



NRC-CNRC

CHALLENGE PROGRAM

MATERIALS FOR CLEAN FUELS



**Material innovation for a cleaner, more sustainable
Canadian energy and chemical industry**



National Research
Council Canada

Conseil national de
recherches Canada

Canada



**Developing
transformative
technologies
to sustainably
transition
Canada's energy
and chemical
industries to
a low-carbon
economy**



The Materials for Clean Fuels Challenge Program is a 7-year \$57M collaborative research program to develop new technologies to decarbonize Canada's oil & gas and petrochemical sectors.

It has been tremendously rewarding to build the foundation of a new program at the National Research Council of Canada (NRC) poised to unlock disruptive technologies to sustainably transform Canada's oil and gas and petrochemical industries.

We developed collaborative research projects with world-leading academics and small and medium-sized enterprises (SMEs) in Canada and abroad.

Our program has three thrusts — **carbon dioxide (CO₂) conversion, hydrogen (H₂) production, and AI-accelerated materials discovery.**

CO₂ conversion will focus on developing new catalyst materials that can efficiently convert captured CO₂ (either from the air or from industrial flue) into renewable fuels and chemical feedstocks such as syngas and ethylene.

H₂ production will support new technologies, such as water electrolysis and methane pyrolysis, that can produce H₂ for industrial use while emitting less CO₂ than the industry standard — steam methane reforming.

AI-accelerated materials discovery will combine robotics, artificial intelligence and high-throughput experimentation to accelerate the discovery of new catalyst materials.

The NRC is building materials acceleration platforms (MAPs) — robotic and AI enabled "self-driving labs" to enable this vision. These activities will be housed at a brand new facility in Mississauga — the first NRC research presence in the Greater Toronto Area.

To date, we have developed over 20 collaborative projects with 15 universities and start-up companies in Canada and abroad (US, Germany, and the UK) with more currently under development. Building talented multi-disciplinary teams is crucial to the translation and impact of these promising technologies.

We are ready to make an impact and strengthen Canada's leadership position in this exciting area of clean tech.





PROGRAM OVERVIEW

WHY WE EXIST

Canada needs to reduce 716 megatons of carbon dioxide emissions per year to reach its goal of net-zero emissions by 2050. Electrification and energy efficiency alone is not enough to meet our targets. Scalable technologies to produce zero-emission industrial chemicals and transportation fuels do not currently exist.

WHAT WE ARE AIMING TO DO

The mission-driven Materials for Clean Fuels (MCF) Challenge program is focused on advancing high-risk, high-reward technologies to produce feedstock chemicals and fuels from air and water rather than from fossil-based resources.

Working with the best in Canada from academia and industry, it will catalyze development of materials for renewably-powered CO₂ conversion and hydrogen production using artificial intelligence and robotics to accelerate this discovery.

OUR RESEARCH ACTIVITIES

- Artificial intelligence and robotics for materials discovery
- Catalyst design and synthesis
- Membrane design and synthesis
- Device development and prototyping
- Advanced characterization and spectroscopy
- Technoeconomics and lifecycle assessments

PROGRAM TIMELINE

The program will run for seven years from 2019-2026 and follows a funnel approach whereby the number of projects in the program decreases and the amount of investment per project increases over time. The goal is to advance technologies as fast as possible from a low technology readiness level (TRL) to a high technology readiness level.

Expression of interest calls to collaborate will occur before each phase with academics or SMEs eligible for collaboration funding.

RESEARCH FACILITIES

Research will be conducted at the NRC's facilities across Canada.

Vancouver is home to the NRC's Hydrogen Laboratory and will play a pivotal role in the development of electrochemical device development.

Edmonton hosts the NRC's Nanotechnology Laboratory with advanced microscopes and unique molecular modelling.

Ottawa is where the NRC's materials characterization, life-cycle and technoeconomic analyses, and artificial intelligence expertise lies.

Montreal is focused on bio-refining and will be where the majority of our hybrid electro/biocatalysis work will be performed.

Mississauga is the site of our robotic materials acceleration platforms or "self-driving labs".

Taken together, the NRC's unique and specialized facilities host all the tools and expertise needed for breakthrough innovation, materials discovery, prototyping, and demonstration.

NRC MISSISSAUGA

Pictured above

Coming in 2020 to the Greater Toronto Area

A large focus of this brand new advanced materials facility will be on developing new clean energy materials and acting as a catalyst to accelerate the development of advanced materials technologies and their commercialization in disruptive new products.

RESEARCH ACTIVITIES



**ARTIFICIAL
INTELLIGENCE**



CATALYSTS



MEMBRANES



PROTOTYPES

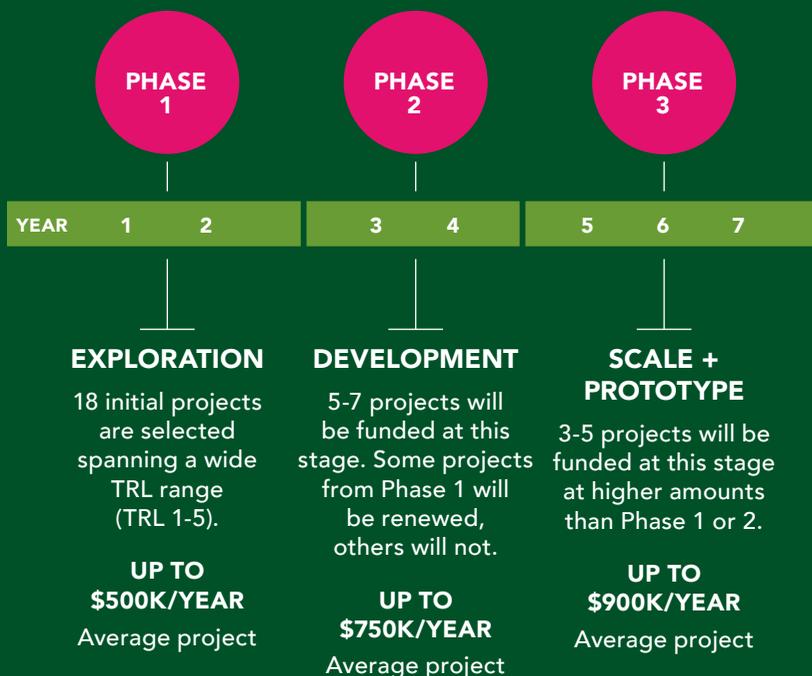


CHARACTERIZATION



TECHNOECONOMICS

TIMELINE



PROGRAM TEAM

THE NRC'S WORLD-CLASS EXPERTS IN CLEAN TECHNOLOGY
LEAD THE MATERIALS FOR CLEAN FUELS CHALLENGE PROGRAM



PHIL DE LUNA
PROGRAM
DIRECTOR



RUSSELL GIRARD
CHALLENGE
OFFICER



CLAUDIE ROY
CO₂ THRUST
LEADER



NIMA SHAIGAN
H₂ THRUST
LEADER



FARID BENSEBAA
TEA/LCA
THRUST LEADER



ISAAC TAMBLYN
AI THRUST
LEADER

ADVISORY COMMITTEE

THE PROGRAM IS GUIDED BY A COMMITTEE OF CLEAN TECH
PROFESSIONALS REPRESENTING THE NRC'S IMPORTANT STAKEHOLDERS

Randy Cortright (Chair) · Senior Research Advisor
National Renewable Energy Laboratory (NREL)

Walter Cicha · Industrial Technology Advisor
NRC Industrial Research Assistance Program (IRAP)

Fiona Cunningham · Director of Innovation · CIFAR

Monica Gattinger · Director, Institute of Science,
Society, and Policy · University of Ottawa

Mark Kirby · President & CEO
Canadian Hydrogen and Fuel Cell Association

Mike Lyne · Director of Operations · Suncor

Fiona Zuzarte · Science and Technology Advisor
Natural Resources Canada

Barry MacDougall · Senior Science Advisor · NRC (retired)

ARE YOU INTERESTED IN PARTICIPATING?

If you would like to learn more about the Challenge program and how to participate, please contact us.

●●● CONTACT

Phil De Luna, Program Director
Materials for Clean Fuels Challenge program
647-355-5421 · phil.deluna@nrc-cnrc.gc.ca
NRC.EnergyMaterials-MateriauxPourEnergie.CNRC@nrc-cnrc.gc.ca

canada.ca/nrc-challenge-programs

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