Letter of Transmittal

May 23, 2023

Reice Haase

Executive Director

North Dakota Industrial Commission

State Capitol-14th Floor

600 East Boulevard Ave Dept 405

Bismarck, ND 58505-0840

Dear Mr. Haase,

On behalf of 4H2, Inc. we are submitting our grant application for the May 26th, 2023, grant round of the ND Industrial Commission Renewable Energy Program. We have sent via USPS the $100 Application fee separately from the electronic submission of the grant.

Our submission includes the grant application, patent rights reservation, tax liability statement, and an appendix containing Letters of Support from agriculture-related associations and economic development entities.

4H2, Inc. is requesting $346,915.00 over a 2-year research period, matched equally with private funding from within 4H2, Inc. for a total research and development proposal of $693,832.00.

4H2, Inc. is a North Dakota corporation operating in the renewable, clean energy industry. We greatly appreciate the opportunity to apply to the Renewable Energy Program. Please feel free to contact me at any time with any questions regarding this submission.

Sincerely,

Jason LaPlante

Jason LaPlante

CEO - 4H2, Inc.

1610 Mill Road

Grand Forks, ND 58201

Renewable Energy Program

North Dakota Industrial Commission

Application

Project Title: DEFC Research and Development

Applicant: 4H2, Inc.

Principal Investigator: Dr. Yang Yang

Date of Application: May 22, 2023

Amount of Request: $346,915

Total Amount of Proposed Project: $693,832

Duration of Project: 2023 - 2025

Point of Contact (POC): Brian LaPlante

POC Telephone: (218) 280-0945

POC Email: brian.laplante@4h2inc.net

POC Address: 1610 Mill Road, Grand Forks, ND 58201

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ABSTRACT

Objective:

4H2, Inc is engaging in a "Sponsored Research Project" with the University of Central Florida for the development of a high-energy density, direct ethanol fuel cell (DEFC). The goal is to develop a catalyst that is low in rare earth metals yet can achieve the same energy density as current state hydrogen fuel cell technology (1 watt per centimeter-squared). 4H2, Inc., (herein referred to as 4H2) will own the patent rights to this technology upon completion of the research work. Dr. Yang Yang and his team of researchers at the University of Central Florida (UCF) will be conducting the research and development effort of this novel catalyst.

In achieving the research goals of this project, the high energy output catalyst allows for 4H2 to create DEFC systems which are scalable in power output based upon its application. 4H2 believes that with the advent of high-energy density DEFC, this technology can assist the corn ethanol industry in surviving the negative market impact from recent California Air Resources Board (CARB) and related government regulations. These regulations will drive the phasing out of internal combustion engines and therefore the demand for ethanol fuel currently used to blend with gasoline.

DEFC technology allows for the direct creation of electricity from ethanol as a fuel source for the fuel cell without any additional steps. DEFC stationary, portable, and mobile electricity generation competes favorably against hydrogen fuel cell systems, utilizing the existing production and distribution infrastructure system of ethanol, whereas hydrogen fuel cell technology does not have significant production or distribution infrastructure to date.

Expected Results: Upon completion of the 2-year research project, the "Deliverables" from the UCF research team are:

1.) Novel, patentable, low rare or noble earth metal catalyst with a power density of 0.8 – 1.0 W per CM^2.
2.) DEFC prototype stack based upon the novel catalyst for 4H2 for the purposes of testing, feasibility, and design of a commercially viable DEFC system.
3.) 4H2 and UCF will file for patent of this novel catalyst, which 4H2 will own.

Duration: Research commences in 2023 and will continue for a period of two years, culminating in 2025 with the completion of the above-stated deliverables to 4H2.

Total Project Cost: The UCF project budget is $693, 832.

Participants: Dr. Yang Yang as Primary Investigator and his team of UCF graduate students will undertake the direct research on behalf of 4H2 who is sponsoring the research.

PROJECT DESCRIPTION

Objectives: The objective of this project is to develop a novel technology based on direct-ethanol (EtOH) fuel cells (DEFC) with a power density of 0.8-1.0 W cm^{-2} in both single cell and stack, which will be ideal as the power source in various commercial and defense applications.

Methodology: We will develop a high-throughput synthesis method to produce palladium (Pd)-based alloys, which will be employed as the catalysts for the DEFC.

Anticipated Results: The DEFC will deliver a power density of 0.8-1.0 W per cm^2 in both single cell and stack, which is competitive to hydrogen fuel cells but can be operated in a much safer and more convenient normal atmospheric pressure condition without the need for a high-pressure condition as is needed in hydrogen fuel cell.

Facilities: The University of Central Florida (UCF) research Laboratory has the necessary research facilities, including three hoods, three sinks, and sufficient counter space for postdocs and students to be working on simultaneously. More detailed information can be found from: http://www.yangyanglab.com/facilities.html

Resources: Material characterization equipment is available at the UCF shared facilities. The Advanced Materials Processing and Analysis Center (AMPAC) has two user facilities centers, Advanced Microfabrication Facility (AMF) and Materials Characterization Facility (MCF), that provide sufficient shared instrument facilities to pave the way to project success. The following equipment and facilities can be accessible: Cryo Small Single Sputtering, CHA E-Beam Evaporation, Physical Electronics 5400 ESCA (XPS), PANalytical Empyrean Thin Film X-ray Diffraction (XRD), Hitachi S3500N Scanning Electron Microscope (SEM), FEI Tecnai F30 Transmission electron microscope (TEM), Renishaw RM 1000B Micro-Raman Spectrometer, inductively coupled plasma mass spectrometry (ICP-MS, Agilent Technologies, Palo Alto, CA) model 7500s, Perkin Elmer Spectrum 100 attenuated total reflection (ATR) Fourier Transform Infra-red Spectroscopy (FT-IR) Spectrometer, N_2 adsorption/desorption analyzer (NOVA 2000e, Quantachrome Instrument) for specific surface area measurement, PAR model M273 potentiostat/galvanostatic (Princeton Applied Research) for electrical conductivity measurement. A cleanroom facility is also available for nanodevice fabrication.

Techniques to Be Used, Their Availability and Capability: Thermal annealing technique will be used to synthesize the desired materials for DEFC, which has been well explored in the research lab at UCF.

Environmental and Economic Impacts while Project is Underway:

Current means of utilizing ethanol as an energy source is primarily via blending with gasoline for use in passenger vehicles. As has been determined, this contributes to the generation of climate threatening GHG's and the generation of harmful levels of nitrous oxides (NOx) emissions. Recent CARB and EPA regulations imposed on the internal combustion engine market calls for the phasing out of these internal combustion engines within the next several years. This will severely impact the current market for corn-derived ethanol resulting in a substantial loss of market revenue to corn producers and the ethanol production industry. This loss of revenue will have an extensive negative ripple-effect impact on the agriculture industry as a whole.

Further, with the current production of ethanol produced with the intention of blending with gasoline as a fuel oxygenation additive, this requires ethanol to be distilled to an anhydrous state. The energy required to remove all water from the ethanol requires significant energy input which in turn drives up the cost to reach this state. Because natural gas is used to fuel the distillation process, this adds to the CO_2 generated during production. Comparatively, it is desirable for ethanol used for fueling DEFC's to retain a certain amount of water, thereby reducing cost and CO_2 generation. As a result, the amount of fuel produced by existing ethanol plants could be increased by as much as 30% with no additional cost.

Ultimate Technological and Economic Impacts:

DEFC technology can utilize ethanol directly without blending with gasoline and without using thermal combustion. Rather, electro-chemical conversion of ethanol directly to electricity under ambient temperature and pressure is how DEFC operates. An important benefit of the DEFC technology that 4H2 will manufacture is that CO_2 found in ethanol will be molecularly converted to a non-gaseous carbon product, thereby not entering the atmosphere. Essentially, ethanol as a fuel becomes CO_2 negative within the DEFC we are developing.

The impact of the DEFC technology is that it provides a market pathway for ethanol to remain as a strategic commodity for North Dakota for the near and foreseeable future. 4H2 also seeks to set up manufacturing of the DEFC product line in the state of ND due to its business-friendly policies and proximity to the raw materials needed to produce DEFC's.

Why the Project is Needed:

Maintaining the current market for corn-derived ethanol is critical for maintaining the health of the agricultural industry and all those employed downstream and upstream of the corn producers. Furthermore, corn ethanol is a sustainable fuel that contributes to the United States' energy independence. DEFC technology creates a path forward for ethanol in a "post-internal combustion" era. DEFC technology increases the potential applications of ethanol beyond what is able to be achieved

today. Finally, by converting ethanol fuel into electricity by chemical process, it can help lead to the zero-carbon production of energy per the goals of federal regulations.

STANDARDS OF SUCCESS

Standards of Success should include: The measurable deliverables of the project that will determine whether it is a success; The value to North Dakota; An explanation of what parts of the public and private sector will likely make use of the project's results, and when and in what way; The potential that commercial use will be made of the project's results; How the project will enhance the education, research, development and marketing of North Dakota's renewable energy resources; How it will preserve existing jobs and create new ones; How it will otherwise satisfy the purposes established in the mission of the Program.

The measurable deliverables of the project:

- Report on DEFC prototype single cell - 12 months after Effective Date
- Report on DEFC prototype stack – 24 months after Effective Date
- Novel catalyst which will be patented and owned by 4H2

The value to North Dakota:

The DEFC research sponsored by 4H2 provides for the continuation of and growth of the value of corn-derived ethanol production in the state of North Dakota and the preservation of the jobs and commerce related to this industry. Further, with the support of North Dakota, 4H2 is looking to establish a DEFC manufacturing presence in the state, creating new job opportunities for its residents. Finally, in communications with the administration of North Dakota State University, 4H2 seeks to collaborate with the University in developing a biofuels research and development program starting with the manufacturing process development for DEFC production.

An explanation of what parts of the public and private sector will likely make use of the project's results, and when and in what way:

As stated above, the direct benefit for the private sector of the research is the preservation and growth of the state's corn growers, ethanol producers and the supply chains associated with both. An important public sector benefit is the continuation of state revenues related to these industries. Equally important is the utilization of the DEFC technology by the private and public sector. Stationary, portable, and mobile electricity generation via DEFC allows for a new approach to electricity generation for farms, homes, businesses, vehicles, and off-road vehicles and equipment. Power generation to complement the power grid via micro-grids and distributed energy resources (DER's) is critical today.

How the project will enhance the education, research, development and marketing of North Dakota's renewable energy resources:

By bringing a biofuels focus to North Dakota State University, this will enhance the University's standing in this extensive field of research and development. We have had discussions with and intend to partner with the ND Department of Ag Extension to demonstrate the feasibility of multiple applications of electrified ag production equipment as the future trend in the industry. Furthermore, by collaborating with the Agronomy department at NDSU, 4H2 wishes to explore the development of additional ethanol product feedstock plant varieties. The ability of DEFC to play a critical role in complimenting existing electricity generation (especially intermittent sources such as wind and solar) by producing electricity on demand when insufficient electricity exists will impact renewable energy vitality in North Dakota. Finally, promoting ethanol as a verified carbon neutral (or negative) fuel will aid in the transition of North Dakota as a leader in fossil fuels production to a sustainable clean energy production state of the future.

How it will preserve existing jobs and create new ones:

By supporting the ND ethanol industry in its transition from ethanol as a pure additive for blending with gasoline as a fuel for ICE-powered vehicles, which is facing its demise via recent fossil fuel free regulatory mandates, this research will lay the foundation for a more robust future for the ethanol industry and all who are employed in it and its supply chain. Growing this industry brings with it the opportunity for employment growth, as will the manufacturing of the DEFC's themselves in the state of ND.

How it will otherwise satisfy the purposes established in the mission of the Program:

An important aspect of the Renewable Energy Development program is to identify technologies "presently not used in North Dakota". DEFC technology does not commercially exist on the market today. 4H2 will endeavor to make DEFC commercially viable after this research is completed and intends to set up manufacturing within North Dakota. DEFC research serves to promote the growth of North Dakota's standing as a renewable energy industries leader through direct research and development. Furthermore, by collaborating with NDSU and the ND Department of Ag Extension, we will be enabling the education of a new and future generations of technical careers in this industry.

BACKGROUND/QUALIFICATIONS

Please provide a summary of prior work related to the project conducted by the applicant and other participants as well as by other organizations. ***This should also include summary of the experience and qualifications pertinent to the project of the applicant, principal investigator, and other participants in the project.***

Dr. Yang Yang, an associate professor at UCF, has devoted research and published more than 130 peer-reviewed articles related to the programmable and controlled synthesis of innovative materials for many applications across different fields of renewable energy, including energy conversion and storage, green catalysis, artificial photosynthesis, and reactor design for various energy devices such as fuel cells, flow batteries, and (water and CO_2) electrolyzers. In particular, Dr. Yang's expertise in exploring innovative techniques and approaches for the development of fuel cells catalysts will be the solid basis for the project's success.

This new research intends to build on the science used to develop the catalyst which is now under patent pending and for which 4H2 has secured the option for exclusive rights. This previous catalyst technology shows that the DEFC can generate 0.7 W per CM^2 and therefore is a solid basis on which to improve to the desired output of 1.0 W per CM^2 while reducing the amount of rare earth materials in the catalyst formulation.

Jason LaPlante, co-founder of 4H2 Inc., obtained his B.S. degree in Agricultural Engineering from North Dakota State University in 1986 and has been leading product development efforts for several major corporations since then. He currently serves as Vice President of Product and Technology for TBEI, Inc., a manufacturer of light to heavy duty dump trucks and semi trailers. While serving as VP at TBEI, Jason is also involved in running 4H2, Inc.

Brian LaPlante, co-founder of 4H2, Inc., obtained his B.S. degree in Business Administration from North Dakota State University in 1990. He has since led a career in research and development in a number of industries, including machinery and food production. He co-authored published studies jointly with the University of Minnesota in the field of cereal grain genetics and fermentation. He was the co-founder of the Hydrogen Economy Collaborative launched in 2020, now administered by the Great Plains Initiative in Minneapolis, MN. Brian initiated the founding of 4H2 in order to pursue the research and development of direct ethanol fuel cells based on his knowledge of the science and a need for this technology as detailed elsewhere in this application.

MANAGEMENT

*A description of **how** the applicant will manage and oversee the project to ensure it is being carried out on schedule and in a manner that best ensures its objectives will be met, **and a description of the evaluation points to be used** during the course of the project.*

Jason LaPlante and Brian LaPlante have extensive experience in project management and research management. The following project management approach will be implemented, along with the utilization of a Project Management software system for precise implementation, tracking, and cataloging of data.

- **Management and Oversight of the Sponsored research by 4H2, Inc.**
  - 4H2, Inc. is the sponsor of the research project with Dr. Yang and the UCF team. As such we will manage and oversee the funding of the research as well as "milestone" and "deliverables" set forth in our "Master Agreement" and "Task Orders" of the project.
  - Dr. Yang will complete monthly reports for work completed and hours of work undertaken for invoicing by the UCF. 4H2 will pay the invoices on a monthly basis.
  - 4H2, Inc. will remain in weekly, monthly, and quarterly "Status Meetings" for project progress and to address any specific questions or needs of the UCF team.
  - Quarterly and Semi-annual performance and outcome reports from Dr. Yang will be delivered to 4H2 to ensure progress of the project is on time as per the Task Order timeline.
  - 4H2 will remain in quarterly contact with the Director of Intellectual Property at UCF for discussions regarding patent application as the project meets specific goals and the stated deliverables are undergoing performance testing.
- **Ensuring the project remains on schedule and objectives are met.**
  - 4H2 will maintain very tight schedules for weekly, monthly, and quarterly meetings with Dr. Yang to monitor progress and to discuss any needs the research team has that may impact milestones stated within the project task order.
  - 4H2 will establish a weekly and monthly "Roadblocks Protocol" which will be a designated discussion in our meetings in the attempt of anticipating any research roadblocks either in outcomes, materials used in research, equipment malfunctions, staffing situations, etc. and how alternate solutions can be made ready for such potentials.
- **Evaluation points within the project.**
  - Specific evaluation points are tied directly to the Project Task Order with Milestones and Deliverables stated. These milestones and deliverables are:
    - Milestone 1.1: Catalyst with a power density of 0.7-0.8 W cm^{-2} in DEFC
    - Milestone 1.2: Scale up of DEFC prototype cell from 10 cm^2/cell to 50 cm^2/cell
    - Deliverable 1: DEFC prototype single cell (3-4 W/Cell)
    - Milestone 2.1: The catalyst with a power density of 0.8-1.0 W cm^{-2} in DEFC
    - Milestone 2.2: DEFC prototype cell (50 cm^2/cell)
    - Milestone 2.3: DEFC prototype cells in a stack (50 cm^2/cell)
    - Deliverable 2: DEFC prototype stack (20-100 W/stack)

TIMETABLE

Please provide a project schedule setting forth the starting and completion dates, dates for completing major project activities, and proposed dates upon which the interim reports will be submitted.

Master Schedule for DEFC Project (2-Year timeline)

Project Begin Date (proposed): August 1, 2023

Project Completion Date (proposed): July 31, 2025

Task 1: Composition selection of Pd-based Catalysts (August 2023-July 2024)

Milestone 1.1: Catalyst with a power density of 0.7-0.8 W cm^{-2} in DEFC (to be completed by July of 2024).

Milestone 1.2: Scale up DEFC prototype cell from 10 cm^2/cell to 50 cm^2/cell (to be completed by July of 2024).

Deliverable 1: DEFC prototype single cell, 3 to 4 W/ cell (to be completed by July of 2024).

Quarterly reporting due dates: (Due to 4H2, Inc.)

October 31, 2023

January 31, 2024

April 30, 2024

July 31, 2024

Semi-annual reporting due dates: (Due to the ND Industrial Commission-REP)

January 31, 2024

July 31, 2024

Task 2: Supporting materials selection to immobilize Pd-based catalysts (August 2024-July 2025).

Milestone 2.1: The catalyst with a power density of 0.8 W cm^{-2} in DEFC (to be completed by January 31, 2025).

Milestone 2.2: DEFC prototype cell, 50 cm^2/cell (to be completed by July of 2025).

Milestone 2.3: DEFC prototype cells in a stack, 50 cm^2/cell (to be completed by July of 2025).

Deliverable 2: DEFC prototype stack, 20-100 W/stack (to be completed by July of 2025).

Quarterly reporting due dates: (Due to 4H2, Inc.)

October 31, 2024

January 31, 2025

April 30, 2025

July 31, 2025

Semi-annual reporting due dates: (Due to the ND Industrial Commission-REP)

January 31, 2025

July 31, 2025

BUDGET

*Please use the table below to provide an **itemized list** of the project's capital costs; direct operating costs, including salaries; and indirect costs; and an explanation of which of these costs will be supported by the grant and in what amount. The budget should identify all other committed and prospective funding sources and the amount of funding from each source. **Please feel free to add columns and rows as needed.** Higher priority will be given to those projects have matching private industry investment equal to at least 50% or more of total cost.*

Project Associated Expense	NDIC's Share	Applicant's Share (Cash)	Applicant's Share (In-Kind)	Other Project Sponsor's Share
Key Personnel	$ 13,023	$13,024		
Other Personnel	$152,250	$152,250		
Fringe Benefits	$ 28,397	$ 28,398		
Direct Costs	$ 2,000	$ 2,000		
Other Direct Costs	$ 39,096	$ 39,096		
Indirect Costs	$112,149	$112,149		
Total	$346,915	$346,917		

Below is the budget prepared by UCF to cover the expenses for the research project as defined in their proposal. The funds indicated below have been entered into the table above.

Cumulative Budget				
		Funds Requested		
Budget Cost Category	RATE	Year 1	Year 2	Total Project
A. Direct Labor - Key Personnel				
Dr. Yang Yang	1	$ 12,831	$ 13,216	
Subtotal Salary		$ 12,831	$ 13,216	$ 26,047
Direct Labor - Other Personnel				
Post Doctoral Associate	2	$ 100,000	$ 103,000	
Graduate Student	2	$ 50,000	$ 51,500	
Undergraduate Student				
Subtotal OPS		$ 150,000	$ 154,500	$ 304,500
B. Fringe Benefits				
Faculty	31%	$ 3,978	$ 4,097	
Post Doc	23%	$ 23,000	$ 23,690	
Students	2%	$ 1,000	$ 1,030	
Subtotal Fringe		$ 27,978	$ 28,817	$ 56,795
Total Labor Costs (A+B)		**$ 190,809**	**$ 196,533**	**$ 387,342**
C. Direct Costs - Equipment		$ -	$ -	$ -
D. Direct Costs - Travel				
Domestic Travel		$ 2,000	$ 2,000	
Total Travel Costs		**$ 2,000**	**$ 2,000**	**$ 4,000**
F. Other Direct Costs				
Materials & Supplies		$ 10,000	$ 10,000	
OCO or Facility Rental		$ 10,000	$ 10,000	
Tuition	2	$ 18,630	$ 19,562	
Total Other Direct Costs		**$ 38,630**	**$ 39,562**	**$ 78,192**
G. Total Direct Costs (A+B+C+D+E+F)		**$ 231,439**	**$ 238,095**	**$ 469,534**
Modified Total Direct Costs		$ 212,809	$ 218,533	$ 431,342
H. Indirect Costs	**52%**	$ 110,661	$ 113,637	$ 224,298
I. Total Direct and Indirect Costs (G+H)		**$ 342,100**	**$ 351,732**	**$ 693,832**
				$ 693,832

Please use the space below to justify project associated expenses, and discuss if less funding is available than that requested, whether the project's objectives will be unattainable or delayed.

The project expenses indicated above are the direct and indirect costs associated with performing the research at the University of Central Florida. If the funding of $346,915 is not available from the NDIC, then other sources of funding will need to be sought out and obtained, which will delay the start of the research project. In turn, this will delay the economic benefits for ND as a result of this research.

CONFIDENTIAL INFORMATION

Any information in the application that is entitled to confidentiality and which the applicant wants to be kept confidential should be placed in an appendix to allow for administrative ease in protecting the information from public disclosure while allowing public access to the rest of the application. The appendix must be clearly labeled as confidential and must include the following information: (a.) a general description of the nature of the information sought to be protected, (b.) an explanation of why the information derives independent economic value, actual or potential, from not being generally known to other persons, (c.) an explanation of why the information is not readily ascertainable by proper means by other persons, (d.) a general description of any person or entity that may obtain economic value from disclosure or use of the information, and how the person or entity may obtain this value, and (e.) a description of the efforts used to maintain the secrecy of the information.

If there is no confidential information, please note that below. If you plan to request confidentiality for ***reports*** *if the proposal is successful, this section must still be completed.*

There is no confidential information in this application.

PATENTS/RIGHTS TO TECHNICAL DATA

Any patents or rights that the applicant wishes to reserve must be identified in the application. If this does not apply to your proposal, please note that below.

4H2, Inc holds the exclusive rights to the following patent filed by the University of Central Florida:

High-Entropy Alloy for High-Performance Direct Ethanol Fuel Cells (63/388,085)

STATE PROGRAMS AND INCENTIVES

Any programs or incentives from the State that the applicant has participated in within the last five years should be listed below, along with the timeframe and value.

None to date

Appendix: Tax Liability Statement

Tax Liability Statement

Applicant:

4H2, Inc.

Application Title:

DEFC Research and Development

Program:

- ☐ Lignite Research, Development and Marketing Program
- ☑ Renewable Energy Program
- ☐ Oil & Gas Research Program
- ☐ Clean Sustainable Energy Authority

Certification:

I hereby certify that the applicant listed above does not have any outstanding tax liability owed to the State of North Dakota or any of its political subdivisions.

Signature JASON LAPLANTE

CEO - 4H2, Inc.

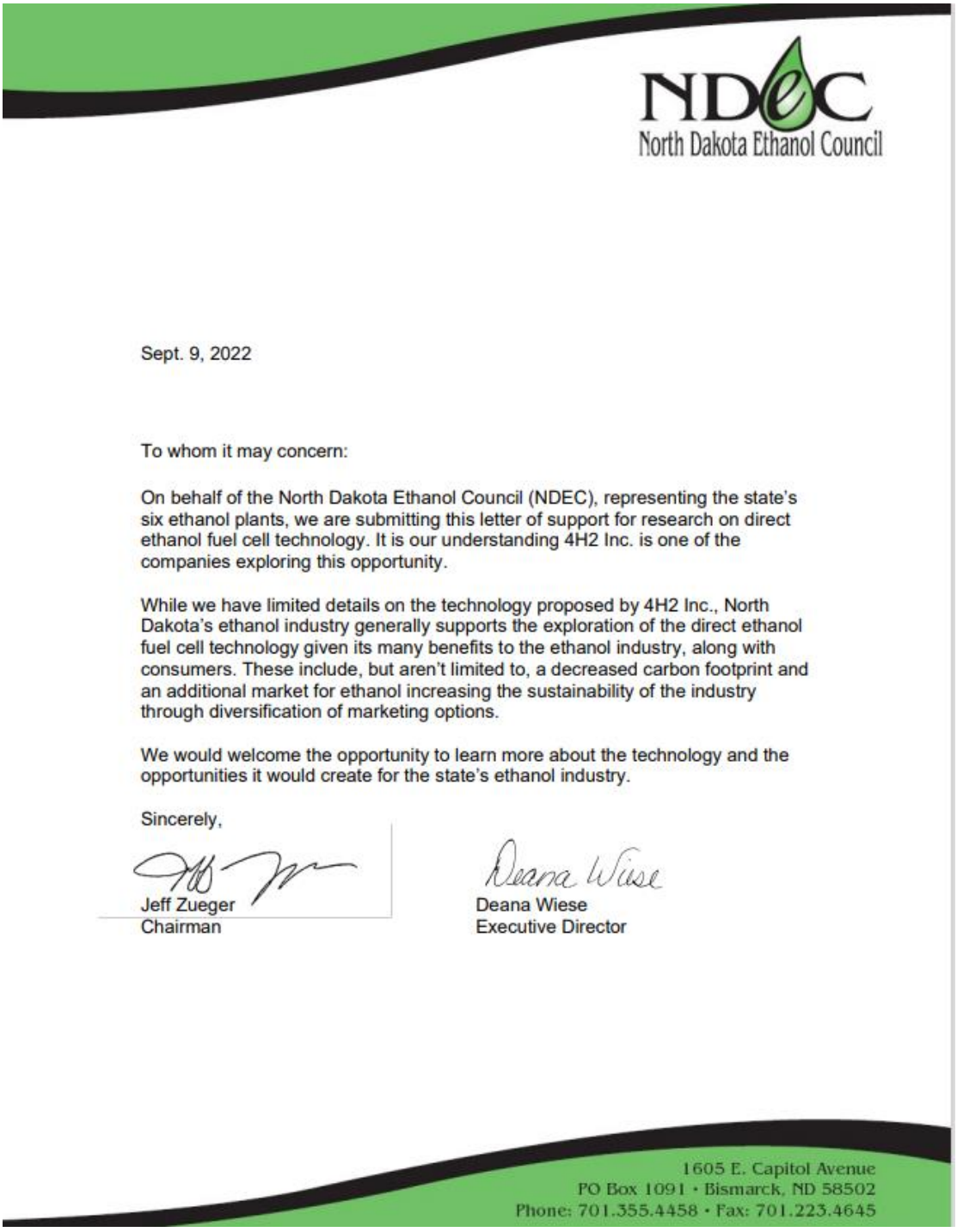
Title

May 22, 2023

Date

Appendix: Letters of Support

North Dakota Ethanol Council:



NDEC
North Dakota Ethanol Council

Sept. 9, 2022

To whom it may concern:

On behalf of the North Dakota Ethanol Council (NDEC), representing the state's six ethanol plants, we are submitting this letter of support for research on direct ethanol fuel cell technology. It is our understanding 4H2 Inc. is one of the companies exploring this opportunity.

While we have limited details on the technology proposed by 4H2 Inc., North Dakota's ethanol industry generally supports the exploration of the direct ethanol fuel cell technology given its many benefits to the ethanol industry, along with consumers. These include, but aren't limited to, a decreased carbon footprint and an additional market for ethanol increasing the sustainability of the industry through diversification of marketing options.

We would welcome the opportunity to learn more about the technology and the opportunities it would create for the state's ethanol industry.

Sincerely,

Jeff Zueger
Chairman

Deana Wiese
Executive Director

1605 E. Capitol Avenue
PO Box 1091 · Bismarck, ND 58502
Phone: 701.355.4458 · Fax: 701.223.4645

auri
Agricultural Utilization Research Institute

May 12, 2023

North Dakota Renewable Energy Program
Director: Reice Haase
North Dakota Industrial Commission
State Capitol, 14th Floor, 600 E Boulevard Ave. Dept. 405
Bismarck, ND 58505-0840

RE: AURI Letter of Support for 4H2, Inc.'s North Dakota Renewable Energy Program application

North Dakota Renewable Energy Program Review Committee,

It is my pleasure to write this letter of support on behalf of the Agricultural Utilization Research Institute (AURI) for 4H2 Inc.'s proposal submitted to the North Dakota Renewable Energy Program. AURI is a non-profit corporation funded primarily by the State of Minnesota with a mission to foster long-term economic benefit for Minnesota through value-added agricultural products. AURI accomplishes this by developing new uses for agricultural products through science and technology, using a deliberate approach on multiple levels, including focused basic research, public information dissemination, building strategic collaborations among partners and by placing a strong emphasis on applications with near-term implementation plans.

The proposed project aims for direct ethanol fuel cell systems which will direct conversion of ethanol to electricity via fuel cell technology. Developing this technology may play a critical role in complimentary electricity generation. 4H2, Inc. believes the additional benefits of agriculturally sourced byproducts for the components of the DEFC systems are important factors.

AURI supports 4H2, Inc. as it partners to seek external funding to reach its research objectives.

Sincerely,

Jennifer L Wagner-Lahr

Jennifer Wagner-Lahr
Senior Director of Commercialization

Minnesota Corn Research & Promotion Council:

MinnesotaCorn
RESEARCH & PROMOTION COUNCIL

5/17/2023

500 E. Travelers Trail, Suite 600
Burnsville, MN 55337
952.233.0333
mncorn.org

Riece Haase
Executive Director
North Dakota Industrial Commission
State Capitol-14th Floor
600 East Boulevard Ave Dept 405
Bismarck, ND 58505-0840

Dear Ms. Haase,

I am writing this letter on behalf of the Minnesota Corn Research and Promotion Council (MCR&PC) to provide support for funding research on Direct Ethanol Fuel Cell technology. The mission of MCR&PC is to identify and promote opportunities for Minnesota's 24,000 corn farmers, while enhancing quality of life. As a part of this mission, the MCR&PC supports quality research and encourage novel ideas.

Corn plays a vital role in the supply chain for human, animal, and ethanol feedstocks. Minnesota is the 3rd largest corn producer in the U.S. and corn is the largest crop grown in Minnesota. Regarding ethanol, Minnesota is home to 19 ethanol plants producing over 1.4 billion gallons. Corn and ethanol are critically important to the state of Minnesota.

The MCR&PC is aware of technology being developed by 4H2, Inc. which could impact the future of ethanol. 4H2, Inc. is developing Direct Ethanol Fuel Cell systems which allows for the **DIRECT** conversion of ethanol to electricity via fuel cell technology. Ethanol is electro-chemically manipulated to release electrons for direct electricity creation, rather than ethanol being utilized as a thermal energy source via internal combustion engines. The process also has the potential to reduce or even eliminate CO_2 release to the atmosphere from the utilization of ethanol. This technology allows for stationary, portable, and mobile electricity generation. Microgrids, portable generators, and vehicle electrification are just a few of the applications of this DEFC technology.

MinnesotaCorn
RESEARCH & PROMOTION COUNCIL

Clean energy technologies are the focus of great attention and developing technologies for ethanol as a clean power source is essential for the future of ethanol. Therefore, MCR&PC supports the ongoing development of this technology and encourages the REP to support funding of 4H2, Inc. research and development.

Sincerely Yours,

Maciej Kazula, Ph.D.
Research Director
Minnesota Corn Research and Promotion Council

We are dedicated to identifying and promoting opportunities for corn growers while enhancing quality of life.

Southern Valley Economic Development Authority:

SOUTHERN VALLEY
SVEDA
ECONOMIC DEVELOPMENT AUTHORITY

Reice Haase

Executive Director

North Dakota Industrial Commission

State Capitol-14th Floor

600 East Boulevard Ave Dept 405

Bismarck, ND 58505-0840

Dear Reice Haase,

SVEDA is writing to express our strong support for 4H2, Inc. in their application for a grant from the Renewable Energy Program. As an economic development entity, we have had the pleasure of working closely with 4H2, Inc. and witnessing their dedication, innovation, and impact they will have on our region.

4H2, Inc. is dedicated to providing a better source of energy. Their commitment to renewable energy involving ethanol has set them apart as a true leader in the industry.

SVEDA believes that 4H2, Inc. would make excellent use of the grant funds from the Renewable Energy Program. The grant would enable them to develop high energy output catalysts for their direct ethanol fuel cell system. This would not only benefit their business, but also our region as a whole.

I strongly urge you to consider 4H2, Inc. for the grant from the Renewable Energy Program. They are a deserving and impactful business that has already achieved great things and has the potential to achieve even more with the support of this grant.

Thank you for your time and consideration.

Sincerely,

Southern Valley Economic Development Authority

Justin Neppl
Executive Director

Kory Kaste
Business Development

Crookston MN Housing & Economic Development Authority:

HOUSING & ECONOMIC DEVELOPMENT AUTHORITY
CROOKSTON

May 18th, 2023

To whom it may concern:

On behalf of the Crookston Housing & Economic Development Authority we are submitting this letter as a letter of support for funding research on Direct Ethanol Fuel Cell (DEFC) technology.

Minnesota is in the top 5 largest producers of ethanol in the nation and houses 19 ethanol plants capable of producing over 28 million barrels of ethanol per year. Ethanol is produced from fermenting the sugar in the starches of grains which includes corn. There are more than 24,000 farmers who grow corn in Minnesota, making Minnesota the 3rd largest corn producer in the nation. Therefore, corn and ethanol are very important to the state of Minnesota and its economy.

Recent federal events, including Minnesota and California (California Air Resource Board), are creating potential risks and opportunities for the corn and ethanol industries. Creating a focus on developing Clean Energy technologies surrounding ethanol and using it as a clean power source is essential for ethanol's future.

Crookston Housing & Economic Development Authority is aware of the technology and initiatives being developed by 4H2, Inc. which could greatly impact the future of ethanol. 4H2, Inc. is developing Direct Ethanol Fuel Cell systems which allows for the direct conversion of ethanol to electricity via fuel cell technology. In this system, ethanol is electro-chemically manipulated to release electrons for direct electricity creation, rather than ethanol being applied as a thermal energy source through internal combustion engines.

This process also has the potential to reduce and possibly eliminate CO2 release to the atmosphere as a product of utilizing ethanol. This technology allows for stationary, portable, and mobile electricity generation. Microgrids, portable generators, and vehicle electrification are just a few of the applications of this Direct Ethanol Fuel Cell technology.

The Crookston Housing & Economic Development Authority supports 4H2, Inc.'s ongoing development of Direct Ethanol Fuel Cell technology and encourages REP to support funding of their continued research and development.

Karie Kirschbaum

Executive Director