertise from partners like EcoMaterial Technologies Inc. and Barr Engineering Co.

C-05-12: Scranton Green Pig Iron (Grant)

Scranton Holding Company/North American Iron, Inc. (NAI) embarked on a project to develop a "green" pig iron production facility aimed at replacing traditional high-carbon-emission iron production with a near carbon-neutral, U.S.-based alternative. This project received a **$7 million grant**.

The initiative focused on deep decarbonization in the steel production process, reclaiming mining waste stockpiles, and bolstering market competitiveness by supplying major U.S. steel buyers. Project efforts included collaboration with Civil and Environmental Consultants, Inc. (CEC) to commence the FEL-2 Front-End Engineering Design (FEED) study, with equipment and process design work supported by Tenova. During this period, NAI also engaged in land acquisition, securing leases at multiple sites, and prepared for various environmental and operational permits with state regulatory bodies.

Figure 18: Pig Iron Materials Handling

Progress highlights included mineral exploration and ore testing by Northeast Technical Services, with specifications met for pellet production to be tested by

Tenova. Permitting processes advanced, notably with applications submitted to the Minnesota Department of Natural Resources for mining operations. The project reached milestones such as 85% completion of mineral exploration and 50% of permitting tasks.

C-05-13: EERC Marathon Renewable Fuel Expansion (Grant)

The Energy & Environmental Research Center (EERC), in partnership with Marathon Petroleum Corporation (MPC), proposed a front-end engineering and design (FEED) study for the expansion of the Dickinson Renewable Fuel Facility in North Dakota. The project received a **$3.3 million grant**.

This project aimed to enhance the facility's renewable fuel production capacity by up to 90% and diversify its output to include sustainable aviation fuel (SAF). The scope also involved the addition of a pretreatment unit to process various low-carbon feedstocks and the integration of carbon capture technology at the hydrogen production facility to reduce the carbon intensity (CI) of its operations by more than 20%.

In 2024, the project sponsor notified the NDIC that it would not be moving forward with the project, citing market challenges. The entire award was de-committed.

C-05-14: Dakota Lithium Batteries (Grant)

Dakota Lithium Materials (DLM) launched a project to develop a production line in Grand Forks, North Dakota, capable of producing 1,000 metric tons per year (MT/Y) of lithium iron phosphate (LFP) cathode materials using a novel dry-process technology. This project received a **$2 million grant**.

The project was funded partly by CSEA to help mitigate U.S. supply chain challenges for battery materials. Initial progress focused on project management, planning, and the procurement of necessary equipment. Despite not receiving funding from the Department of Energy's Storage Innovation program, DLM increased its contribution by $2 million to match the NDIC grant, securing a project total of $4,019,944. Facilities

were leased, including a 6,542-square-foot warehouse in Grand Forks that was equipped for chemical lab operations, testing, and pilot production.

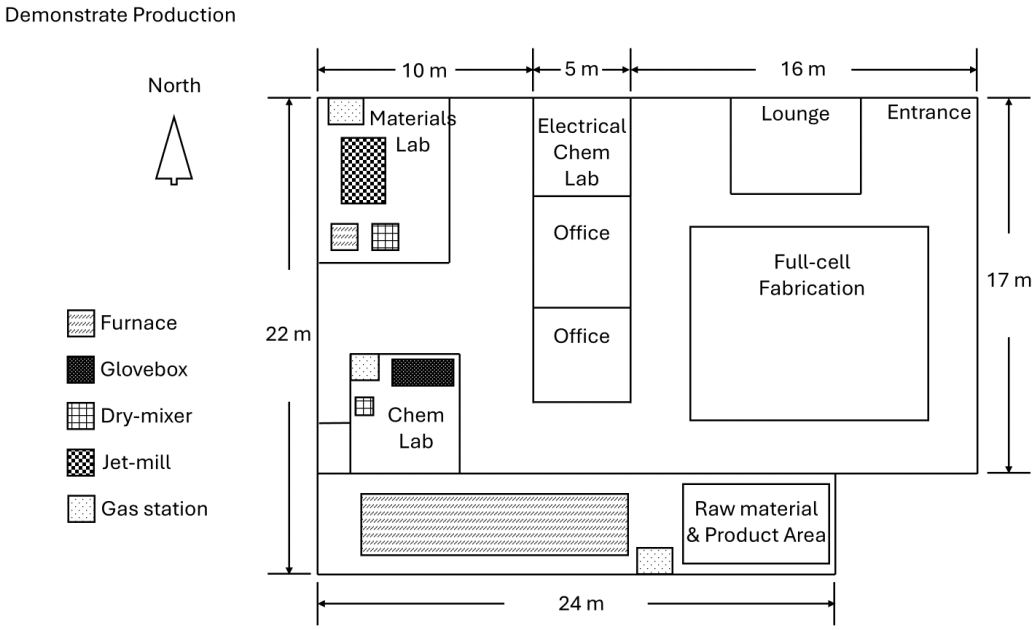

Figure 19: Dakota Lithium Facility Layout

The project's progress included the installation and activation of key equipment such as a two-station glovebox, a Resodyn LabRAM II mixer, and a full-cell battery tester, among others. Initial material testing and preparation were conducted, resulting in mixed LFP batches now pending further calcination and testing. Some delays occurred due to city code compliance requirements for high-power outlet installations needed for the pilot-scale furnace. Lessons learned emphasized the importance of early engagement with local suppliers for services such as power and gas, highlighting the efficiencies gained from consolidating all tasks in-house at their leased facility.

C-05-15: Cerilon GTL FEL-3 (Grant and Loan)

This project involved continuing the Cerilon GTL project into the FEL-3 phase. The project received a **$9.5 million grant** and a **$8 million loan**. The grant award is contingent upon Cerilon fully drawing upon its loan, and it must match the award from non-public funds.

C-05-B: NextEra Spiritwood Fertilizer (Forgivable Fertilizer Loan)

In 2024, NextEra received a **$125 million forgivable loan** to support the construction of a fertilizer production facility in Stutsman County, ND. The award is only forgivable upon completion of the construction of the facility, and the facility must produce up to 75% of its nameplate capacity.

The facility will produce 100,000 tons of ammonia per year via electrolysis of water. Power will be produced by NextEra's wind generation in North Dakota.

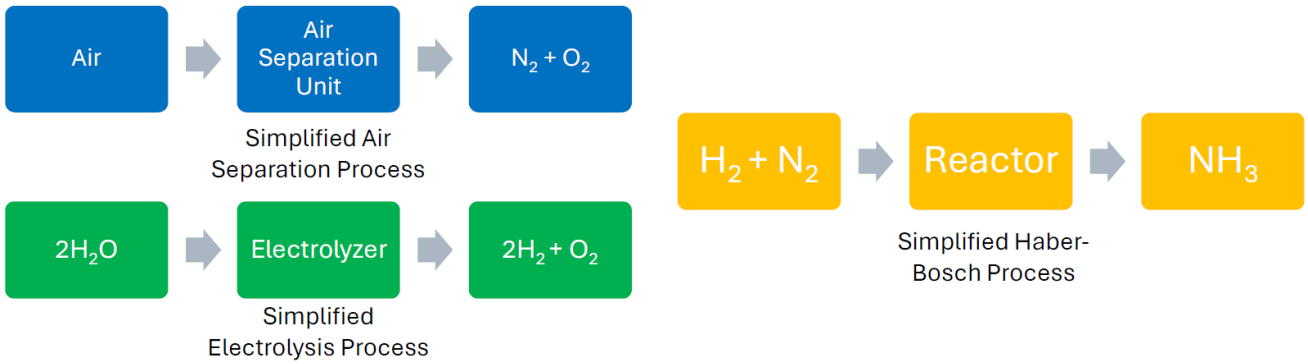

Figure 20: Process Flow Diagram of Fertilizer Production at NextEra's Facility

C-05-I: Packet Digital Battery Manufacturing Plant (Loan)

Packet Digital's project titled "Grand Power – United States Flexible Lithium-Ion Battery Cell Manufacturing Plant," aimed at establishing a U.S.-based, high-performance lithium-ion battery production facility in North Dakota. The project received a **$17 million loan**.

This initiative was driven by the critical need to strengthen the national supply chain for energy storage, specifically to support the U.S. military and commercial autonomous systems that rely on high-energy-density, lightweight batteries. The plant, set to be operational by late 2026, aims to enhance national security by reducing dependency on foreign battery suppliers and emphasizing domestic production of critical goods.