



Natural Resources
Canada

Ressources naturelles
Canada

Focus on RD&D priorities and key programs and projects

Allison (Allie) Simmonds, P.Eng.

A/Deputy Director, Clean Fuels

Office of Energy R&D, NRCan

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Canada



Office of Energy Research & Development

- Leads the Government of Canada's efforts in delivering energy research, development, and demonstration (RD&D) funding.



Grants and Funding Programs for RD&D

- Supports wide range of external proponents, such as academia, Canadian SMEs, utilities, oil & gas companies, and start-ups.



Federal Government RD&D

- Provides funding to thirteen federal departments and agencies to undertake R&D and technology demonstrations.



International Collaboration

- Leads Canada's involvement in various international organizations (International Energy Agency, Mission Innovation).

The Office of Energy R&D (OERD)

OERD'S MISSIONS:

Improve Energy Efficiency and Processes to Reduce Emissions from Energy End-use

Accelerate Electrification and Maximize Benefits to Renewable Heat and Power

Develop Cleaner Fuels Pathways

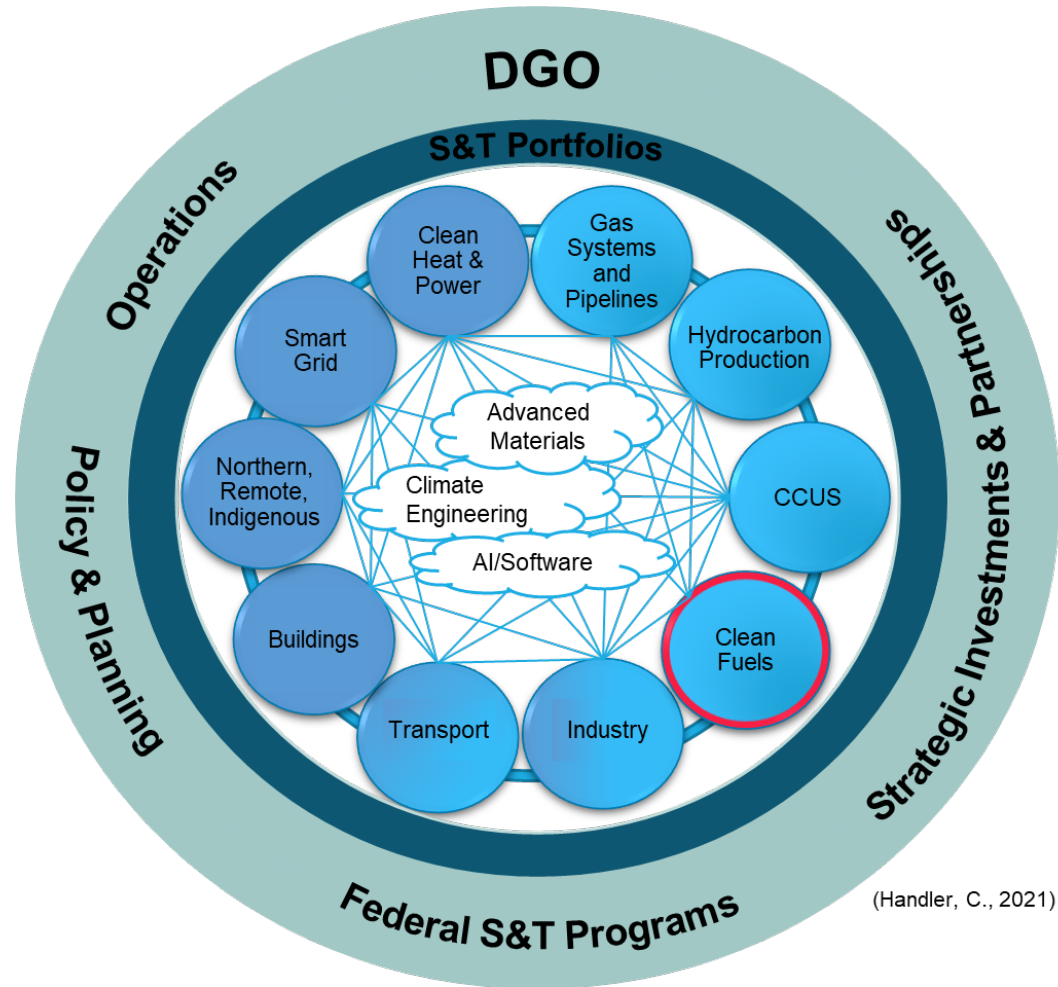
Reduce Reliance on Diesel in rural, remote and indigenous communities

OERD'S MAIN FUNDING PROGRAM

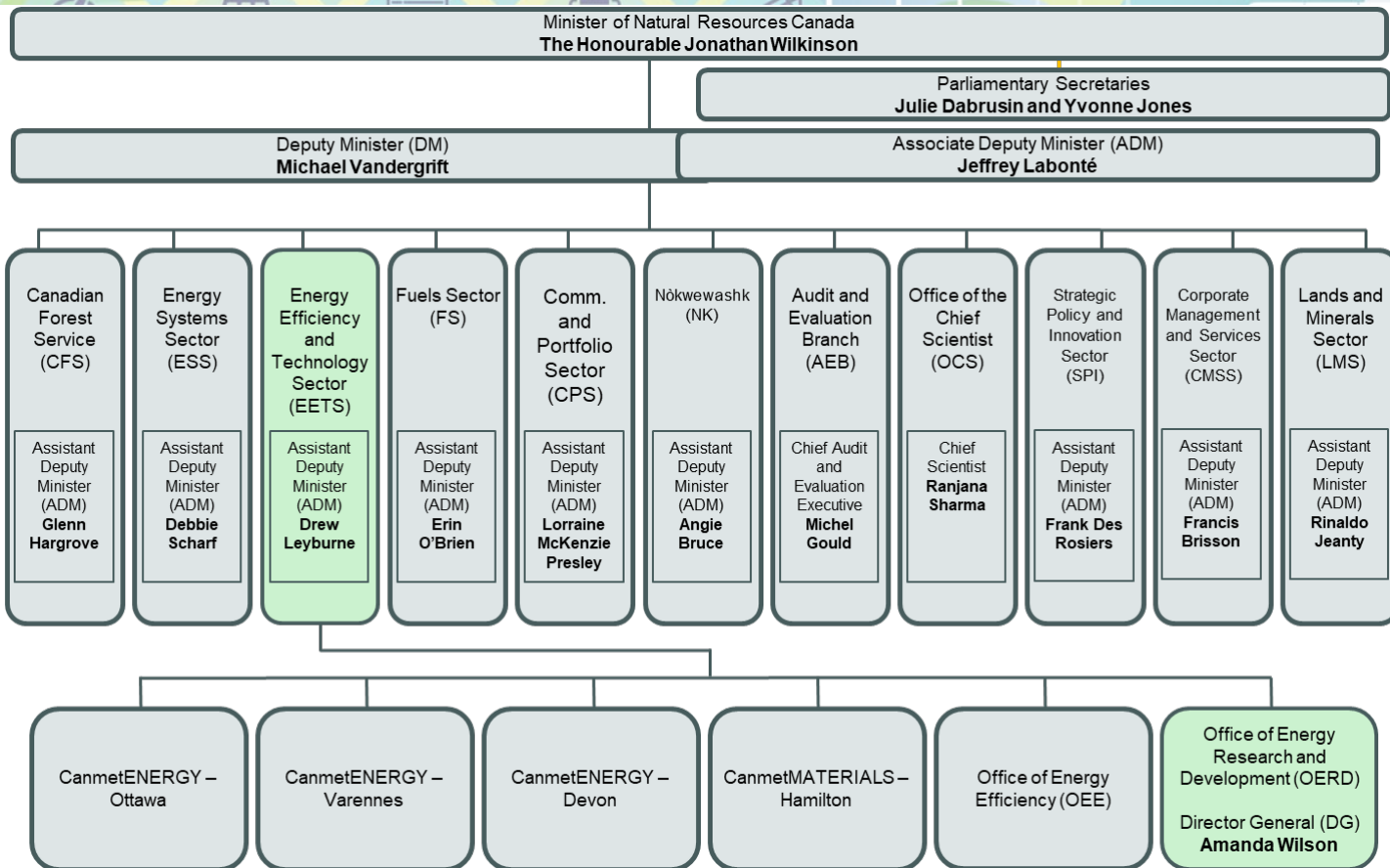
The **Energy Innovation Program (EIP)** is OERD's flagship funding program supporting energy research, development and demonstration projects.

OERD Science & Technology

- OERD houses technical expertise across ten areas.
- Each S&T portfolio delivers targeted energy RD&D funding and accelerates efforts in energy innovation and cleantech programming.
- S&T portfolios support other divisions including operations, policy & planning, federal S&T programs, and strategic investments and partnerships.



Where we “sit” at NRCan



MISSION

The Clean Fuels Portfolio (CFP) strives to provide technical and market information for **clean fuels technologies on the path to commercialization** and **support clean fuel technology research, development, and demonstrations (RD&D)** aligned with Canada's natural resource availability, policies, and regulations.

VISION



Provide expert clean fuels-related technical advice and thought leadership to NRCan Executive Management as well as other Government of Canada departments.



Support Canadian clean fuels RD&D through federal funding programs and incentives, which provide financial and technical support as well as networking opportunities to internal and external parties conducting RD&D projects in clean fuels.



Develop strong relationships on a national and international level to increase collaboration and knowledge sharing for the advancement of clean fuel technology pathways.

Promoting clean fuels technology development

Innovation supply: technology-push

Production technologies



End use technologies



Innovation demand: market-pull

Innovation funding

International collaboration

Research

Development

Demonstration

Deployment

Maturity

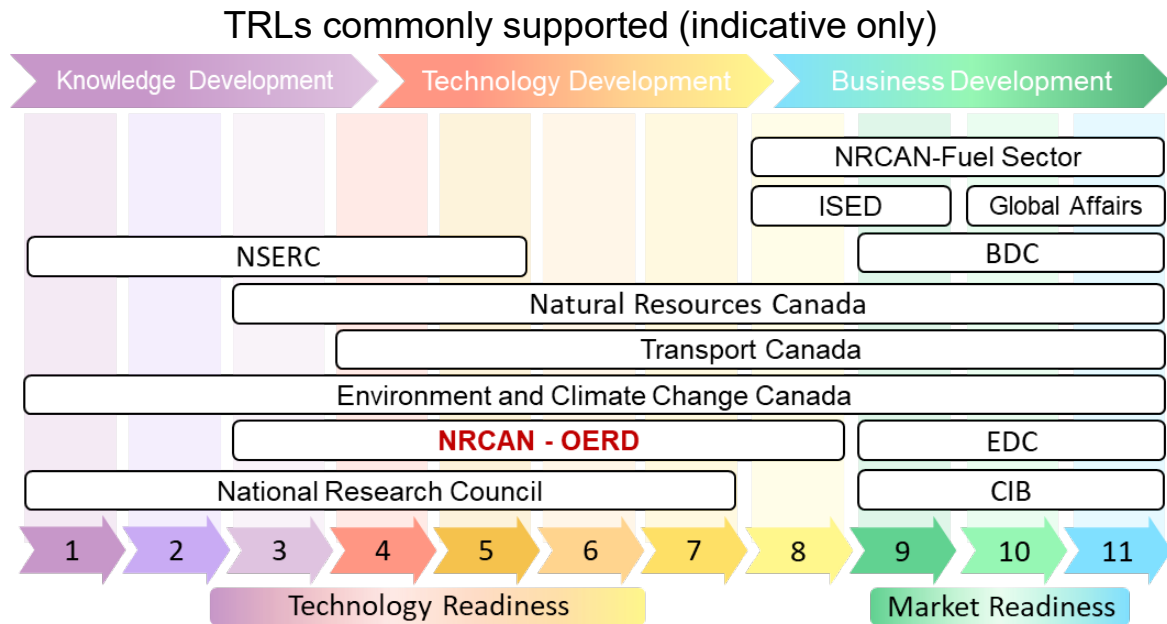
Policies and regulations

Codes and standards

Information campaigns

What does the CFP do?

- Focuses on the production of clean fuels
 - Liquid and gaseous biofuels, synthetic fuels, and low-carbon hydrogen.
- Supports related science activities
 - e.g., tools, studies/strategies, and the development of codes, standards, and regulations.
- Complements work performed by other NRCan sectors as well as other government organizations.



ISED – Innovation, Science and Economic Development

BDC – Business Development Bank of Canada

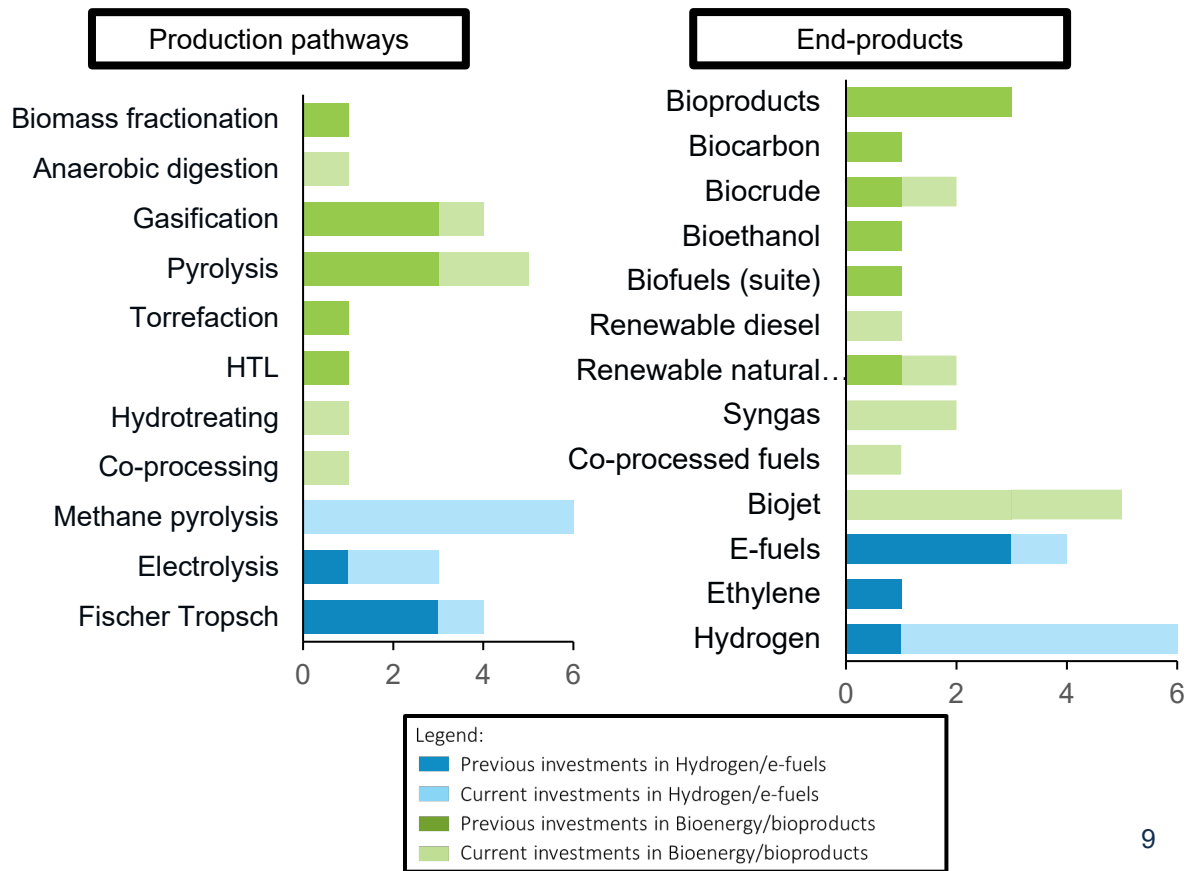
EDC – Export Development Canada

CIB – Canada Infrastructure Bank

NSERC- Natural Sciences and Engineering Research Council of Canada

Pathways Analysis

- Supported projects cover diverse production pathways and end products.
- Recent investments are focused on emerging pathways
 - e.g., methane pyrolysis, co-processing, and end products for hard to decarbonize sectors, including hydrogen and drop in fuels (e.g., renewable diesel and biojet)

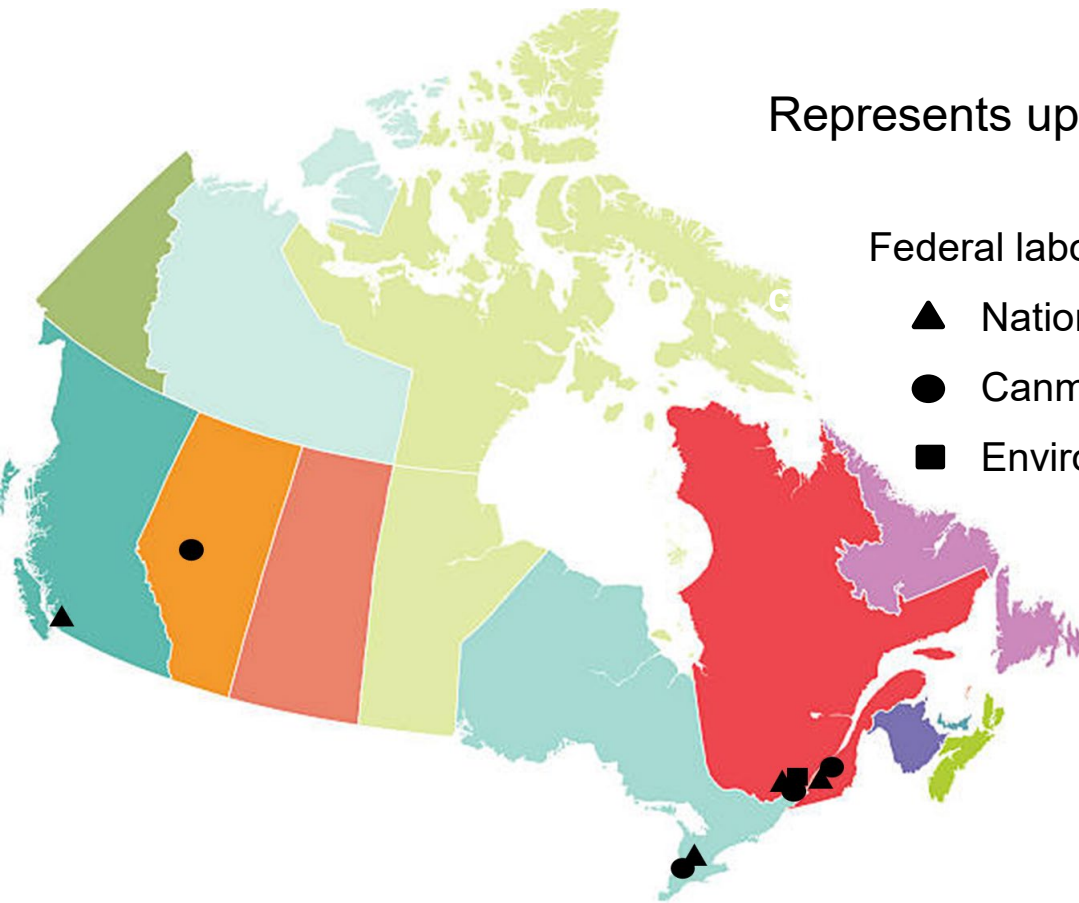


Federal Internal Energy R&D

Represents up to **\$50 million in funding per year.**

Federal laboratories doing clean fuels research include:

- ▲ National Research Council Canada
- Canmet Energy, Materials or Mining
- Environment and Climate Change Canada



Federal R&D – 2023-28

CLEAN FUELS PRODUCTION PROJECTS

- Examples of clean fuels production projects for gaseous and liquid fuels include hydrogen, advanced biofuels, liquid synthetic fuels, and renewable natural gas, for example.

34 Projects

The projects run across 5 federal labs

CanmetENERGY-Devon,
CanmetENERGY-Ottawa,
CanmetENERGY-Varenes,
CanmetMATERIALS, National
Research Council

**\$8.5 M
in funding
/ year**

**56
Collaboration
Partners**

Projects funded involve extensive collaboration across the **federal government, industry partners and academia.**

Federal R&D - H₂ Codes & Standard

This interdepartmental program funds federal researchers to enable the hydrogen economy via the development of codes and standards to safely produce, store, transport, and use hydrogen across the country.



H₂ PRODUCTION

The carbon intensity of hydrogen varies by production method, LCAs are essential for assessing its impact.



BLENDING

In existing pipeline network and in end use applications



UNDERGROUND STORAGE

of hydrogen in a variety of storage mediums



UTILIZATION IN INDUSTRY OR TRANSPORTATION

e.g. underground mining, heavy duty trucking



GAP ANALYSIS

Understand and prioritize what codes and standards are required to enable to hydrogen economy





12 Projects

45 Collaborators

\$14.1M over 5 Years

Select Federal R&D H₂ Capacity – Canmet Labs

- Four labs across Canada with varied expertise that also **collaborate** on critical projects with **other federal agencies, academia, and industry.**

	Production	Distribution & Storage	End Use
 <p>Canmet ENERGY Devon</p>	<ul style="list-style-type: none"> • Cleaner steam methane reforming • Photocatalytic H₂S water splitting • Oxidative dehydrogenation of alkanes with CO₂ 	<ul style="list-style-type: none"> • Using asphaltenes as storage • Hydrogen embrittlement of pipeline steels in hydrogen and natural gas blends transportation 	<ul style="list-style-type: none"> • Purification processes for H₂ to achieve high purity
 <p>Canmet ENERGY Ottawa</p>	<ul style="list-style-type: none"> • Bio-based production + CCUS • Chemical looping • Thermal cracking • Zero carbon H₂ using metal fuels 	<ul style="list-style-type: none"> • Ammonia production from solid oxide electrolyzers • Deep well / reservoir storage 	<ul style="list-style-type: none"> • Iron / steel production • Residential equipment performance and industrial NO_x emissions of H₂ blends in NG network
 <p>Canmet ENERGY Varennes</p>	<ul style="list-style-type: none"> • Mapping worldwide production • Advancing PEM + Alkaline electrolysis • LCA for H₂ production 	<ul style="list-style-type: none"> • Energy system modelling (enhancement of LEAP modelling platform) 	<ul style="list-style-type: none"> • End-users market assessment and prioritization • Assessment of H₂ use in buildings • Use of fuel cells + heat pumps
 <p>Canmet Materials Hamilton</p>	<ul style="list-style-type: none"> • Accelerated catalyst development • Materials for high temperature reformation • Biomass gasification 	<ul style="list-style-type: none"> • Pipeline materials selection, manufacturing, assembly, and codes and standards for H₂/NG blending • Advanced material storage 	<ul style="list-style-type: none"> • Materials selection for transport fuel cell plate development • Steelmaking via H₂ direct reduction of iron ore

Clean Fuels and Industrial Fuel Switching (CFIFS) funding call:

The up to **\$53M** call for proposals launched in December 2021, supporting research, development and demonstration projects in 3 focus areas:

Industrial fuel switching

- Substitution of lower-carbon fuels or feedstock in heavy industry:
- Targeting chemicals/fertilizers, iron and steel, smelting and refining, and cement

Clean fuels production

- Production of clean gaseous and liquid fuels including hydrogen, advanced biofuels, liquid synthetic fuels, and renewable natural gas

Hydrogen codes and standards

- Advancement of codes and standards along the hydrogen life cycle, from production to end use

OERD "Trusted Partners"

OERD leverages its "Trusted Partnerships" to:

- **Facilitate collaboration** and **co-funding of projects**
- Cooperate on projects as future opportunities arise, not limited to specific programs



Canada
Infrastructure
Bank



Next Generation
Manufacturing Canada

Innovative Clean Energy (ICE)
Fund



our nature. our power. **our future.**



Recent calls with "Trusted Partners" on Hydrogen



Natural Resources
Canada

Ressources naturelles
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Hydrogen Competitions 1 and 2 was led by the Alberta Innovates Hydrogen Centre of Excellence and co-funded by NRCan.

	Research area	TRL
Competition 1 (2022)	Production, transport/distribution, carrier/storage, end-use/ markets opportunity analysis, relationship building, codes and standards	3-9
Competition 2 (2023)	Production, storage, transmission, end-use in heavy-duty transportation, industrial heat, power, and chemicals, commercial and residential heating, and other industries.	AI: 3-6 ERA:7-9

Clean Fuels Calls – Recent and Future



2021 CFIFS Clean Fuels Stream

Period	5 Years
TRL	3-8
Process	EOI + FPP
Key Terms	R&D \$500k-1M (75% stacking) Demo \$1M-3M (50% stacking)
Scope	<p>Clean fuels production</p> <ul style="list-style-type: none"> Production technologies for gaseous and liquid fuels, specifically, hydrogen, advanced biofuels, liquid synthetic fuels, and renewable natural gas that: <ul style="list-style-type: none"> Reduce the capital and operating costs of producing clean fuels. Develop new clean fuels production processes Improve the process and efficiency of clean fuels production using advanced feedstock Advance the usability of waste or underutilized feedstock

2025 Clean Fuels Call (Unconfirmed)*

- Possible OERD **call for proposals for clean fuels RD&D** planned for **Spring 2025**
 - Scope and design may be similar to the **2021 Clean Fuels and Industrial Fuel Switching – Clean Fuels Production Stream**
 - Potential expansion to innovations that address clean fuels challenges with transportation and storage
- Further information will likely be available in early 2025.

Join the OERD mailing list for information on new funding opportunities and applicant support sessions (one planned for January 2025):

<https://natural-resources.canada.ca/science-and-data/funding-partnerships/opportunities/oerd/electronic-updates/24609>

***Call has not yet been confirmed and may be cancelled without notice; call scope, timing and details are subject to change at NRCan's sole discretion**

Recent Related Funding Call Experiences



Recent federal funding call (CFIFS) was oversubscribed.



Preliminary gap analysis has identified areas for potential scope expansion.



Engagement session with key stakeholders indicated the need for government funding availability and gaps in scope.

Clean Fuels & Industrial Fuel Switching:

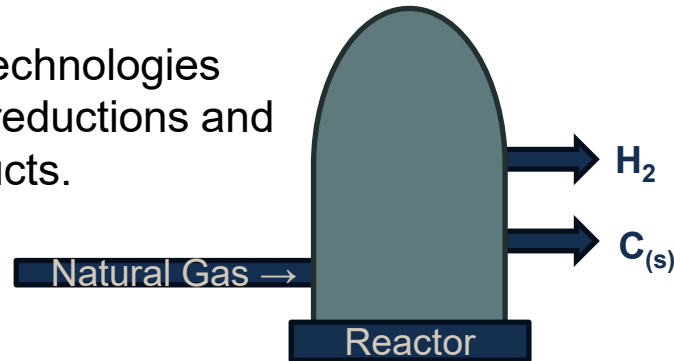
155 Submissions } **18** Selected Proposal are being Implemented
\$315M funding requested } \$53M available in funding

6x
oversubscribed

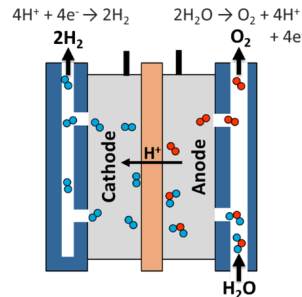
EIP- Examples of hydrogen projects in scope

Hydrogen Production

- Various production technologies targeting emissions reductions and improved solid products.



- Electrolysis
 - Hydrogen and Syngas Production



Codes and Standards

- New method development for pipeline standard
 - Transport of pure and natural gas blended hydrogen in transmission pipelines



Recent RD&D Project Announcements



Production of Pure Hydrogen from Natural Gas Thermal Cracking

- Building a pilot plant, on site at ATCO, that can produce hydrogen and carbon black in a continuous mode using a molten metals technology.
- \$1.25M awarded



Canadian Nuclear
Laboratories

Laboratoires Nucléaires
Canadiens

Development of High Temperature Steam and CO₂ Electrolysis Towards Clean Fuels Manufacturing

- Advance the knowledge base of high temperature steam electrolysis for hydrogen and syngas production
- Will use captured CO₂ from a cement plant
- \$1M awarded

Recent RD&D Project Announcements



AYRTON
ENERGY

Liquid Organic Hydrogen Carrier (LOHC) for Secure, Efficient, and User-Friendly Hydrogen Storage and Transportation Technology

- Demonstrate operation of Ayrton's liquid organic hydrogen carrier system for safe and efficient hydrogen storage
- Develop single module size of 30 kg H₂/day.
- \$1.09M awarded



Scale-up the synthesis methods of e-hydrogen and e-methanol catalysts.

- Improve the performance and reduce costs associated with electrochemical hydrogen and e-methanol catalysts production
- \$1M awarded

Examples of biofuel projects in scope (Canfor – CGP)

- \$4.5M towards a FEED study to support a commercial scale demonstration plant to produce advanced biofuels → **Chuntoh Ghuna facility**
- Facility managed by Arbios - a joint venture between Canfor and Licella
- Based on Cat-HTR™ technology platform (hydrothermal liquefaction)
- Initial capacity 25,000 dry tonnes of forest residue to 50,000 barrels of renewable bio-oil intermediate → permits to double the capacity
- Products can be further refined to produce renewable transportation fuels
- Coming on-line later in 2024



Arbios Biotech's Chuntoh Ghuna facility in Prince George, British Columbia

International cooperation

- Accelerate knowledge transfer and promote economies of scale
- Align creation of new demand for clean technologies in one region with the development of supply in other regions





Contact Information:

Oshada Mendis,
A/Director, Cleaner Fuels and Industry,
Oshada.Mendis@nrca-nrcan.gc.ca

Allison Simmonds,
A/Deputy Director, Clean Fuels Portfolio
Allison.Simmonds@nrca-nrcan.gc.ca

QUESTIONS ?

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slide deck.**

Canada 

Select Federal R&D Biofuel Capacity - Canmet Labs

- **Four labs across Canada** with varied expertise that also **collaborate** on critical projects with other federal agencies, academia, and industry.

Production

Upgrading, Refining and End Use

Canmet
ENERGY
Varenes

- Review of clean fuel production pathways
- Modeling and simulation of clean fuel production pathways
- TEA/LCA/LCC for clean fuel production
- Feedstock availability

- Clean Fuels Market Assessment

Canmet
Materials
Hamilton

- Advancing BECCS for clean fuel production
- Investigating impact of biomass feedstock on corrosion under HTL and SCWG conditions

- Investigating corrosion under biocrude upgrading and co-processing conditions

Canmet
ENERGY
Devon

- Refining and co-processing of biocrudes and lipid feedstocks
- Upgrading, co-processing and bio-refining of biocrude to SAF and RD
- Advanced modelling for biorefining
- LCA studies of biofuel pathways

Canmet
ENERGY
Ottawa

- Feedstock pretreatment for biomass gasification
- Production of bio-crudes via fast pyrolysis and hydrothermal liquefaction
- Biochar production via slow pyrolysis and hydrothermal carbonization
- Steam-oxygen fluidized bed for gasification

- Catalytic conversion of aqueous phases to hydrogen
- Hydro-processing biocrudes and blending oil fractions for marine applications
- Hydro-upgrading of various biocrudes into SAF and renewable diesel