



EERCSM



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Critical Challenges. Practical Solutions.



Energy & Environmental Research Center (EERC)

Hydrogen Energy Development for North Dakota

North Dakota Oil and Gas Research Council Meeting

Bismarck, ND

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BACKGROUND

The Energy & Environmental Research Center (EERC) proposes to perform a study that directly addresses Section 15 of Senate Bill 2014 of the Sixty-Seventh Legislative Assembly of North Dakota:

“OIL AND GAS RESEARCH FUND – EXEMPTION – ENERGY AND ENVIRONMENTAL RESEARCH CENTER – STUDY OF HYDROGEN.

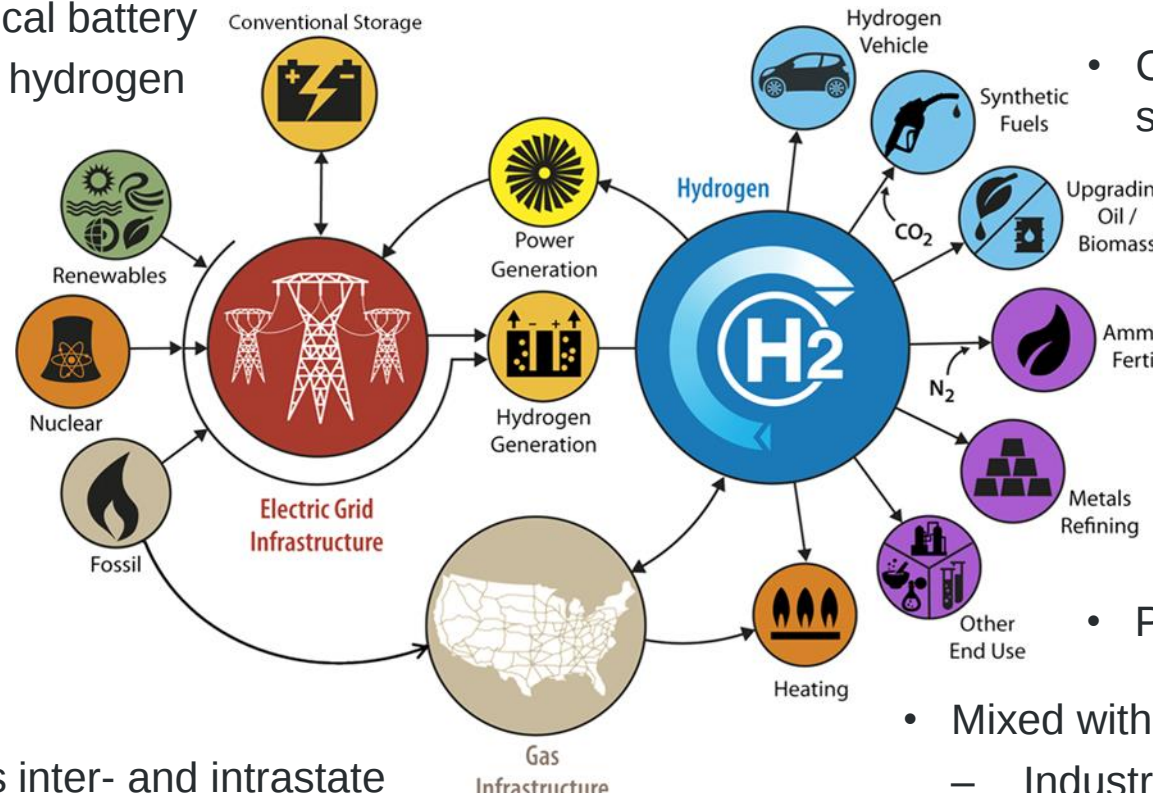
Pursuant to the continuing appropriation in section 57-51.1-07.3 and notwithstanding any policies developed by the oil and gas research council requiring matching funds, the industrial commission shall use \$500,000, or so much of the sum as may be necessary, from the oil and gas research fund to contract with the energy and environmental research center for a study regarding the development and implementation of hydrogen energy in the state. The study must include a plan for the development and implementation of hydrogen energy and must include consideration of existing resources, methods of production and delivery, and potential uses of hydrogen. The study may include estimates of the cost and timeline to develop infrastructure for hydrogen energy and the use of public and private partnerships to assist in the development of infrastructure for hydrogen energy. During the 2021–22 interim, the energy and environmental research center shall provide at least one report to the legislative management regarding the study.”

WHY HYDROGEN?

- High energy content. On mass basis, H₂ beats all conventional fuels.
- Numerous feedstocks/production scenarios:
 - Reform natural gas, natural gas liquids/condensates, light oils, other hydrocarbons
 - Gasify coal and/or biomass
 - Electrolyze water using fossil fuel or renewable electricity
- Clean – whether combusted or converted to electricity in fuel cell, emission is water:
$$\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$$
- In addition to energy/electricity generation, numerous uses include:
 - Petroleum, renewable fuel, and metals refining.
 - Feedstock for production of ammonia, methanol, other commodity and higher-value products.
- When produced using renewable energy or fossil energy with CO₂ capture, near-zero life cycle carbon emissions.

HYDROGEN OPPORTUNITIES IN NORTH DAKOTA

Power for Water Electrolysis

- Storage
 - Electrochemical battery
 - Compressed hydrogen
 - Wind and hydropower
 - Electrical generation
 - Lignite
 - Natural gas
 - Pipelines inter- and intrastate
- 
- The diagram illustrates the hydrogen production and use cycle. It features a central blue circle with 'H2' and a circular arrow. To the left, a red circle labeled 'Electric Grid Infrastructure' contains a power line icon. Arrows show the flow from power sources (Renewables, Nuclear, Fossil) to the grid, then to 'Hydrogen Generation' (a yellow circle with a sun icon). From 'Hydrogen Generation', arrows lead to 'Conventional Storage' (a yellow circle with a battery icon), 'Gas Infrastructure' (a map of the US), and directly to the 'H2' hub. The 'H2' hub has arrows pointing to 'Hydrogen Vehicle' (a car icon), 'Synthetic Fuels' (a fuel pump icon), 'Upgrading Oil / Biomass' (a leaf icon), 'Ammonia/Fertilizer' (a purple circle with a flame), 'Metals Refining' (a purple circle with a factory), 'Other End Use' (a purple circle with a test tube), and 'Heating' (an orange circle with a furnace). A 'CO2' label is near the synthetic fuels icon, and an 'N2' label is near the ammonia/fertilizer icon.

Hydrogen Production and Use

- Fuel cell vehicles
- Coal and biomass gasification and synfuel production
- Refining: petroleum and renewable oil
- Fertilizer manufacture
- Petrochemical manufacture
- Mixed with natural gas or pure hydrogen
 - Industrial
 - Buildings

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Power for Water Electrolysis

- Storage
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**EXISTING
INFRASTRUCTURE**

Hydrogen Production and Use

- Fuel cell vehicles

- Coal and biomass gasification and synfuel production
 - Refining: petroleum and renewable oil
 - Fertilizer manufacture

- Petrochemical manufacture

- Mixed with natural gas or pure hydrogen
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PROJECT GOAL

- Develop a road map for hydrogen energy in North Dakota that addresses:
 - Regional feedstocks and logistics.
 - Hydrogen production and purification technologies.
 - Energy storage and distribution infrastructure.
 - Hydrogen demand: current, emerging, and future.
 - Hydrogen energy development that is synergistic with existing agricultural and energy sectors.
 - Scale and viability.

SCOPE OF WORK

- Stakeholder engagement
 - Engage industry stakeholders and policymakers
 - Review research and patent literature
 - Analyze policy and regulatory drivers relevant to hydrogen energy
 - Assess technology readiness and applicability to North Dakota
 - Evaluate near-term, niche, and long-term opportunities for hydrogen
- Assessment of hydrogen production:
 - Feedstock types and quantities
 - Conversion pathways
 - Infrastructure requirements
- Assessment of hydrogen demand:
 - Fuel and chemical manufacture
 - Transportation applications
 - Centralized and distributed power
 - Heating
- Assessment of hydrogen infrastructure:
 - Storage: engineered and geologic
 - Transport: truck, rail, and pipeline
 - Energy carriers: methanol, ammonia, etc.
 - Utilities and land use

EXPECTED RESULTS AND DELIVERABLE

HYDROGEN ENERGY ROAD MAP FOR NORTH DAKOTA

- Identification and quantification of scale:
 - Magnitude of production from North Dakota's resources
 - Possible demand from various sectors, near- and long-term
 - Magnitude of infrastructure needed: storage and transport
 - Impacts of hydrogen use on emissions
- Notional timeline and cost for commercial deployment of various hydrogen energy technologies and approaches
- Assessment of opportunities to grow North Dakota hydrogen energy economy by leveraging and adding value to agriculture, oil and gas, and electrical generation industries, while preserving land, water, and air resources for future generations

RESPONSE TO REVIEWER COMMENTS

The EERC is appreciative to the technical reviewers and the generally positive feedback provided through the review process.

Comments worthy of mention:

- The legislatively directed study waived cost-share requirements. As such, no cost share was proposed for this OGRP project.
- The EERC will actively engage hydrogen energy stakeholders throughout this study, seeking guidance and knowledge from subject matter experts. A formal stakeholder committee was not proposed because of the extremely diverse nature of the topic.



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A wide-angle photograph of a university campus at sunset. The sun is low on the left, casting a warm glow over the scene. In the foreground, there are large trees with yellowing leaves. In the background, there are several large, multi-story brick buildings, likely university halls or administrative buildings. A parking lot with many cars is visible in front of the buildings. The sky is a mix of orange, yellow, and blue.

THANK YOU

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