Management Board Meeting of FCH JP

Time Thursday 14th of March 2024, 13:00 - 14:00 (CET)
Place Teams Meeting

Persons present:
Jari Kiviaho (VTT), Chair
Jose Bellosta von Colbe (Hereon)
Daria Vladikova (BAS)
John Irvine (University St. Andrews)
Mathias Gérard (CEA)
Alfredo Iranzo (US)
Marcin Blesznowski (IEN)
Massimo Santarelli (PoliTO)
Marcello Baricco (Unito)
Martin Andersson (LTH)
Josemaria Sanchez (CIEMAT)
Jessica Vepsäläinen (VTT), Secretary

Present in parts of the meeting:
Stefan Ivarsson (RISE)
Olesia Danyliv (RISE)
Bruno Pollet (UQTR)
Yves Monette (UQTR)

1. **Welcome and agenda approval** (Jari Kiviaho)

- The agenda was agreed on and the meeting proceeded accordingly.

2. **Membership applications**

Two new member applications to join the FCH JU from:
RISE Research Institutes of Sweden (Stefan Ivarsson)
University of Quebec Trois Rivières (Bruno Pollet)

- Both organisations gave short presentations and left the meeting. There was no objections from the Management Board and also EERA is supportive of having a Canadian organization in the community. Thus both membership applications were accepted.

Action Point: Jari to inform the applicants and EERA of the decision.

3. **Outcomes from EERA Policy Working Group** (Vito Di Noto & Daria Vladikova)

- Daria & Vito were not in the meeting to give presentations. This topic will be discussed in the next meeting.

4. **Feedback from 46th ExCo Meeting** (Marcello Baricco)

FCH JU was asked to give a presentation in the 46th ExCo Meeting. Marcello summarized in this meeting what he presented. He also received some feedback from the ExCo and presented it to the Management Board.

- Promote connections with other JPs
- Push toward a more “holistic” approach to hydrogen technologies. Broader view

to open issues.
- Promote the engagement of partners.
- OK for an engagement in the Stakeholder Group of Clean Hydrogen Partnership. Jari is already involved on that.
- No new info for the Center of Excellence.
- OK for promoting connections with the developing IWG.
- Specific request from “Energy Storage” JP for more connections in a large view of the storage of renewables.
- Full support from ExCo.
- ExCo would like to participate to one of next MB meeting of JP FCH.

5. AOB

- Joint workshop with EERA e3s JP (Marcello)
  - Sustainability of Hydrogen Technologies
  - This joint workshop is arranged to promote collaboration between JPs.
  - Marcello is happy to be the main contact in the preparation of this workshop. Two more are needed to support the preparation work. Jari agreed to be one of the supporting persons. Others, reflect on this and inform if you wish to take part.
  - The workshop is planned to be held in Spring 2025, preferably together with Management Board meetings of both JPs to get more people to attend the workshop.
- Discussion about future activities
  - Future activities were discussed and it was decided that a specially dedicated meeting will be arranged to discuss the updating of the “Key Performance Indicators (KPIS) for FCH Research and Innovation” document.

Action Point: Jari to prepare and call a dedicated meeting (April/May) to discuss KPIS updating.

6. Next meeting

- Jari will arrange the next MB meeting.

7. End of the meeting

- The meeting ended at 14.42

Attachments

1. Agenda
2. RISE presentation
3. UQTR presentation
4. Sustainability of Hydrogen Technologies Workshop

Management Board Meeting of FCH JP

Time: Thursday 14th of March 2023, 13:00 - 14:30 (CET)

Place: Teams-meeting

12:59 Come to line…

13:00 Welcome and agenda approval

13:05 Membership applications

- RISE Research Institutes of Sweden (Stefan Ivarsson/Anna Larsson)
- University of Quebec Trois Rivières (Bruno Pollet /Yves Monette)

13:35 Outcomes from EERA Policy Working Group (Vito & Daria)

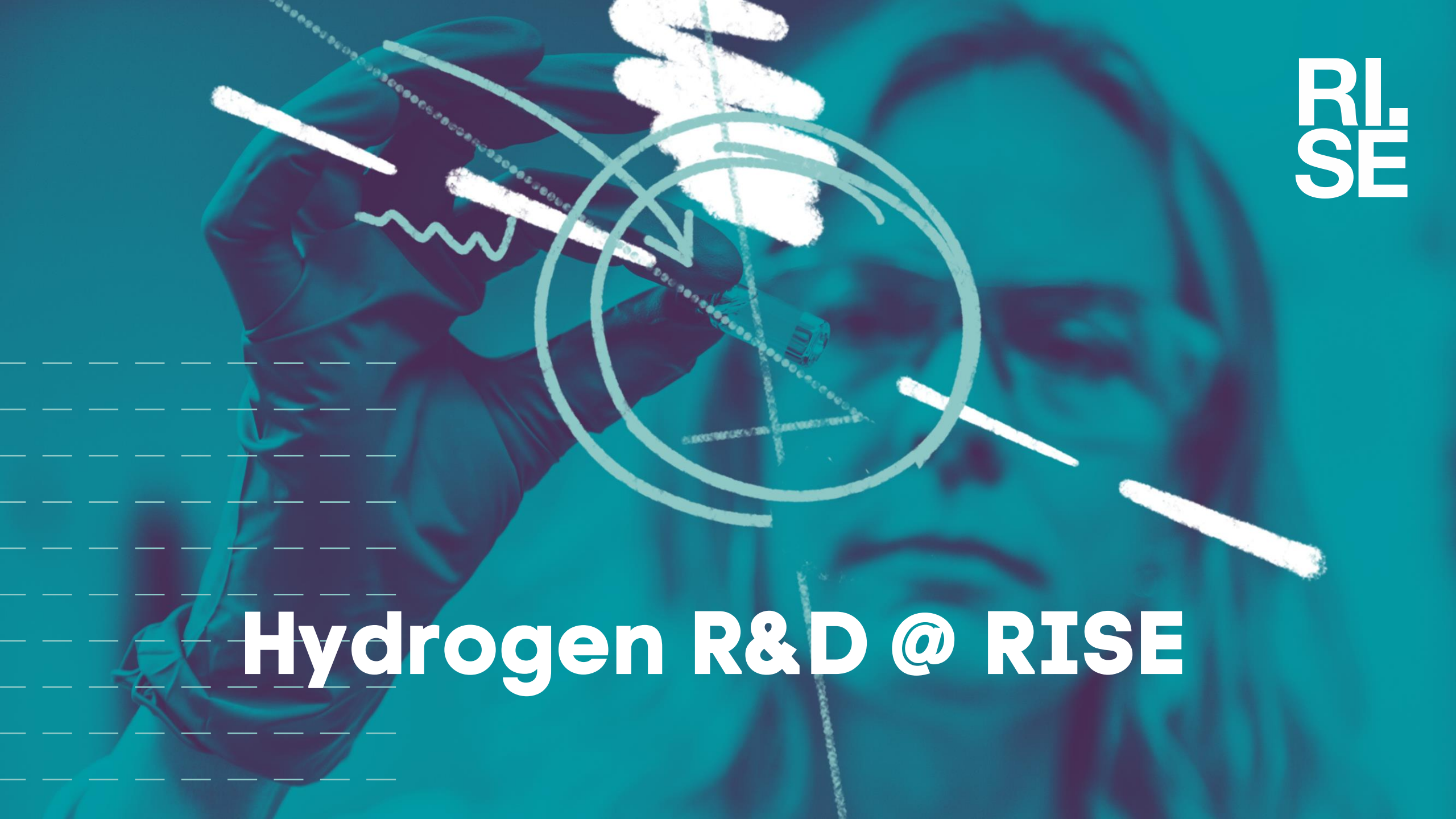
14:05 Feedback from 46th ExCo Meeting (Marcello)

14:25 AOB

- Joint workshop with EERA e3s JP (Marcello)
- Discussion about future activities

14:30 Next meeting

14:30 End of the meeting



Hydrogen R&D @ RISE

Formed in **2016**
Limited company
100% owned by Swedish Government

More than 130 test- and demonstration-environments

~ 3 300 employees

39% women

Sweden’ s Research and Innovation Partner

RI.SE

RISE takes a broad view of future Energy solutions


Industrial Transformation

Biorefinery and Renewable Fuels


Future Electricity System


Roadmaps for a Fossil Free Sweden


Energy efficiency

Our offer

Transformation management

Analysis of the world trends

Strategical roadmaps

Scenarios of the future

Policy development

Applied Research and Development

Research partner

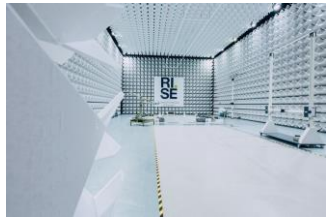
Management and coordination of research program

Test and demo

Industrial processes and leveraging

Problem solving and expertise

Innovation management



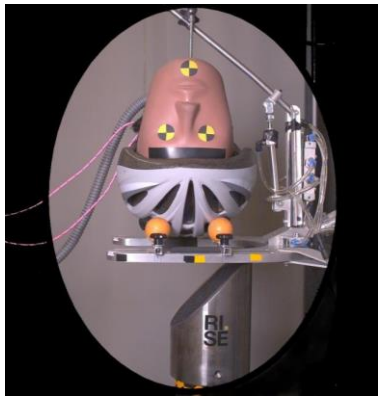
Testing , Certification and Calibration

Testing

Inspection

Certification

Calibration



Lifelong learning

Competence transformation

Knowledge reinforcement activities

Professional education

RISE in the Swedish H2 landscape

Four geographical nodes- with different industrial eco-systems

- Chemicals
- Steel
- Transport
- Electrofuels

Collaboration with:

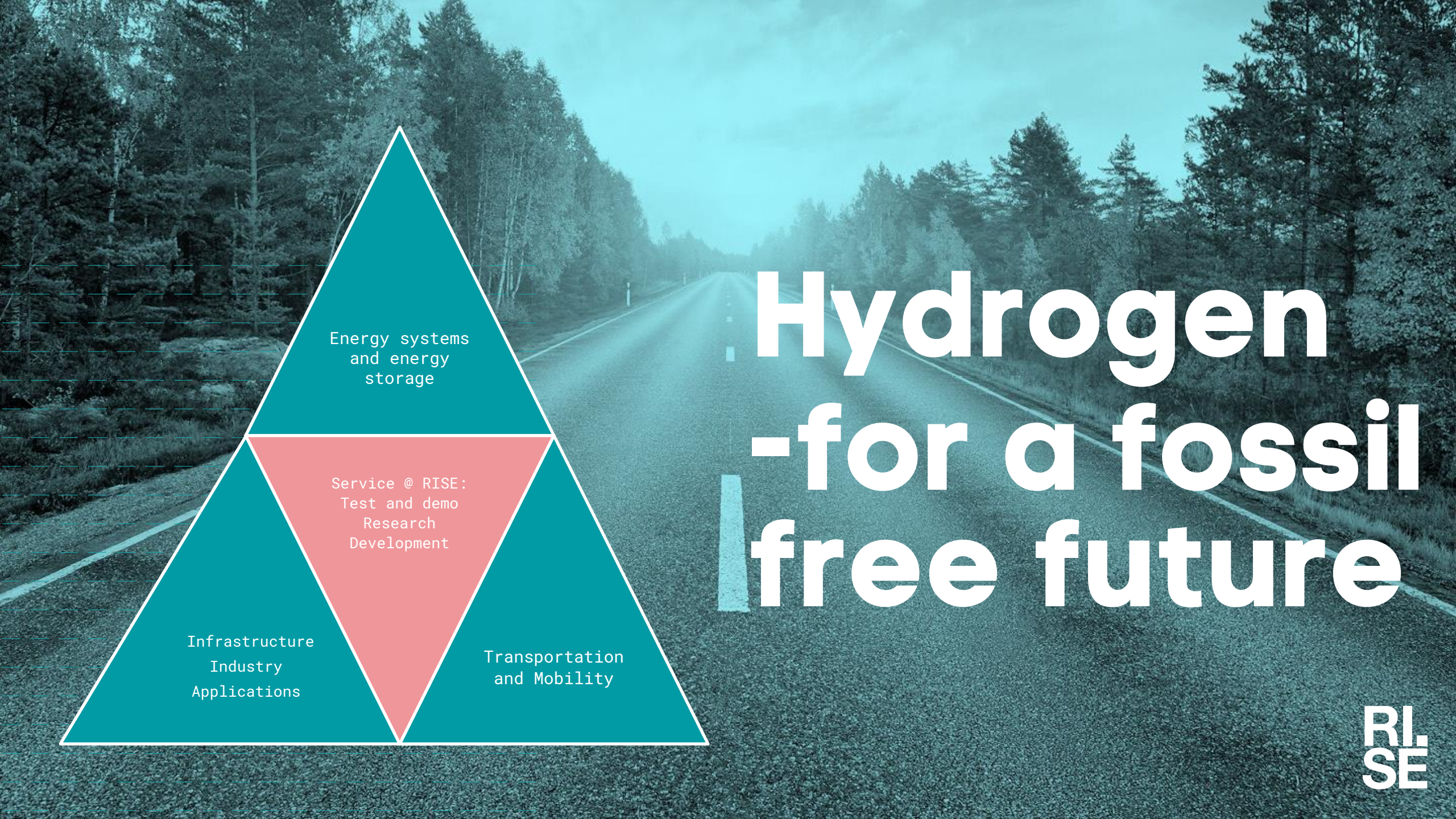
- Swedish Hydrogen Development Center (SHDC)
  Nework for industrial and applied scientific cooperation - whole value chain of hydrogen
- Energiforsk (R&D organization owned by Swedish Utilities)
- Academia
- Clients from industry and public sector

To foster and support

- Connection between regions
- Knowledge exchange
- Networking

Expertise within hydrogen @ RISE

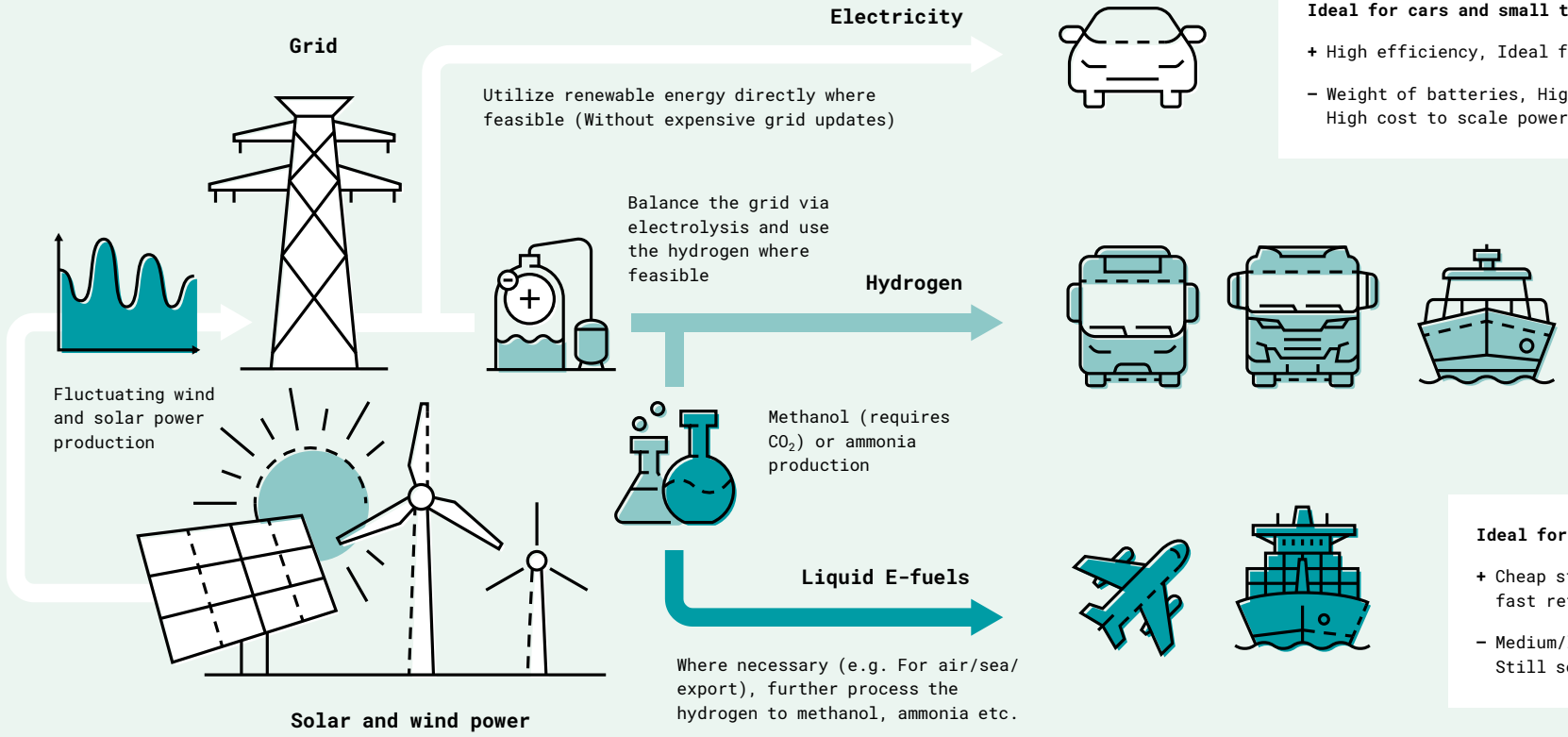
- Process and Analytical Chemistry
- Electrolysis, Reforming, Gasification
- Electric Grid
- Storage, Distribution, Infrastructure System Analysis
- Materials
- Electrification
- Techno-Economics
- Measurement and Calibration
- Simulation, Forecast, Optimization
- Safety
- TIC (Testing, Inspection, and Certification)
- Overview of Laws, Regulations, and Standards in the Hydrogen Field



Hydrogen -for a fossil free future

RI. SE

Complementary routes to green transportation



Ideal for cars and small trucks/buses

+ High efficiency, Ideal for 200–300km range
− Weight of batteries, High cost per kWh stored, High cost to scale power grid

Ideal for vans, buses, trucks, taxis

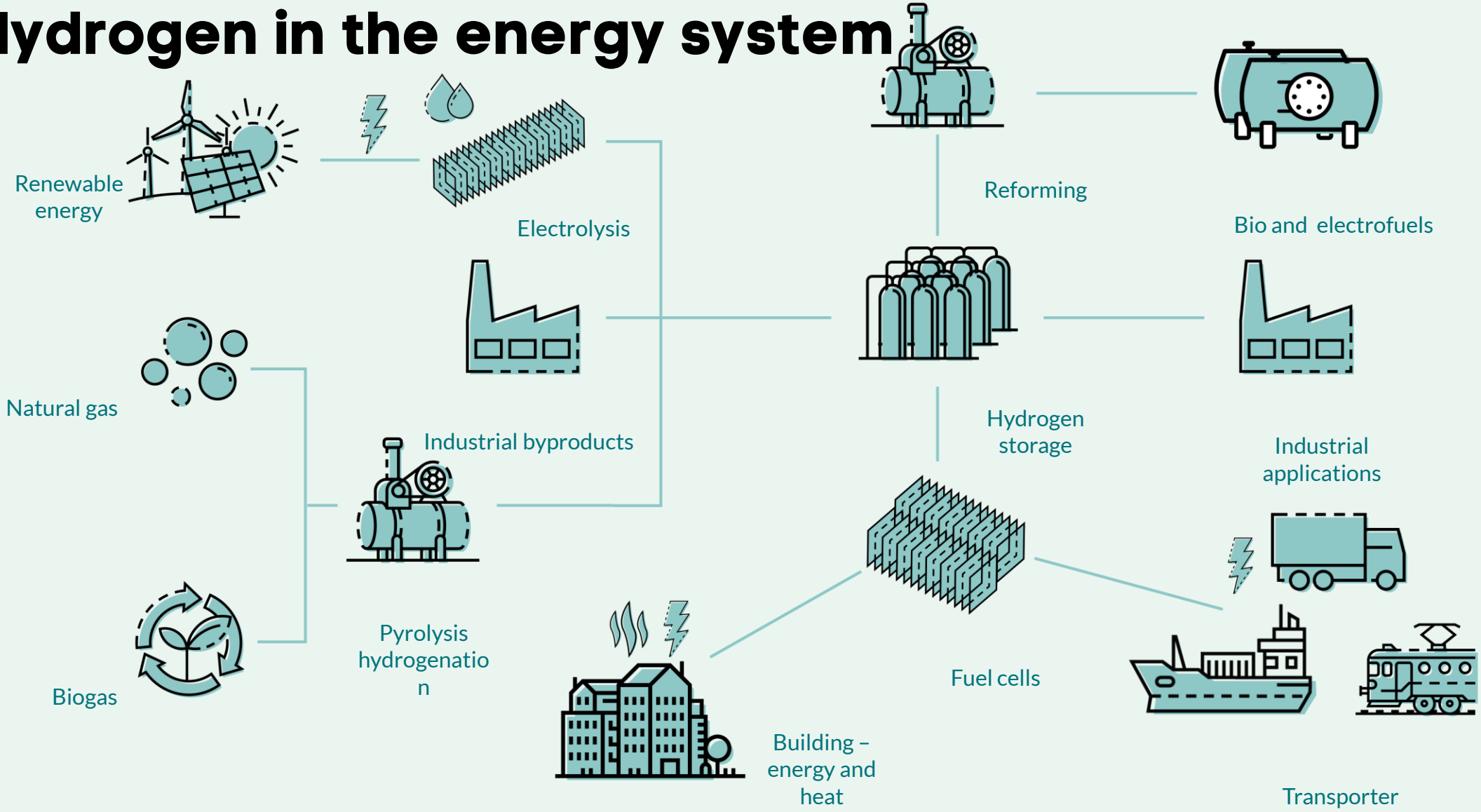
+ Medium/high efficiency, Balancing the electricity grid, low cost to scale up, <5 min refueling
− Cost of initial infrastructure

Ideal for air/maritime

+ Cheap storage/distribution, fast refueling
− Medium/low efficiency, Still some emissions

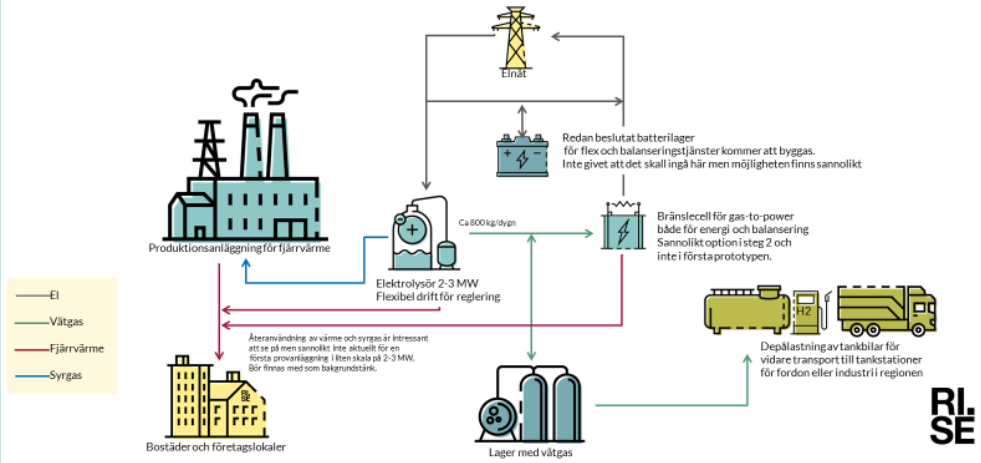
RI. SE

Hydrogen in the energy system



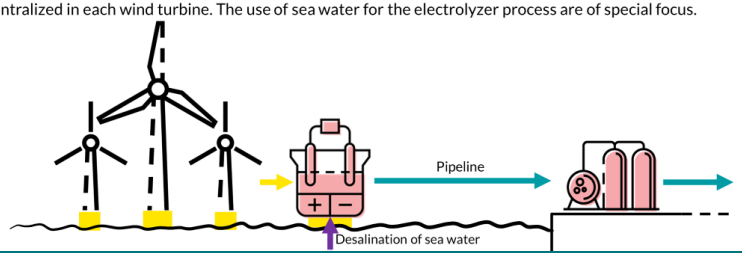
Some of our projects

HydrogenCoGeneration with district heating -HyCoGen



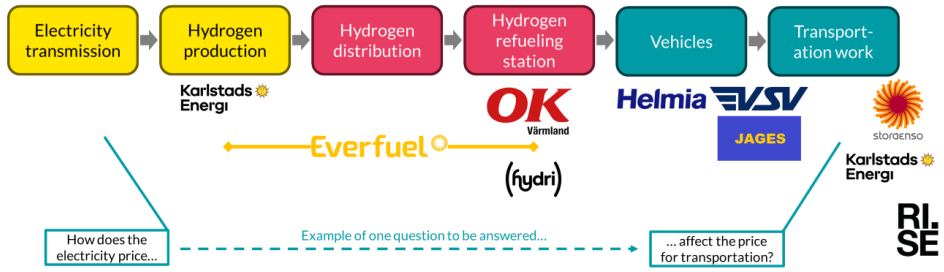
Hydrogens possibilities for wind power

- Research project funded by Energiforsk. 1 MSEK.
- Are to analyze different ways of producing hydrogen in direct connection to wind power by analyzing different system configuration. Main parameter to be analyzed, using developed simulationmodels are **Levelized cost of Hydrogen (LCoH)** but also policy, regulation and business models are to be analyzed.
- Systems using **on shore wind power** are analyzed by looking at how different localizations of the wind farm, electrolyzer and an industry with a hydrogen demand are to be most optimally located.
- Systems using **off shore wind power** are analyzed by changing the placement of the electrolyzer; onshore, offshore platform or decentralized in each wind turbine. The use of sea water for the electrolyzer process are of special focus.



V3-skog (Hydrogen in forestry transports)

- Research project funded by FFI. 2,6 MSEK.
- Are to analyze if its practically, economically and technically possible to power on road forestry transports in a specific value chain in Värmland county using hydrogen as fuel. Project partners from the whole value chain from hydrogen production to actual transportation work are included. Several questions within the whole value chain are to be analyzed and answered.
- The projects vision is to create a concrete formulation of a potential pilot project if it's deemed feasible.



H2 in transport applications

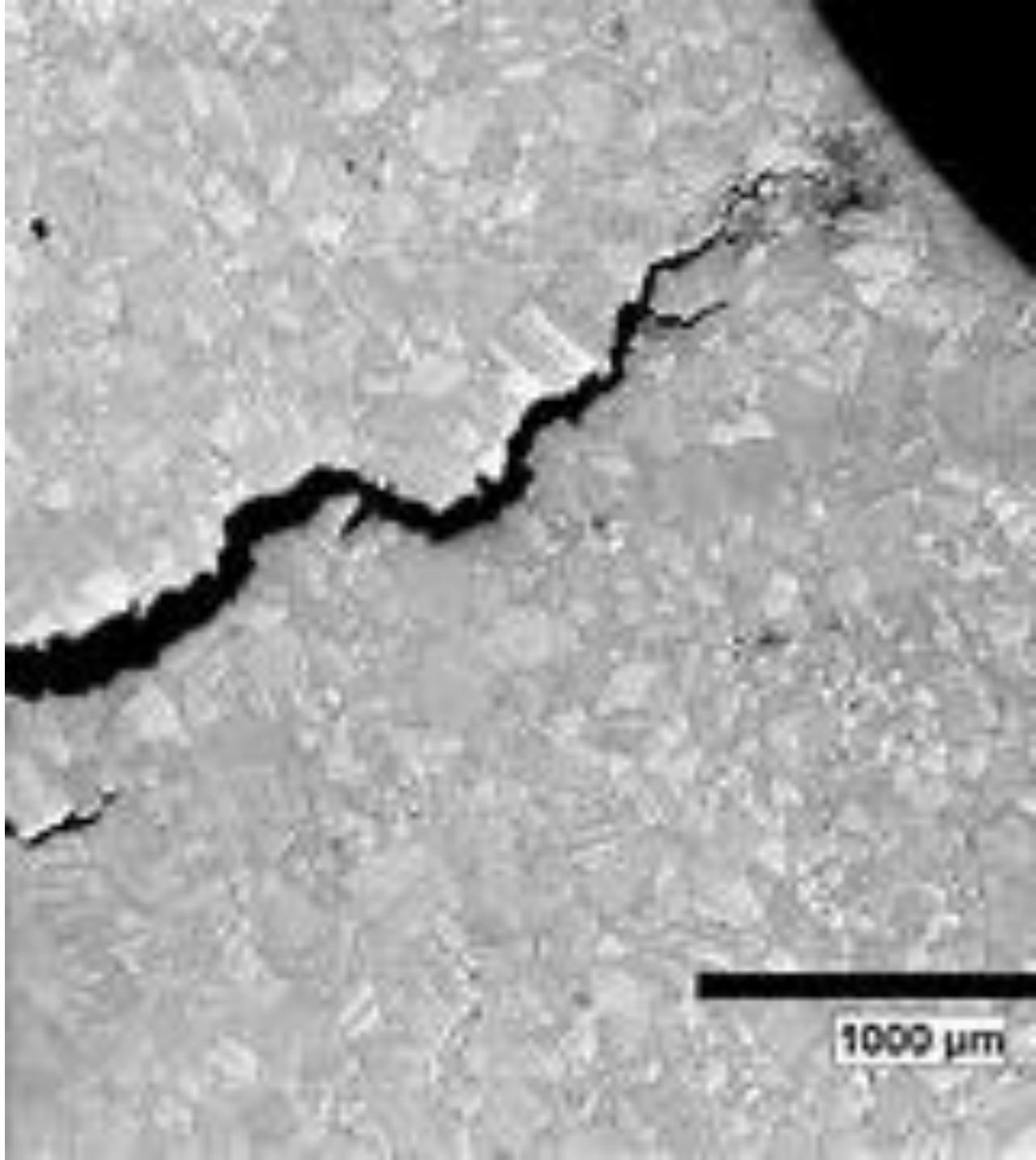
- Road: Fuel cell drvelines
- Aviation: FFFLY, FLYH2UME*
- Maritime: H2 Powertrain and bunkering
- Rail: Rail4Earth, FutuRe
- Construction: ElCharlie, Cleancon, HyLite
- H2 in Agriculture

H2 in large scale energy systems

- Hydrogen as enabler for sector coupling
- H2 & Battery storage for system stability services in energy systems
- Energy system simulations
- Pipeline infrastructures

Materials and H2

- Alloys
- Embrittlement
- Material studies for H2 storage
- Corrosion (RISE L'institut Corrosion, France)
- Development of H2 detection and sensing methods



Hydrogen related Networks

- ❑ Applying member of EERA JP FCH
- ❑ Managing SHDC (Swedish Hydrogen Development Centre) in Sweden
- ❑ Member of Hydrogen Europe Research
- ❑ Member of 2Zero
- ❑ Member of Waterborne

HUR KAN VI HJÄLPA DIG?

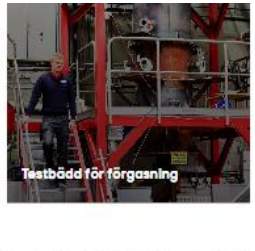
AKTUELLT

UTBILDNINGAR

For more information welcome to visit www.ri.se/en/hydrogen

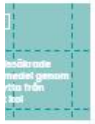
VÅRA TJÄNSTER INOM VÄTGAS

VÅR EXPERTIS INOM VÄTGAS



PROJEKT INOM VÄTGAS

PROJEKT INOM VÄTGAS



NÄTVERK INOM VÄTGAS

Hydrogen Research Institute (HRI)

L'Institut de Recherche sur l'Hydrogène (IRH)

Bruno G. Pollet

Member of the Council of Engineers for the Energy Transition (CEET): An Independent Advisory Council to the United Nations' Secretary-General (UN)

Member of the United Nations Economic Commission for Europe (UNECE) - Hydrogen Task Force

Member of the Working Group of the Renewable Hydrogen Task of the Hydrogen Technology Collaborative (TCP) Programme of the International Energy Agency (IEA)

President of the Green Hydrogen Division of the International Association for Hydrogen Energy (IAHE)

Board of Director member of the Canadian Hydrogen and Fuel Cell Association (CHFCA) / Hydrogène Québec

HRI HYDROGEN RESEARCH INSTITUTE UQTR

UQTR Université du Québec à Trois-Rivières

Presentation for:

EERA FCH JP Management Board

Thursday 14th March 2024

EERA European Energy Research Alliance Fuel Cells and Hydrogen

HYDROGEN RESEARCH INSTITUTE

HRI HYDROGEN RESEARCH INSTITUTE UQTR

UQTR Université du Québec à Trois-Rivières

HYDROGEN RESEARCH INSTITUTE

HRI HYDROGEN RESEARCH INSTITUTE UQTR

Enabling the Energy Transition through Innovation in Advanced Materials and Engineering

Introduction:

- HRI is a research unit of UQTR dedicated to research on hydrogen science and technologies related to the energy transition founded in 1994
- 17 faculties, 9 research personnel (research assistants, technicians, etc.)
- 100+ students (electrical/mechanical engineering, energy and material science, chemistry and physics)

Mandate:

- HRI's mandate is to study and develop technologies for the production, storage and safe use of hydrogen as an energy vector, a means of storing energy and as commercial gas
- The institute is also interested in all aspects of the scientific and technological issues related to the energy transition

Research Themes:

- Production, storage, distribution and use of hydrogen
- Management and distribution of renewable energy systems
- Electrification of transportation and smart mobility
- Innovative materials for the transition to sustainability

HYDROGEN RESEARCH INSTITUTE

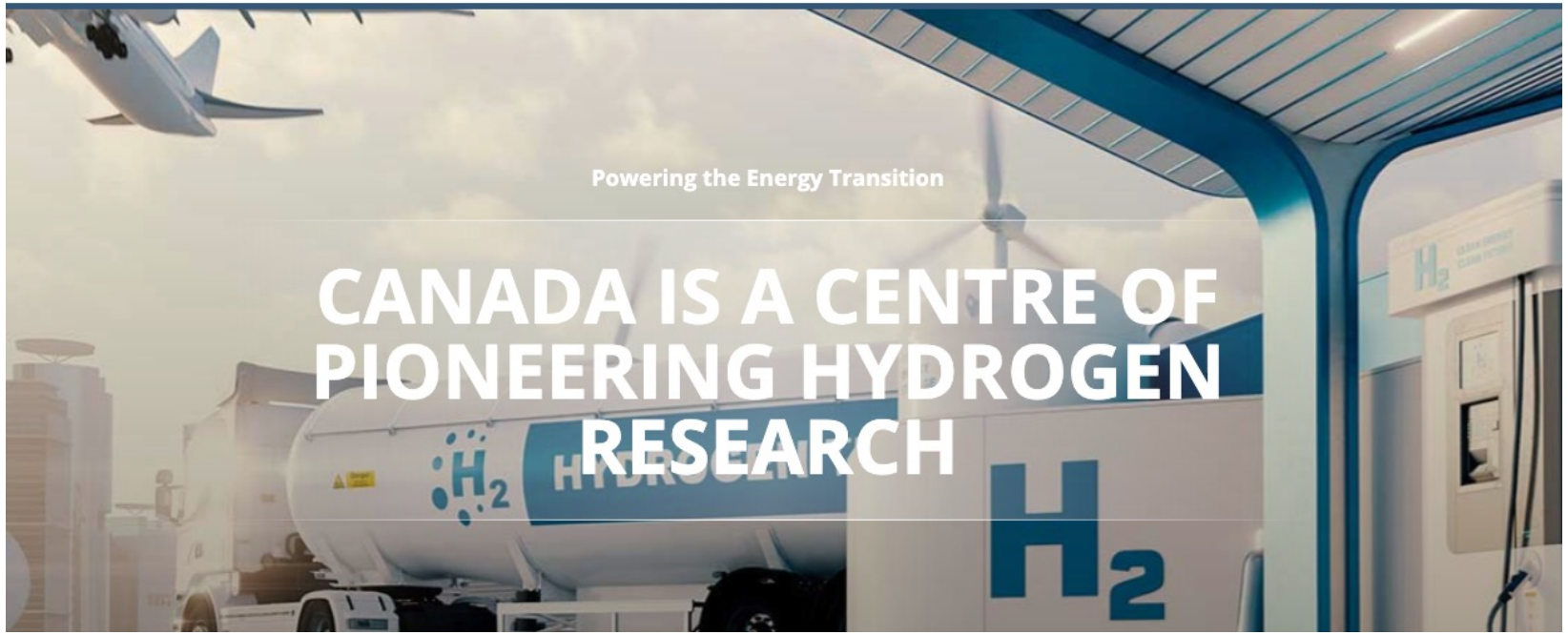
FINANCIAL TIMES

myFT

INVEST IN CANADA

PARTNER CONTENT

Share



Research is at the heart of Canada's work to decarbonise the economy with a number of universities across the country running their own hydrogen research programmes. Among the leading university research institutes are the Clean Energy Research Centre at the University of British Columbia, the Hydrogen Research Institute (IHR) at the Université du Québec à Trois-Rivières (UQTR) and the Clean Energy Research Lab at Ontario Tech University.

The Canadian government is also making big investments in hydrogen technology, including funding the hydrogen pillar of the National Research Council of Canada's Advanced Clean Energy programme and backing the building of Canadian Nuclear Laboratories' new state-of-the-art Hydrogen Isotopes Technology Laboratory.

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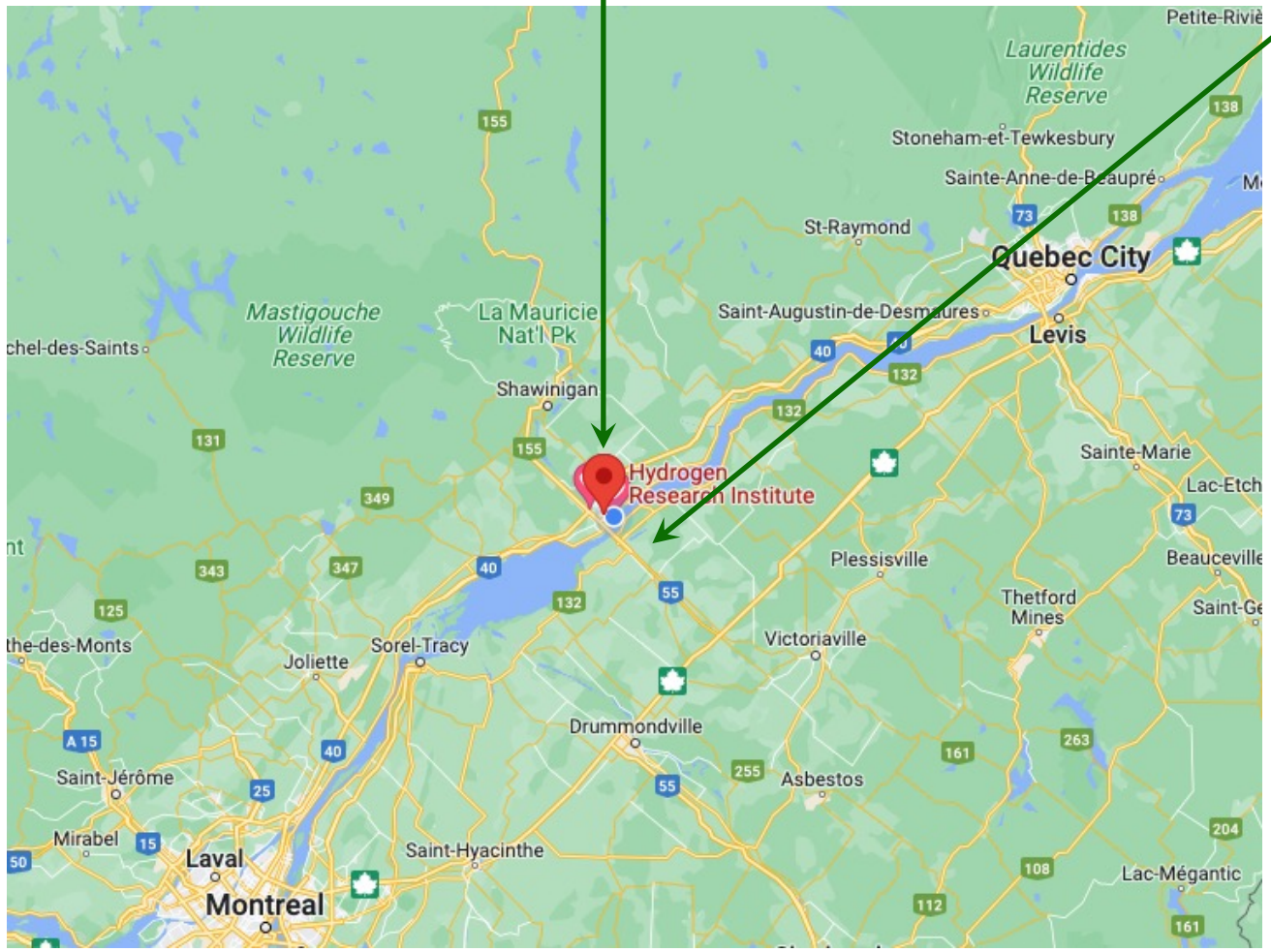
IRH INSTITUT DE RECHERCHE SUR L'HYDROGÈNE UQTR

- **Air Liquide Hydrogen plant** - PEMWE electrolyser (20MW, Cummins/Hydrogenics).
- **Innovation Zone** - Industrial Park on Decarbonation and Electrification.



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Scientific Strategy

Theme A **Hydrogen production and storage technologies**	Axis 1: Electrolysis Axis 2: Biomass conversion Axis 3: Solar technologies Axis 4: Storage technologies
Theme B **System integration and optimal resource management**	Axis 1: Resource management and optimization Axis 2: Advanced materials for energy Axis 3: Coupling to the electricity grid Axis 4: Safe use of technologies
Theme C **Techno-economic, environmental, socio-political and Indigenous governance issues**	Axis 1: Technology Life Cycle Assessment and Assessment Axis 2: Economic, legislative and environmental issues Axis 3: Canadian and International Socio-Political Issues Axis 4: Energy Transition and Indigenous Governance
Theme D **Appropriation of technologies**	Axis 1: Science and technology education Axis 2: Technical and vocational training on renewable hydrogen Axis 3: Scientific entrepreneurship in the field of renewable energies Axis 4: Ethics, citizen voice and socio-environmental controversies

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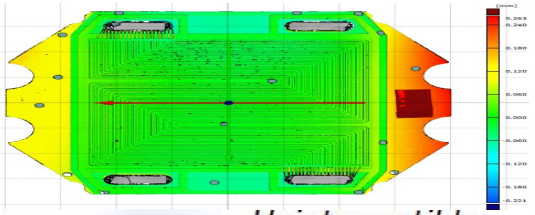
Hydrogen R&D Value Chain



Uninterruptible Power Supply

Combined Heat & Power

Telecommunication

Domestic

2-3 Wheelers

Utility Vehicles

Transport

Passenger Vehicles

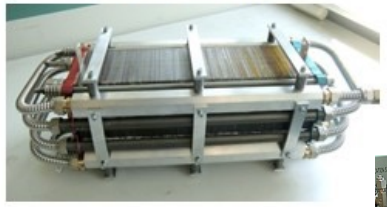
Portable

Industry & Job creation

Innovation

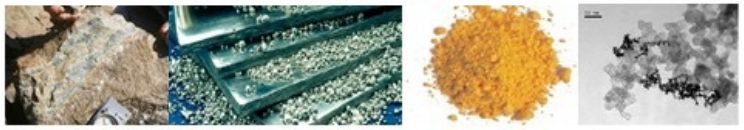
Fuel Cell Components

Fuel Cell Stack



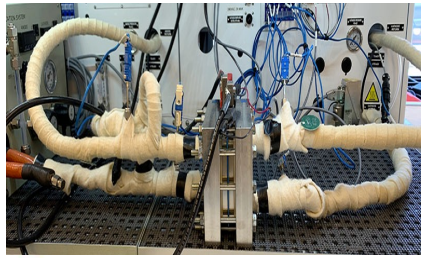
PGM beneficiation

Platinum Group Metals & Minerals



Hydrogen Storage

Electrolyser Stack



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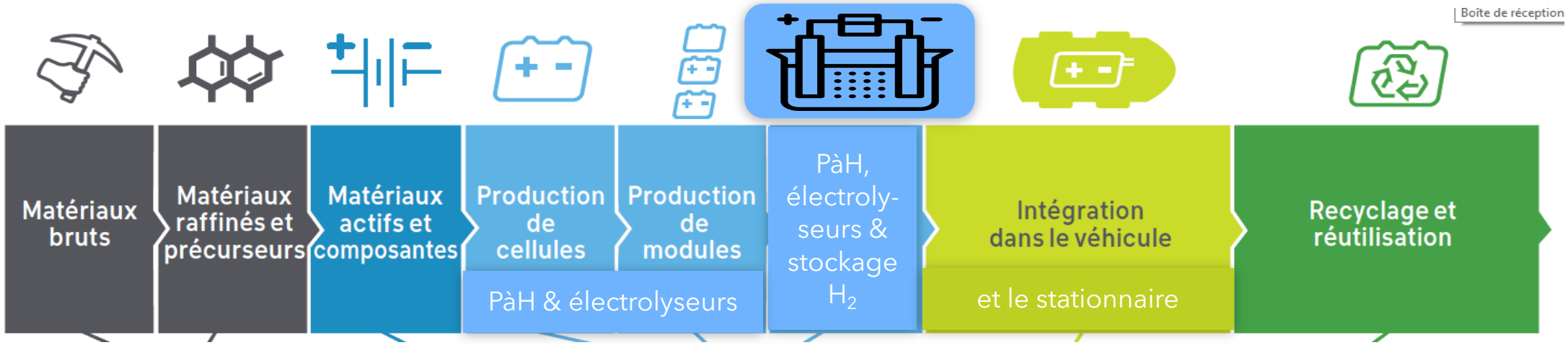
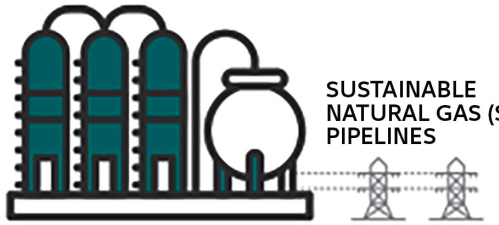
Hydrogen R&D Value Chain



LCH2 and RH2 VALUE CHAIN

HYDROGEN RESEARCH INSTITUTE

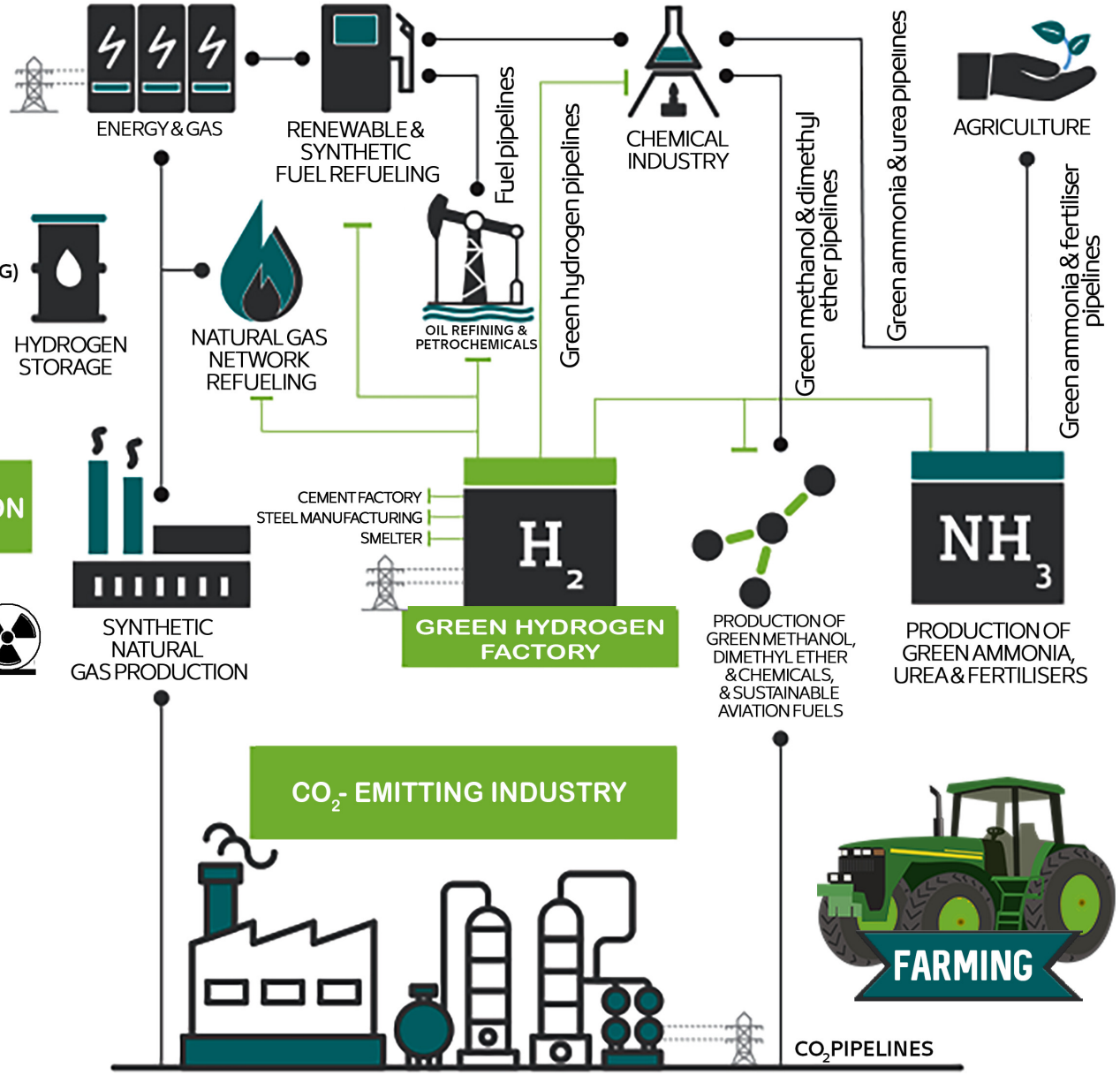
CONVERSION OF BIOMASS FOR GREEN HYDROGEN PRODUCTION

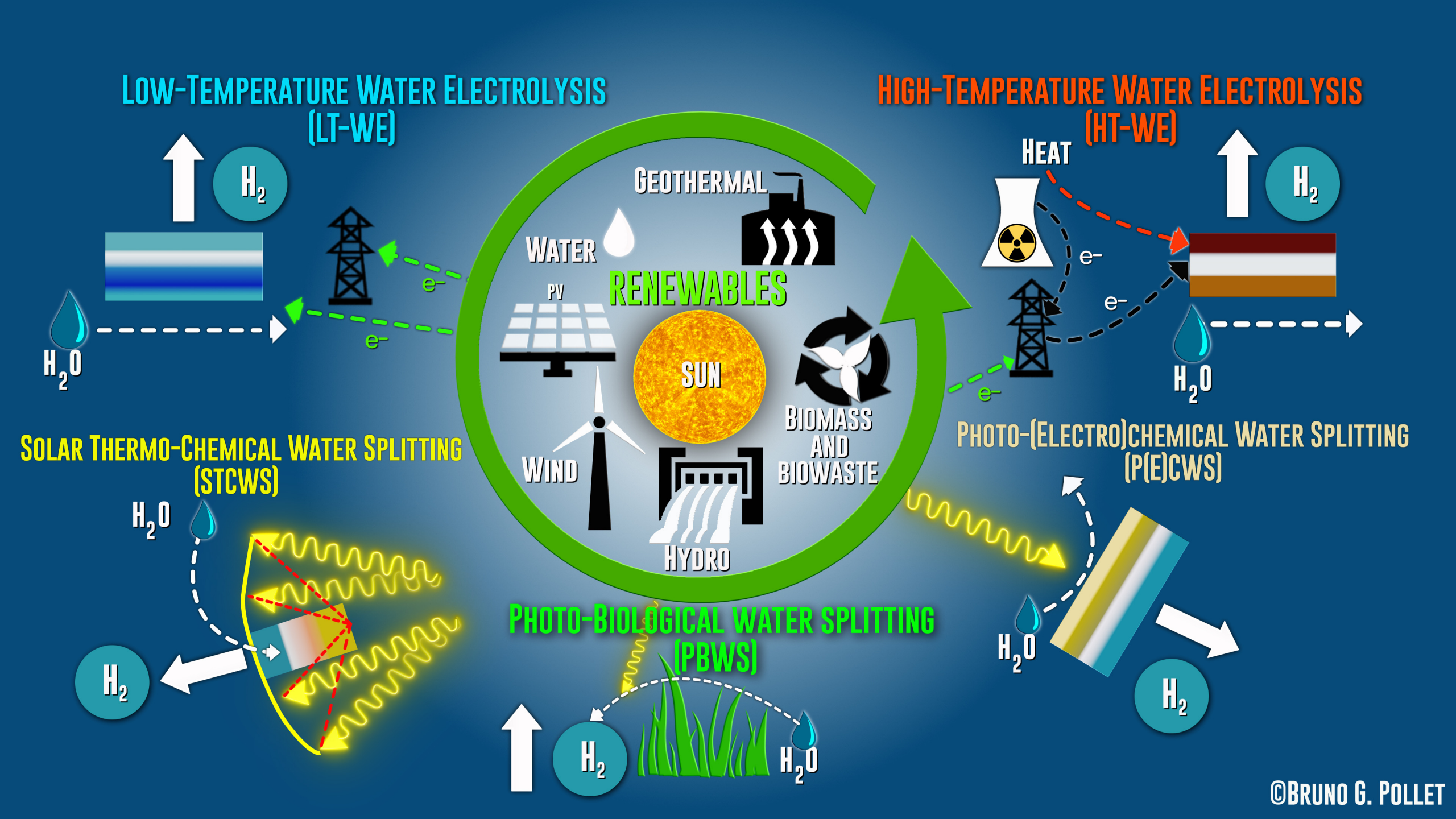


SUSTAINABLE NATURAL GAS (SNG) PIPELINES

RENEWABLE ENERGY GENERATION

ELECTROLYSER & HYDROGEN FUEL CELL GIGAFACTORIES




LOW-TEMPERATURE WATER ELECTROLYSIS
(LT-WE)
H_2
H_2O
e-
e-
HIGH-TEMPERATURE WATER ELECTROLYSIS
(HT-WE)
HEAT
H_2
H_2O
e-
e-
e-
GEOTHERMAL
WATER
PV
RENEWABLES
SUN
WIND
BIOMASS
AND
BIOWASTE
HYDRO
SOLAR THERMO-CHEMICAL WATER SPLITTING
(STCWS)
H_2O
H_2
PHOTO-(ELECTRO)CHEMICAL WATER SPLITTING
(P(E)CWS)
H_2O
H_2
PHOTO-BIOLOGICAL WATER SPLITTING
(PBWS)
H_2
H_2O
©BRUNO G. POLLET

HRI – Academic Members [Full (12) & Associates (5)]

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MATERIALS

- **Bruno G. Pollet** — Materials Chemistry
- Jacques Huot — Materials Chemistry
- Mihaela Cibian — Materials Chemistry
- Samaneh Shahgaldi — Materials Chemistry
- François Allard — Materials Chemistry
- Phoung Nguyen-Tri — Materials Chemistry
- *tbc* — Materials

ENGINEERING

- Loïc Boulon — Electrical Engineering
- Kodjo Agbossou — Electrical Engineering
- Nassim Noura — Electrical Engineering
- Mamadou L. Doumbia — Electrical engineering
- Sousso Kelouwani — Mechanical Engineering
- Marie Hébert — Mechanical Engineering
- Martin Bolduc — Mechanical Engineering

BIOCHEMISTRY

- Simon Barnabé — Bioenergy
- *tbc* — Biotechnology
- *tbc* — Biomass2Energy

HRI HYDROGEN RESEARCH INSTITUTE UQTR

- Gabriel Antonius — Simulations
- Maxime Charlebois — Simulations
- Pierre Bénard — Simulations & Safety

MODELING, MACHINE LEARNING & SAFETY

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HRI – Admin Members

Research officers (7) & Technicians (2)

HRI UQTR HYDROGEN RESEARCH INSTITUTE

Ahmed Hourri Materials	Sadesh K. Natarajan Fuel cells	Shankara S. Kalanur Electrolysers	Nilson F. Henao Engineering
Benjamin Angers Modeling	Ali Amamou Engineering	Mohsen Kandidayeni Engineering	
Marie-Ève Marchand-Lamarche Technician	Raphaël Gervais Lavoie Technician		

Hydrogen and Fuel Cell Infrastructure @ HRI

HYDROGEN RESEARCH INSTITUTE

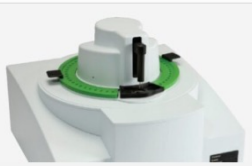
- Potentiostats/galvanostats/EIS
- R(R)DE
- Photoelectrochemistry
- Sonoelectrochemistry
- Ultrasonic devices (baths, probes & US-spray)
- ICP/GC/HPLC etc
- UV-vis
- Scanning Probe Microscopes (AFM/STM)
- FTIR spectrometer, UV-vis etc
- Single cell fuel cell/water electrolyser test stations

CHARACTERIZATION >

Agilent 3000A Micro

CHARACTERIZATION >

ASAP 2050 XP – Xtended Pressure Sorption Analyzer

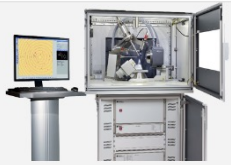


CHARACTERIZATION >

Thermogravimetric Analysis – TGA 4000 System

CHARACTERIZATION >

X-Ray Diffraction – Bruker D8 Focus



CHARACTERIZATION >

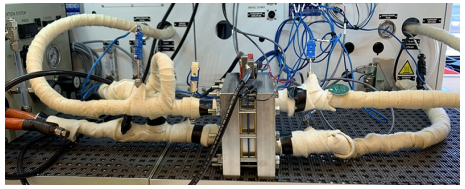
Xcalibur and Gemini single-crystal X-ray diffractometer

ELECTROCHEMISTRY >

SP-300 – Biologic Potentiostat / Galvanostat

TESTING >

Pfeiffer HLT 560 Leak Detector



HYDROGEN RESEARCH INSTITUTE

Hydrogen and Fuel Cell Infrastructure @ HRI

GREENLIGHT INNOVATION

HYDROGEN RESEARCH INSTITUTE

Joint Research Unit (UMR)

INRS-UQTR

Institut national de la recherche scientifique (INRS) and Université du Québec à Trois-Rivières (UQTR) have joined forces to set up a joint research unit (UMR) focused on the development of advanced materials and technologies for a low-carbon economy.

UQTR is actively involved in the Electrification and Climate Change Plan (PECC) in Québec and has gained international recognition for the important facilities it has developed to foster energy transition. The work that its Hydrogen Research Institute (IRH) and Innovations Institute in Ecomaterials, Ecoproducts, and Ecoenergies (I2E3) has done in this regard is a case in point.

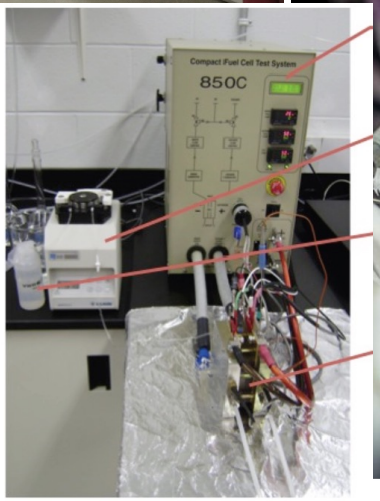
As for INRS, its Énergie Matériaux Télécommunications Research Centre in Varennes and Eau Terre Environnement Research Centre in Québec City are world-class facilities without peer in Canada that bring together one of the world's largest critical masses of scientists specialized in the development of advanced materials and green technologies.

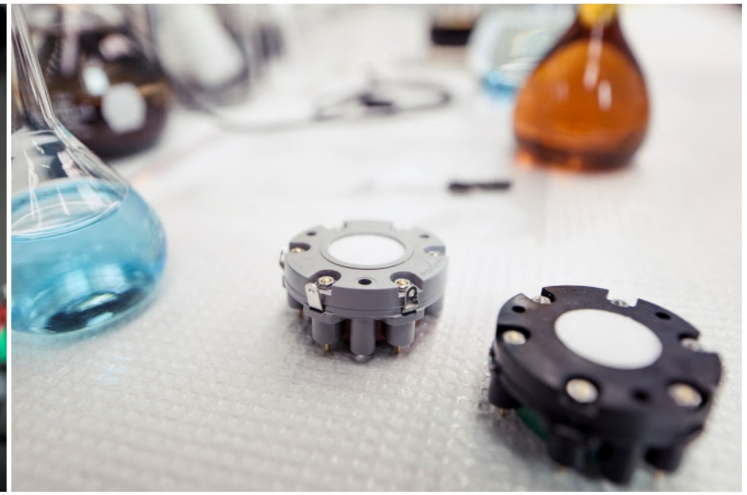
INRS Institut national de la recherche scientifique

UQTR Université du Québec à Trois-Rivières

ELECTROCHEMISTRY & CHEMISTRY LABORATORIES

UMR

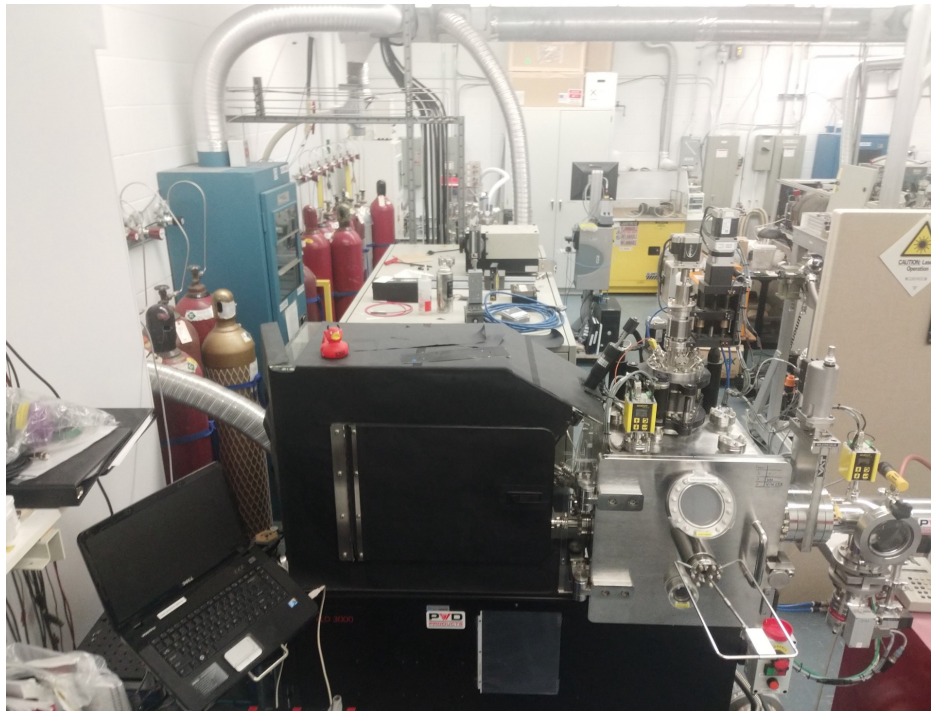




INRS UQTR Université du Québec à Trois-Rivières

LABORATORY for SYNTHESIS by PHYSICAL METHODS

UMR



Analytical methods @ INRS

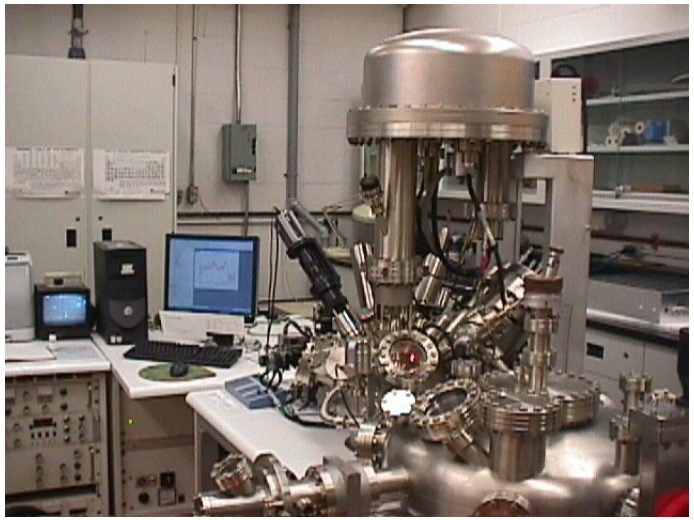
- Access to micro- and nano-fabrication laboratory (**CAN$33m**)

INRS UQTR Université du Québec à Trois-Rivières

UMR

CHARACTERISATION LABORATORY

XPS



AFM / STM

working under ultra-vacuum

SEM

Physical characterisation techniques @ INRS

- BET/TEM/SEM/XRD/XPS/Raman/IR/NMR etc.
- Access to beam time use at Canadian Light Sources

INRS UQTR Université du Québec à Trois-Rivières

HYDROGEN RESEARCH INSTITUTE

HRI HYDROGEN RESEARCH INSTITUTE UQTR

Research Chairs / International Laboratories @ HRI

- ✓ NOOVELIA Research Chair for Intelligent Navigation of Autonomous Industrial Vehicles
- ✓ Hydro-Québec Chair in Transactional Management of Residential Demand for Power and Energy
  - Forthcoming research building in downtown Trois-Rivières (**CAD$46million**)
- ✓ NSERC Canada Research Chair (CRC) 2 in Energy Sources for Vehicles of the Future
- ✓ NSERC CRC 1 in Green Hydrogen Production
- ✓ NSERC CRC 2 in Energy Optimization of Intelligent Vehicles
- ✓ NSERC CRC 2 in Renewable Materials for Fuel Cells
- ✓ Innergex industrial research chair on Renewable Hydrogen Production
- ✓ *UMR INRS-UQTR on Materials and Technologies for the Energy Transition*
- ✓ *International Laboratory on Hydrogen Energy (LIHyEn) – Belfort, France*
- ✓ *International e-Campus Laboratory (Université de Lille, France)*
- ✓ *International Research Network Clean Hydrogen – France-Canada (CNRS, France)*

RECENT RESEARCH FUNDING

NSERC Tier 1 Canada Research Chair
Green Hydrogen Production
(7 years, $1.4m)

>$0.5m

NSERC Discovery
Sonocatalysis and Sonoelectrocatalysis
(5 years, >$0.3m)

INNERGEX Research Chair
Renewable Hydrogen Production
(5 years, >$0.6m)

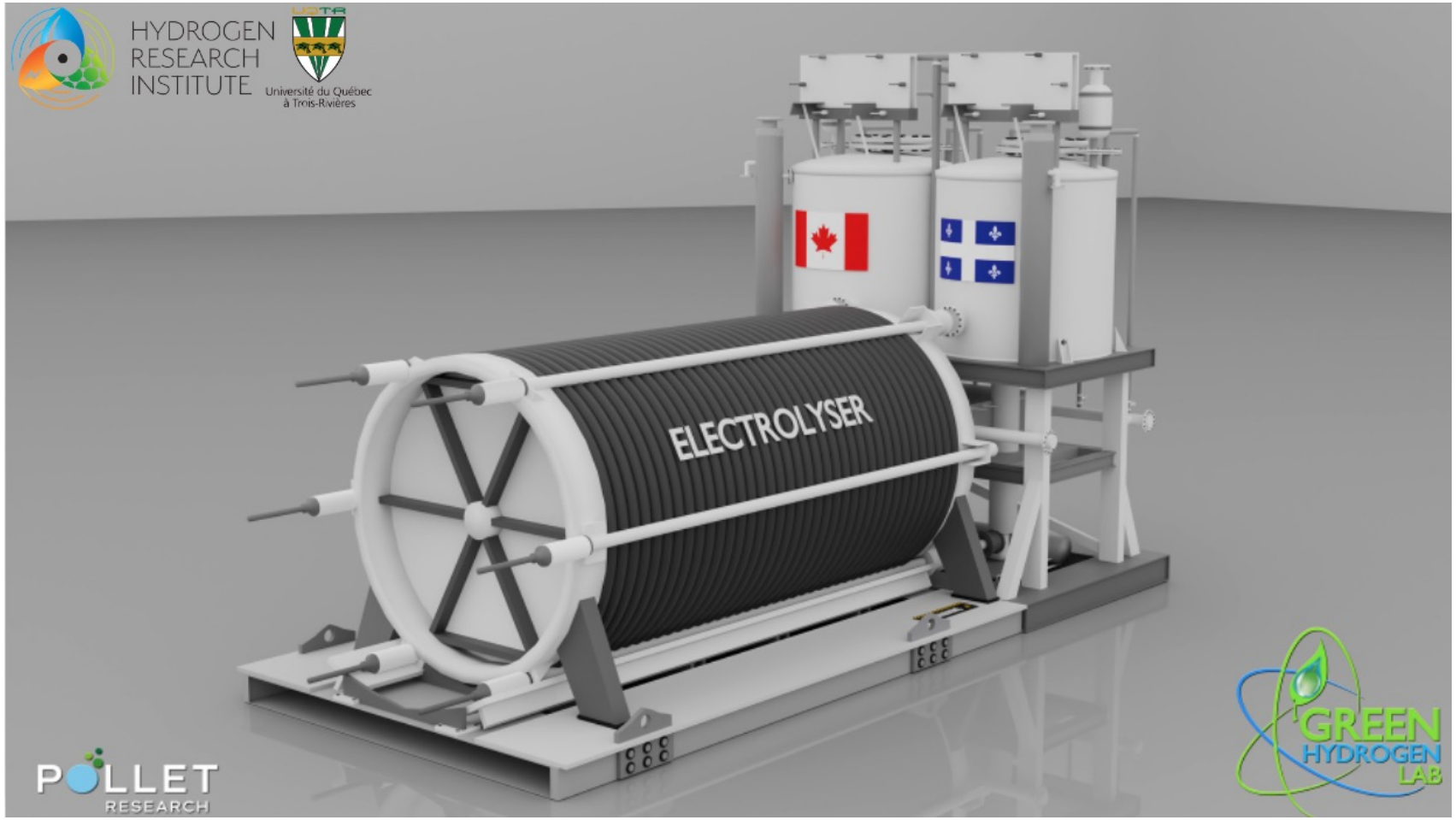
3 years, $0.45m

CFREF
Accelerating Community Energy Transformation
(7 years, $8.9m for HRI/UQTR)

BIOGRAPHY & CAREER HIGHLIGHTS

Next Generation of Water Electrolysers
PEMWE, AWE, AEMWE & DSWE

towards Green Hydrogen and Value-Added Products
-From materials to systems development-



HYDROGEN RESEARCH INSTITUTE

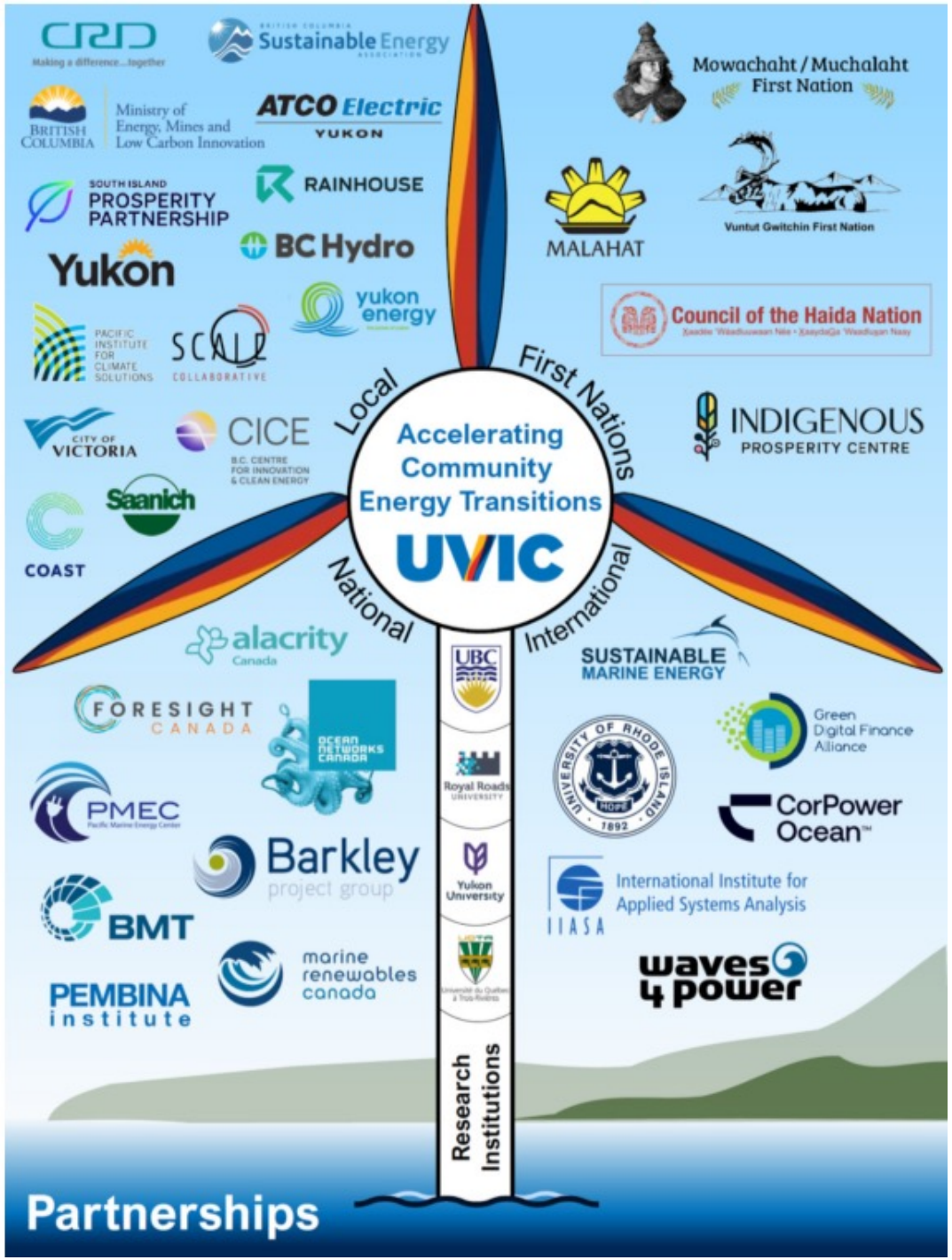
CANADA FIRST RESEARCH EXCELLENCE FUND | APOGÉE CANADA FONDS D'EXCELLENCE EN RECHERCHE

Canada

CFREF

Accelerating Community Energy Transformation

(7 years, $8.9m for HRI/UQTR)



RQEI

Réseau québécois sur l'énergie intelligente

The energy transition from the perspective of natural sciences and engineering

- 10 universities, 6 colleges
- 75 researchers, 700 students
- **CAD$60 million/year** in research grants
- 8 Canada Research Chairs
- 4 NSERC/Hydro-Québec Chairs

Specific mandate of the Ministry of Energy

CAD$12.5M over 5 years for hydrogen research.

- Research Infrastructure
- Structuring of activities
- Internationally: financing of theses in co-supervision

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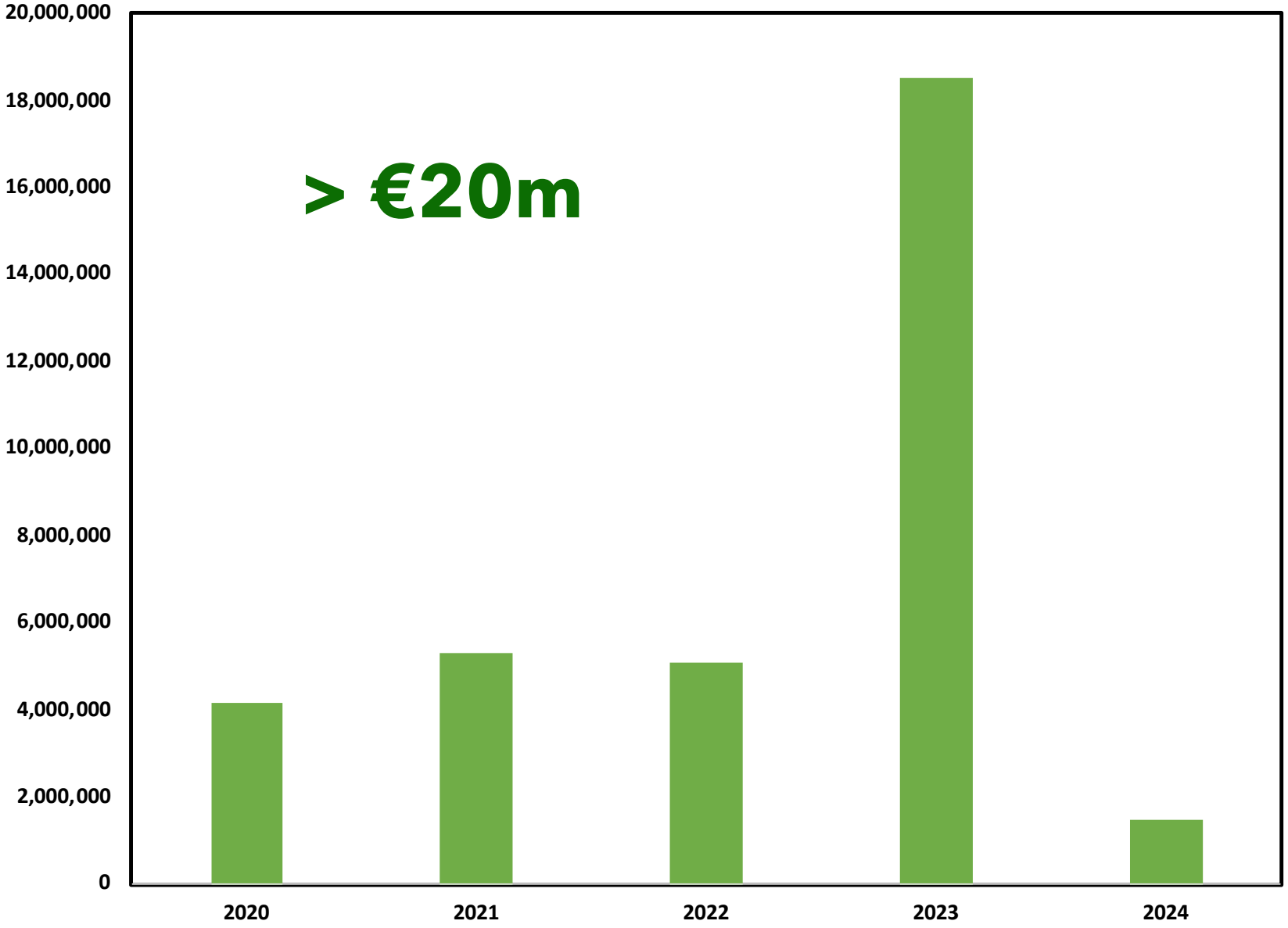
Funding since 2020



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Innovation Zone
Trois-Rivières/Bécancour/Shawinigan

H2CAN - Universités

INNERGEX

NSERC CRSNG

AIR LIQUIDE

Chairs

Canada Research Chairs / Chaires de recherche du Canada

Hydro Québec

noovelia

INRS

H_2 The French Research network on Hydrogen energy

cnrs

CHFCA Clean. Efficient. Energy.

Hydrogène Québec

武漢理工大學 WUHAN UNIVERSITY OF TECHNOLOGY

CQMF

RQMP

RQEI Réseau québécois sur l'énergie intelligente

HRI UQTR HYDROGEN RESEARCH INSTITUTE

INSTITUT d'INNOVATIONS en écomatériaux, écoproduits et écoénergies à base de biomasse UQTR

hySafe INTERNATIONAL ASSOCIATION FOR HYDROGEN SAFETY

CENTER FOR Hydrogen SAFETY Connecting a Global Community

Hydrogen Safety Engineering and Research (HySAFER)

Sandia National Laboratories

NREL Transforming ENERGY

Savannah River National Laboratory OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

US DoE Storage Engineering Centre of Excellence

Énergie et Ressources naturelles Québec

Économie et Innovation Québec

Cummins

NTNU Norwegian University of Science and Technology

ALSTOM

H2 Hydrogen TCP

IEA Hydrogen TCP storage (17, 22, 40) and Safety tasks (19, 31) tasks

Natural Resources Canada / Ressources naturelles Canada

BALLARD

CANOPENER A Trans-Atlantic Partnership in Electrochemical Energy Technologies

HYDROGEN RESEARCH INSTITUTE

Au cours des prochains mois, le train de passagers à hydrogène Coradia iLint d'Alstom circulera dans la région de Charlevoix. L'écosystème de ravitaillement, d'opération et de maintenance de ce train sera étudié par l'Institut de recherche sur l'hydrogène (IRH) de l'UQTR. Photo : © ALSTOM SA 2023

Partenariat avec l'entreprise Alstom

L'Institut de recherche sur l'hydrogène de l'UQTR évaluera l'écosystème d'un train à hydrogène dans Charlevoix

01 JUIN 2023 SERVICE DES COMMUNICATIONS ACTUALITÉS, CHIMIE, BIOCHIMIE ET PHYSIQUE, COMMUNIQUÉS, MÉDIAS, RECHERCHE, SCIENCES ET TECHNOLOGIES

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Led by Prof. Bruno G. Pollet

Canada Strategic Hydrogen R&D Network

SFU

UBC

UVIC

National Research Council Canada

Conseil national de recherches Canada

UNIVERSITY OF ALBERTA

UNIVERSITY OF TORONTO

OntarioTech UNIVERSITY

UNIVERSITY OF CALGARY

Toronto Metropolitan University

uOttawa

UQTR Université du Québec à Trois-Rivières

POLYTECHNIQUE MONTRÉAL

McGill

INRS Institut national de la recherche scientifique

International Research Network (IRN) France-Canada

FC Clean H2: Moving France and Canada to a Low-Carbon Hydrogen Future

Co-leader Canada:

Bruno G. Pollet

Co-leader France:

Christophe Coutanceau

IRN France-Canada

Fuel Cell and Clean Hydrogen H_2: Moving France and Canada to a Low-Carbon Hydrogen Future

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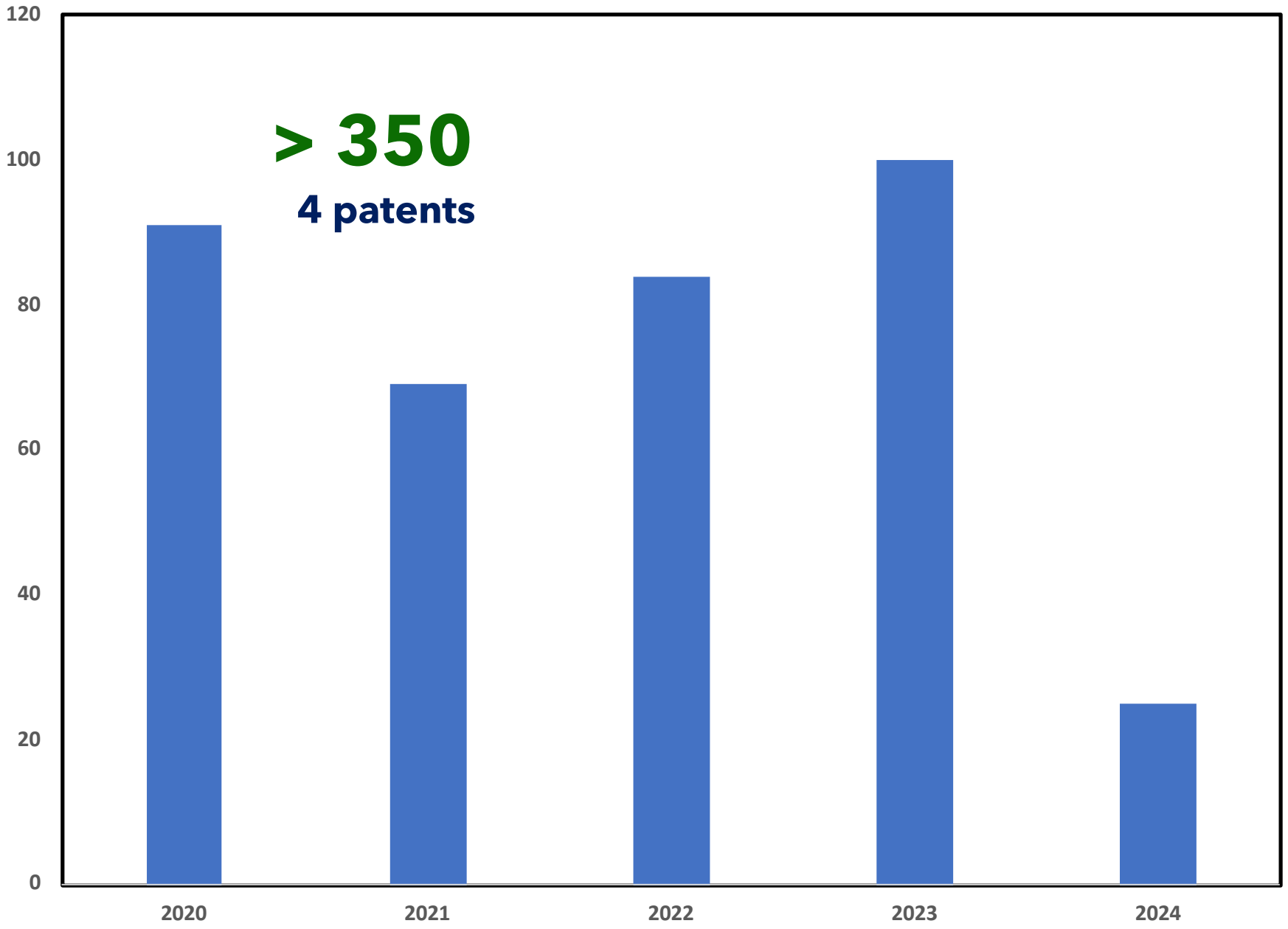
Publications since 2020



> 350

4 patents

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Chem Soc Rev

ROYAL SOCIETY OF CHEMISTRY

REVIEW ARTICLE

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Highly cited!

Check for updates

Cite this: DOI: 10.1039/d0cs01079k

Water electrolysis: from textbook knowledge to the latest scientific strategies and industrial developments†

Marian Chatenet, [a] Bruno G. Pollet, [bc] Dario R. Dekel, [de] Fabio Dionigi, [f] Jonathan Deseure, [a] Pierre Millet, [gh] Richard D. Braatz, [i] Martin Z. Bazant, [ij] Michael Eikerling, [kl] Iain Staffell, [m] Paul Balcombe, [n] Yang Shao-Horn [o] and Helmut Schäfer *[p]

Replacing fossil fuels with energy sources and carriers that are sustainable, environmentally benign, and affordable is amongst the most pressing challenges for future socio-economic development. To that goal, hydrogen is presumed to be the most promising energy carrier. Electrocatalytic water splitting, if driven by green electricity, would provide hydrogen with minimal CO_2 footprint. The viability of water electrolysis still hinges on the availability of durable earth-abundant electrocatalyst materials and the

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[c] Green Hydrogen Lab, Institute for Hydrogen Research (IHR), Université du Québec à Trois-Rivières (UQTR), 3351 Boulevard des Forges, Trois-Rivières, Québec G9A 5H7, Canada
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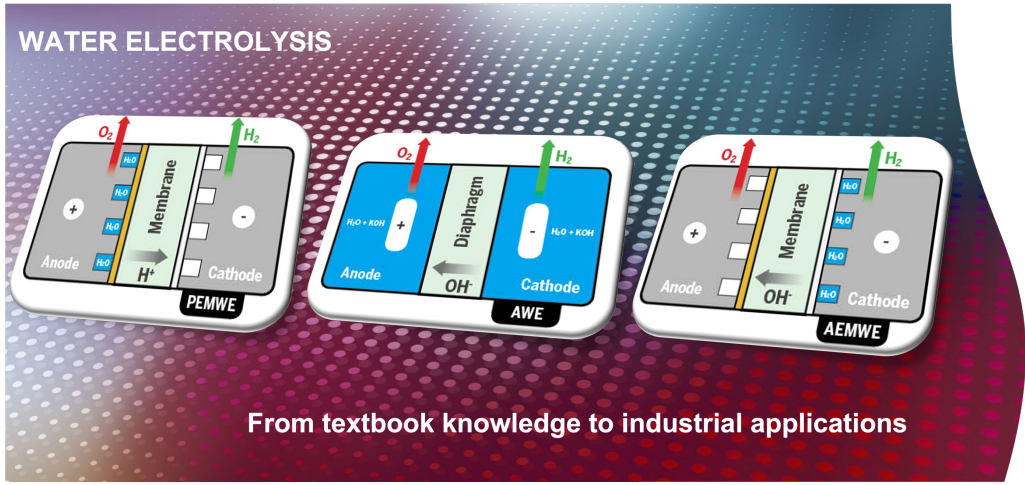
[n] Division of Chemical Engineering and Renewable Energy, School of Engineering and Material Science, Queen Mary University of London, London, UK
[o] Research Laboratory of Electronics and Department of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA
[p] Institute of Chemistry of New Materials, The Electrochemical Energy and Catalysis Group, University of Osnabrück, Barbarastrasse 7, 49076 Osnabrück, Germany.



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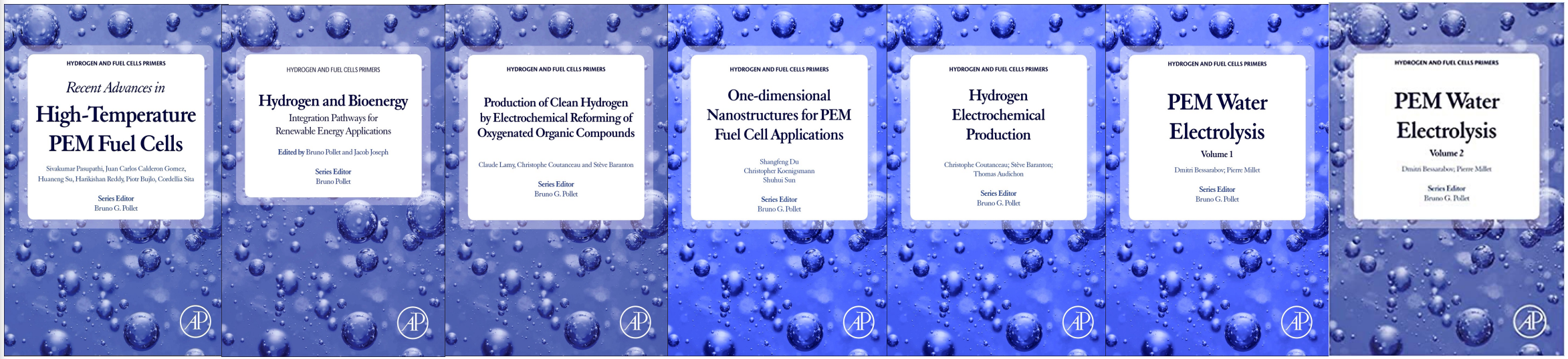
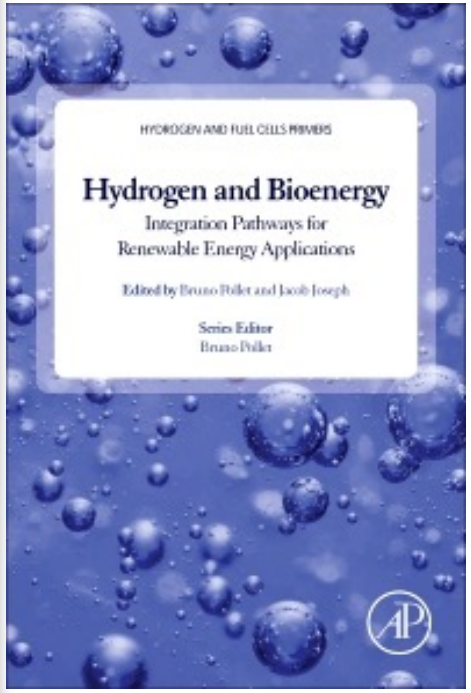
Books





Hydrogen, Biomass and Bioenergy

Jacob J. Lamb & Bruno G. Pollet (eds.)
Elsevier Publishing

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SENATE
SÉNAT
CANADA

MAY 2023

HYDROGEN:

A Viable Option for a Net-Zero Canada in 2050?

Report of the Standing Senate Committee on Energy, the Environment and Natural Resources

The Honourable Rosa Galvez, Chair

The Honourable Josée Verner, P.C., Deputy Chair

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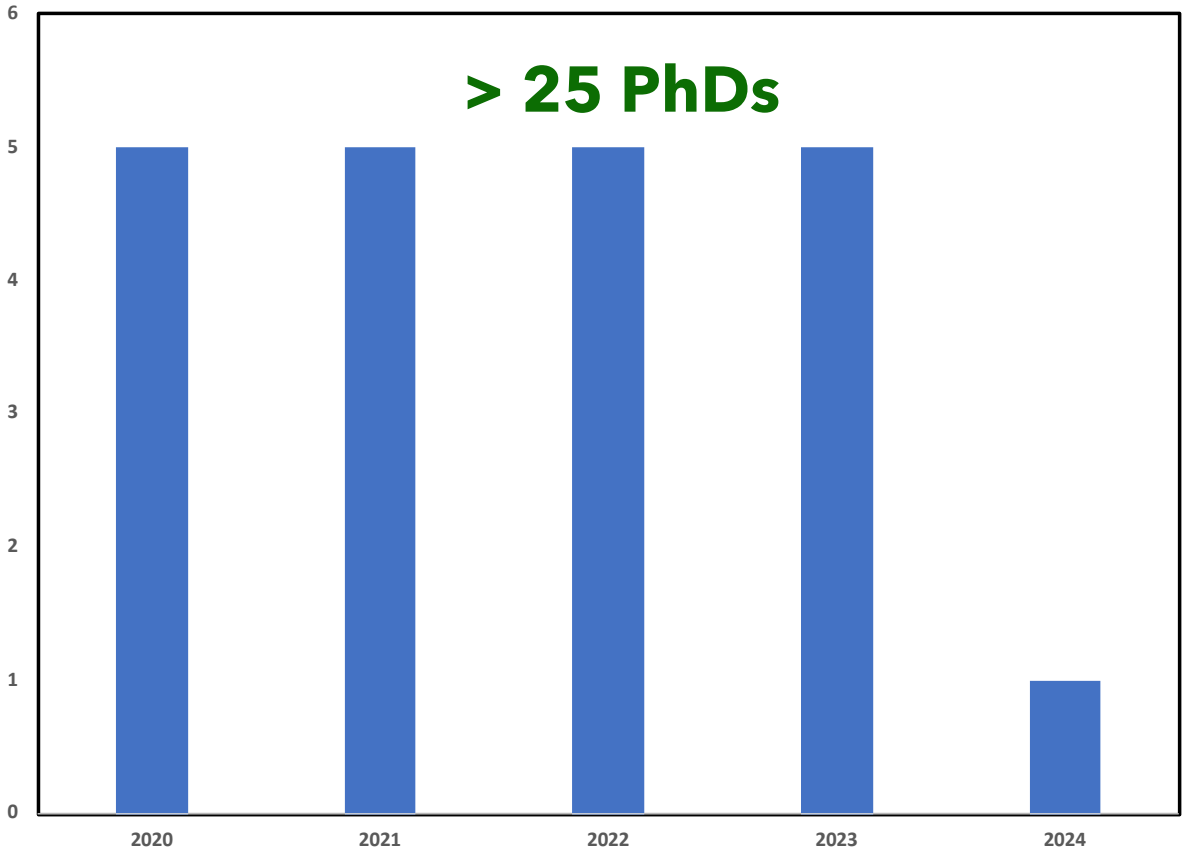

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PRIME MINISTER
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Government of Canada / Gouvernement du Canada

MINISTER OF INNOVATION, SCIENCE AND INDUSTRY
François-Philippe Champagne

HYDROGEN RESEARCH INSTITUTE

Journée Hydrogène Québec

À mettre à votre agenda

12 mars 2024

Amphithéâtre Cogeco, Trois-Rivières

Animé par

Prof. Bruno G. Pollet

Hydrogène Québec

idé Trois-Rivières

IRH INSTITUT DE RECHERCHE SUR L'HYDROGÈNE UQTR

vte Vallée de la Transition Énergétique

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EVÉNEMENT

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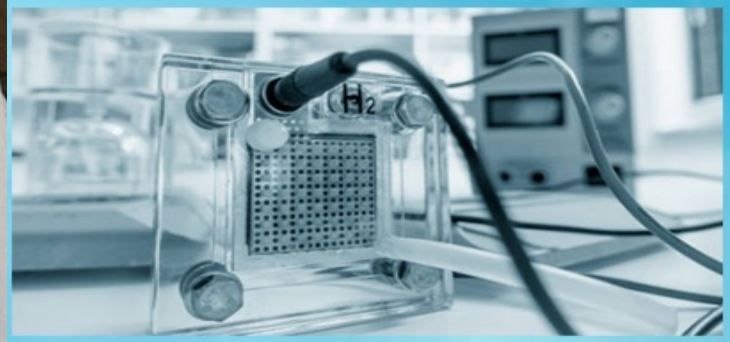

HYDROGEN RESEARCH INSTITUTE

SUPPORTING SLIDES

HYDROGEN RESEARCH INSTITUTE

RESEARCHERS @ HRI

- ✓ **Loïc Boulon**, Co-Director of Internal Management, GEGI, electric vehicles and alternative fuels for new energy vehicles
  - *Canada Chair in Energy Sources for Vehicles of the Future*
  - *Director of the Réseau Québécois sur l'Énergie Intelligente (RQEI)*
- ✓ **Bruno G. Pollet**, Co-Director of Scientific and Partnership Development, CBP
  - *Canada Research Chair in Green Hydrogen Production (focus on PEMWE and AWE)*
  - *INNERGEX Chair on Green Hydrogen Production (focus on AEMWE and DSWE)*
- ✓ **Pierre Bénard**, Département de chimie, biochimie et physique (CBP), Hydrogen safety
- ✓ **Kodjo Agbossou**, Département de génie électrique et génie informatique (GEGI), Intelligent energy systems
  - *Hydro-Québec Chair in Transactional Management of Residential Demand for Power and Energy*
- ✓ **Sousso Kelouwani**, GM, Autonomous Vehicles
  - *Canada Research Chair in Energy Optimization of Intelligent Vehicles*
  - *DIVEL Research Chair for Intelligent Navigation of Autonomous Industrial Vehicles*
- ✓ **Gabriel Antonius**, CBP, Ab-initio development of materials
- ✓ **Maxime Charlebois**, CBP, Ab-initio development of materials
- ✓ **Mihaela Cibian**, CBP, Catalysis and photocatalysis
- ✓ **Jacques Huot**, CBP, Effects of hydrogen on materials, hydrogen embrittlement, cycling/ageing etc
- ✓ **Nassim Noura,** Département de génie électrique et génie informatique (GEGI) Energy management for hybrid systems
- ✓ **Simon Barnabé**, *Membre associé,* CBP
  - *Responsible for partnership and scientific coordination*
  - *Industrial Research Chair in Environment and Biotechnology*
- ✓ **François Allard**, *Associate member*, Unité Mixte de Recherche (UMR), Applied electrochemistry and numerical modeling (focus on HT-fuel cells/electrolysers)
- ✓ **Mamadou Doumbia**, *Associate member*, GEGI, Stationary systems
- ✓ **Samaneh Shahgaldi**, *Associate member*, CBP, PEM fuel cells and electrolysers (materials and MEAs)
- ✓ **Richard Chahine**, *Member Emeritus, Former Director IHR,* GEGI
- ✓ **Yves Dubé**, *Member Emeritus*, GM
- ✓ **Jacques Goyette**, *Member Emeritus*, CBP
  - *Former NSERC Industrial Chair in Hydrogen Storage and Purification*
- ✓ ***Personnel** : 4 professionnels de recherche, 1 technicienne, environ 70 étudiants diplômés*
- ✓ **Jinsheng Xiao**, *Research collaborator*, Université de technologie de Wuhan (Chine), Thermal management of materials-based systems
- ✓ **Alben Cardenas Gonzales**, *Research collaborator,* Département de génie électrique et informatique (GEI)
- ✓ **Christophe Coutanceau**, *Research collaborator*, Université de Poitiers (France), Electrocatalysis
- ✓ **Patrice Mangin**, *Research collaborator,* Département de génie chimique (GCh)
  - *Regional Bioeconomy/Bioenergy Industrial Research Chair*

15 faculty members, 2+3×0.5 research personnel (research officers, research assistants & technicians)

100+ students (electrical/mechanical engineering, energy and material science, chemistry and physics)

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Research Activities in Hydrogen and Energy Technologies

- **Hydrogen production, purification and conversion (B.G. Pollet, S. Shahgaldi, S. Barnabé, S. Natarajan, P. Bénard, F. Allard)**
  - Production of hydrogen from biomass
  - Cheaper and more efficient electrolysis
  - Materials for PEM fuel cells, solid oxide fuel cells and electrolysers (PEMWE, AWE, AEMWE & SOEC)
  - Modular Scale-up of PEMFC, SOFC and electrolysers (PEMWE, AWE, AEMWE & SOEC)
  - Photocatalysis & photoelectrocatalysis
  - Separation and purification: advanced porous materials and system optimisation
  - Metal hydride membranes
- **Hydrogen as a precursor for materials and synthetic fuels (M. Cibian)**
  - Artificial photosynthesis
  - Photocatalysis
  - Power to materials
- **Hydrogen storage and embrittlement (J. Huot, G. Antonius, P. Bénard)**
  - Advanced hydrogen storage research : Advanced materials for physisorption and metal hydride sorption systems
  - Thermal management of hydrogen storage systems
  - Comparative analysis
- **Materials for the transition (G. Antonius, M. Charlebois, P. Bénard, B.G. Pollet, S. Shahgaldi, F. Allard, G. Zhang)**
  - Highly porous materials
  - Numerical design/discovery (*ab initio* quantum methods)
  - Numerical characterization
- **Engineering (L. Boulon, K. Agbossou, S. Kelouwani, M.L. Doumbia, Nassim Noura)**
  - Intelligent energy systems (transport and stationary)
  - Systems engineering
  - Electrical and mechanical engineering
  - Stack development

HYDROGEN RESEARCH INSTITUTE

Expertise:

Fuel cells, Electrolysers, Electrochemistry, Bio- based materials,Nano materials and characterizations

SHAHGALDI RESEARCH

Prof. Samaneh Shahgaldi

Chemical Engineer, Electrochemist
Chemistry, Biochemistry & Physics

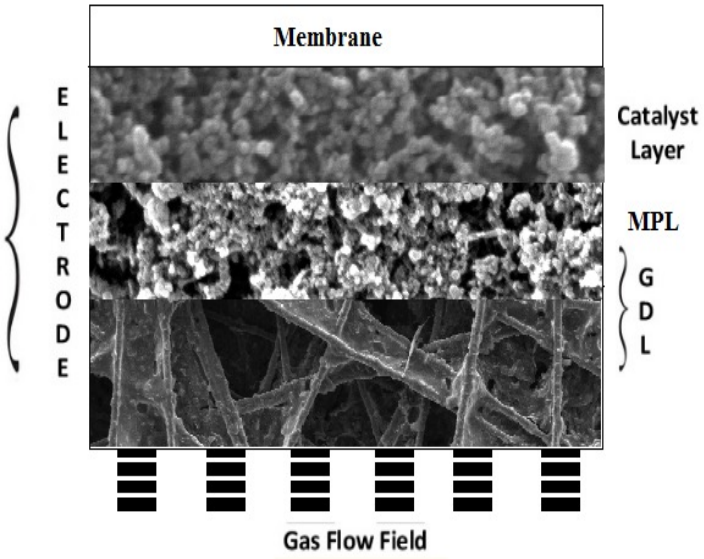
https://www.irh.ca/member/samaneh-shahgaldi/
https://scholar.google.ca/citations?user=_jrfSJ4AAAAJ&hl=en&oi=ao
Samaneh.shahgaldi@uqtr.ca

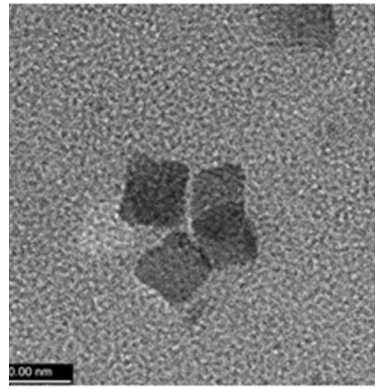
Research interests:

Proton exchange membrane fuel cell and electrolyser
Electrocatalysts and supports
Nanomaterials & Bio-materials
Coating and corrosion

Research description:

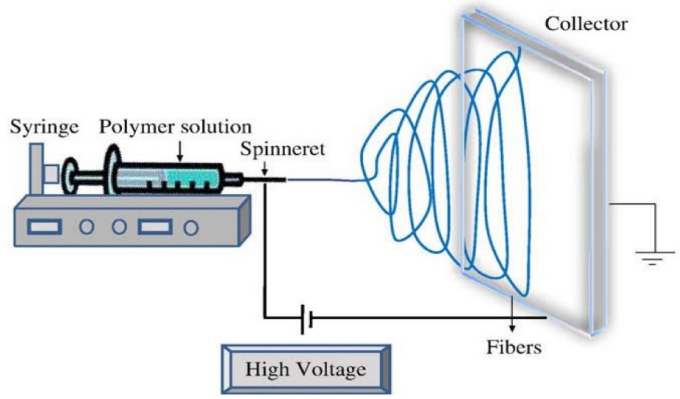
Our research focuses on (i) Development of proton exchange membrane fuel cell and electrolyser components (Catalysts, ionomer, membrane, porous media, bi-polar plate, etc), (ii) Development of shaped catalysts for ORR and OER, (iii) Development of novel membrane electrode assembly based on operational conditions, (iv) Development of Bio-based carbon materials and ionomers





Current funded research projects:

NSERC–CRC 2: Development of Bio-based components for PEM FUEL CELL
Cummins/ Hydrogenic: Development of novel MEA for PEM Water electrolyser
Cummins/ Hydrogenic: Development of novel catalyst layer for PEM FUEL CELL



Main equipment and infrastructures (UQTR + UWaterloo):

Potentiostats, RRDE, EIS, PEMFC- PEMWE test stands, Ultrasonic baths, Tube furnace, Electrospining, Ball milling, Sputtering, Ultrasonic spray, Spray gun, Meyer bar, Porosimeter, Permeability tester,Optical Microscope GC/HPLC/MS/NMR/ICP/UV vis/ PSA/ TEM/ SEM/ XRD/ XPS , Access to Green Energy lab University of Waterloo

HYDROGEN RESEARCH INSTITUTE

Expertise:

Fuel cell systems, energy management systems, altitude and compressor impact on energy consumption of hybrid fuel cell systems.

Research interests:

Design and optimization of hybrid fuel cell systems with a focus on fluid management, active droplet microfluidic systems.

Research description:

Design and optimization of energy efficiency of electric vehicles by considering fluid management.
Development of a digital-twin-supported droplet microfluidic open-source untethered platform.

Current funded research projects:

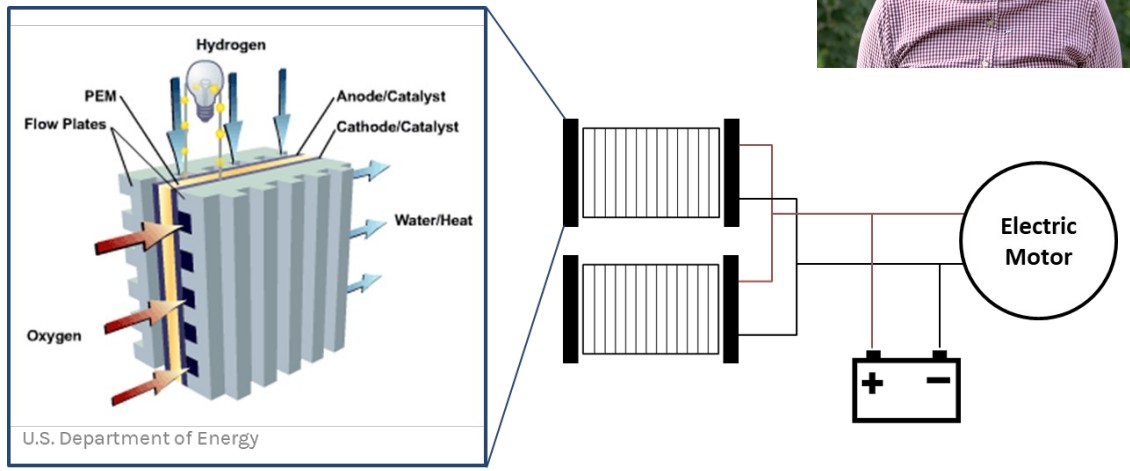
MITACS: Impact of Hydrogen Flow Regulation and Degradation on the Performance of a Hybrid Fuel Cell Multi-Stack Airship

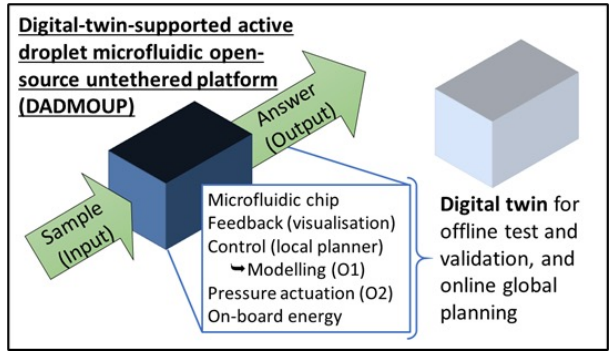
Main equipment and infrastructures:

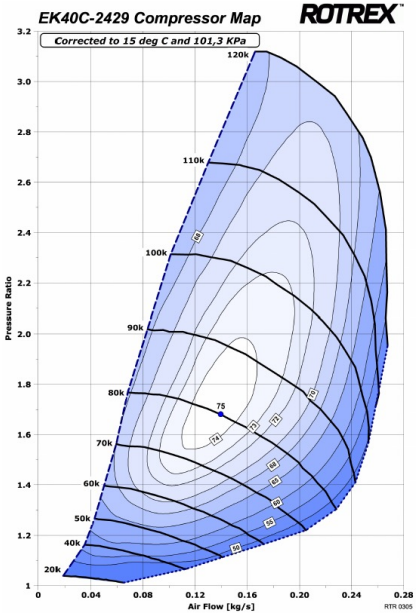
Master and microfluidic chip fabrication station.

Prof. Marie Hébert, ing., Ph.D.

Mechanical Engineering Department
Google Scholar Profile
marie.hebert@uqtr.ca







HYDROGEN RESEARCH INSTITUTE

Expertise:

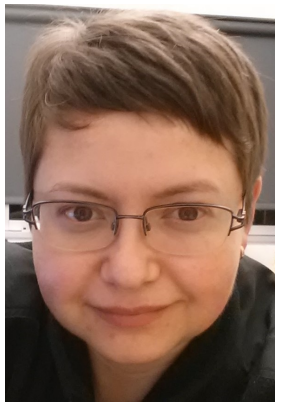
Inorganic/ Coordination Chemistry; Photophysical and redox properties of coordination compounds; XRD (small molecules); Molecular photocatalytic systems for CO_2 reduction and H_2 production

Prof. Mihaela Cibian

Chemistry, Biochemistry & Physics Department

www.irh.ca/research/materials-science/mclab

mihaela.cibian@uqtr.ca

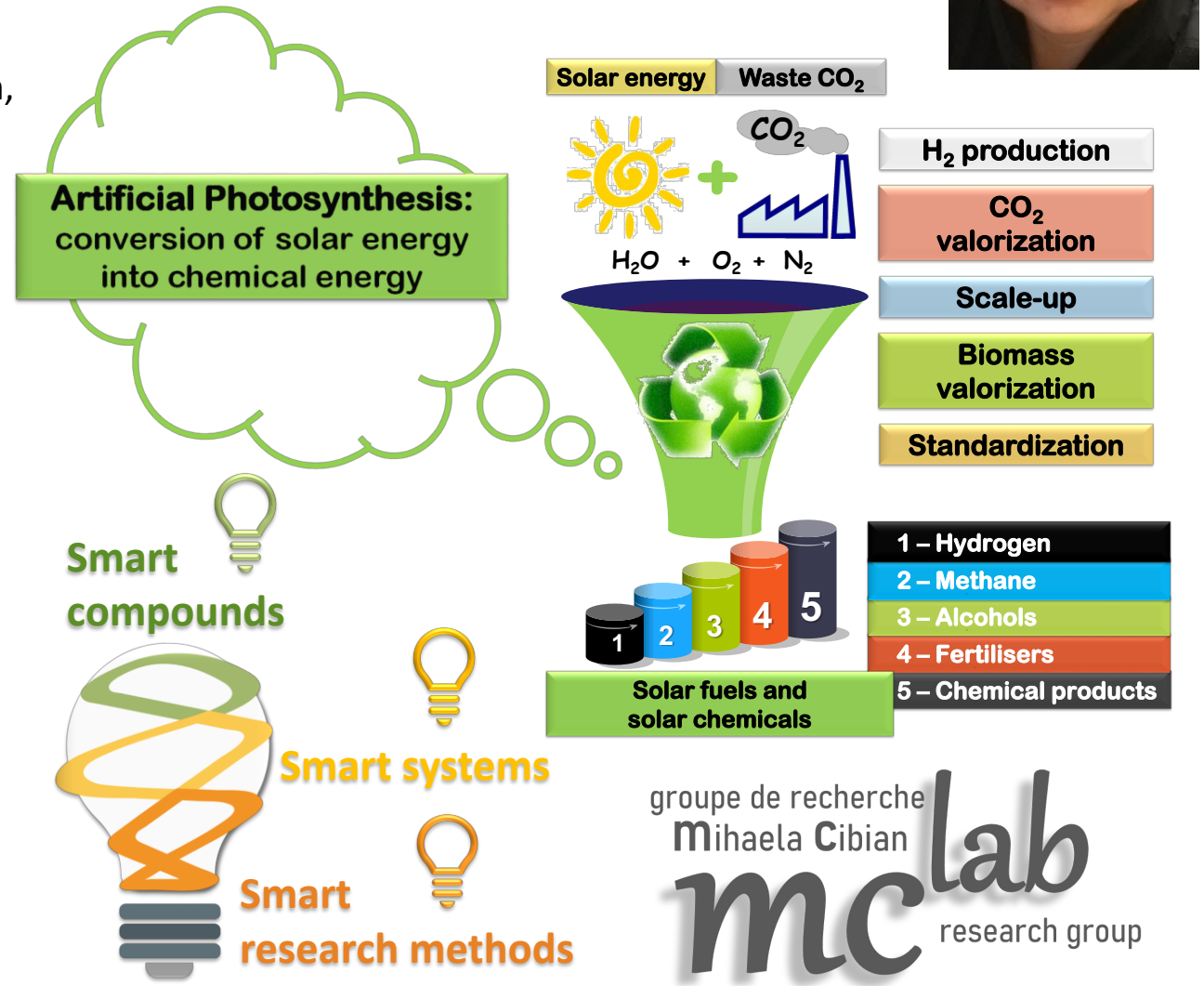


Research interests:

Artificial photosynthesis methods with focus on solar fuels and energy conversion applications as well as on production, purification, use and recycling of advanced materials and critical and strategic minerals.

Research description:

Smart (Chemistry) Tools and Strategies (S(C)TS) for development of smart compounds, systems and research methods, to address the lack of regeneration/ (auto)protection/ (auto)correction features in the artificial systems vs. the successful natural ones, in which they are key (e.g., natural photosynthesis).



Current funded research projects:

NSERC-Discovery: Smart Compounds, Systems and Research Methods in Artificial Photosynthesis

QCAM Interinstitutional Collaboration Research

Main equipment and infrastructure:

-UQTR & IRH infrastructures

-Access to UdeM, INRS and QCAM network infrastructures

HYDROGEN RESEARCH INSTITUTE

Prof. François Allard

INRS-UQTR Joint Research Unit in Energy Transition
Materials and Technologies
https://inrs.ca/en/research/professors/francois-allard/
francois.allard@inrs.ca

Expertise:

High-temperature electrochemistry; Electrometallurgy
Energy storage and conversion; energy materials;
Numerical modeling of electrochemical systems

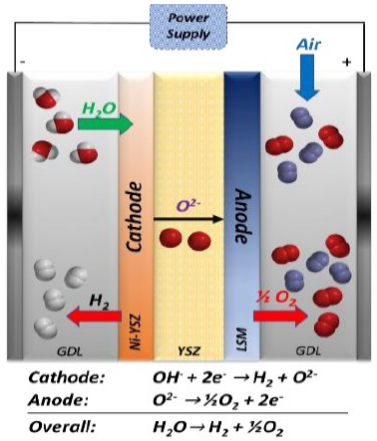
Research interests:

Solid-oxide electrolysis cell (SOEC) and fuel cell (SOFC); Electrolysis of metals; Lithium batteries; Metallic electrodes; Heat and mass transfer modeling; **Electrochemical cell modeling**; finite element analysis (FEA)

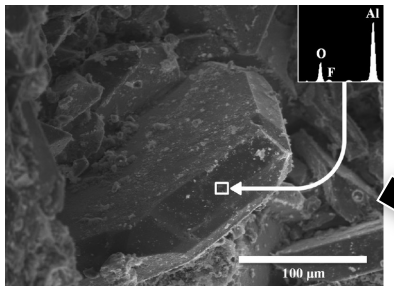
Research description:

Our research focuses on (i) **production and conversion of "green" hydrogen by high-temperature electrochemistry** and numerical modeling to support the development of technologies and materials and (ii) **researching and improving materials for energy storage, batteries, and electrolysers** using electrometallurgy and high-temperature processes.

SOEC

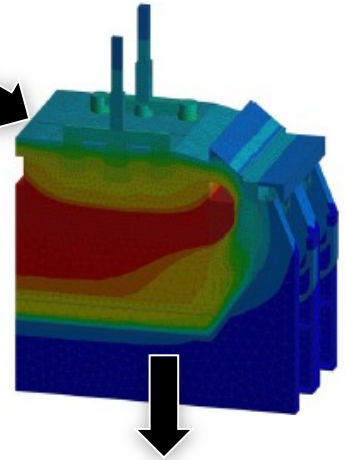


1. Materials characterization

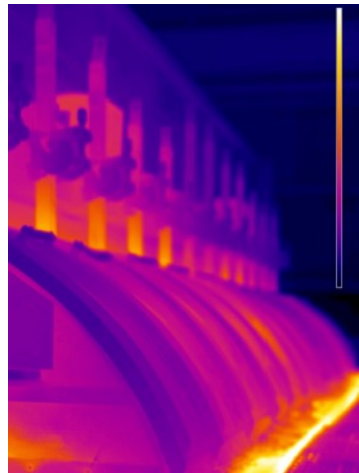


α-Al_2O_3 in solidified Na_3AlF_6

2. Numerical modeling



3. Industrial validation



Inert workstation

Electrochemical testing systems

Current funded research projects:

- Professor recently arrived at the IHR (2022)
- Research contract related to lithium metal batteries (2022)
- Seeking R&D projects in the field of technologies and materials for sustainable and economical development of energy storage and conversion systems

Main equipment and infrastructures:

- Electrometallurgy: Inert workstation for handling air-sensitive materials, high-temperature furnaces, equipment for synthesizing and handling electrodes materials
- Electrochemistry: electrochemical potentiostat, battery and fuel cell testing systems
- Access to INRS and UQTR characterization centres: XRD, SEM-EDS, TEM, XPS, DSC, ICP, GC, HPLC, etc, and access to numerical modeling software (ANSYS, COMSOL, FactSage)

HYDROGEN RESEARCH INSTITUTE

Prof. Phuong Nguyen-Tri

Chemistry, Biochemistry and Physics department

https://nguyen-trilab.ca/
Phuong.Nguyen-Tri@uqtr.ca

NGUYEN-TRI LAB

Expertise:

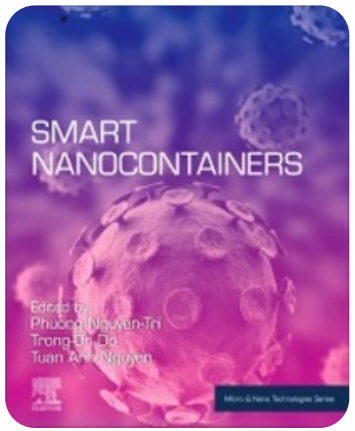
Green chemistry, Nanomaterials, Surface chemistry, Crystallization

Research interests:

Valorization of biomass, Nanomaterials for energy and the environment, Crystallisation and nanostructure of polymers, Smart textiles and devices

Research description:

Our research focuses on i) Conversion of biomass into useful products ii) Surface chemistry of polymers and natural fibers; iii) Development of multifunctional composites with special end-used properties ; iv) investigating the nanostructuration of the biodegradable, renewable polymeric materials by advanced characterization methods.

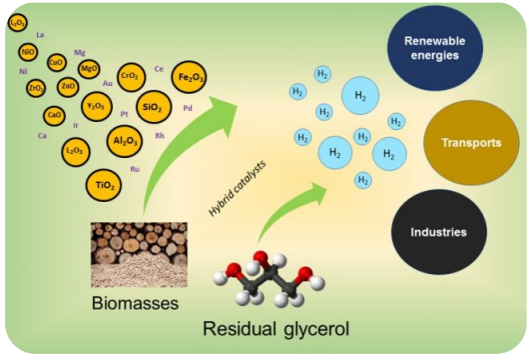


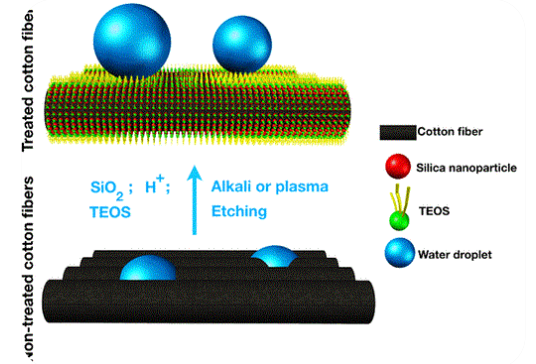
Current funded research projects:

20 projects funded by NSERC (Discovery, Alliance), IRSST, FRQNT, CREPEC, CQMF, Hydro-Québec, NanoBrand Inc, Helix Inc., MaxiDrain Inc.,

Main equipment and infrastructures (UQTR + xxx):

AFM, Polarized microscopes, 3D confocal microscope, CVD Tube Furnace with Gas Mixing and Pumping System, Electrospinning System, Ozone Test Chamber, LED Photoreactor, Dip-Coating and Spin-coating system, plasma etching system, Autolab Workstation, Ultrasonic bath, incubator, autoclaves, UVP lamp, etc.
Access to many different facilities : I2E3, UDEM, Innofibre





HYDROGEN RESEARCH INSTITUTE

Expertise:

Smart grid technologies, power and energy systems, demand-side management, distributed energy resources, and transactive energy markets.

Research interests:

Integration of distributed renewable energy resources, energy storage systems (hydrogen & batteries), home automation, and transactional energy management.

Research description:

Modeling and integration of renewable energy resources, energy storage, and demand-side assets (electrical vehicles & appliances) in the context of transactive energy systems using mathematical optimization and machine learning.

Current funded research projects:

Hydro-Québec research chair on transactive management of power and energy in the residential sector, chair of the smart energy research and innovation laboratory, UQTR.

Main equipment and infrastructures:

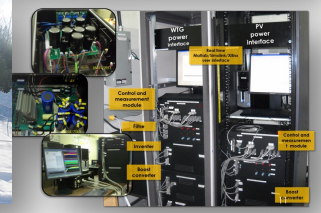
Hydrogen station, battery charging station, hydrogen and electric vehicles, renewable energy infrastructures (wind & solar), micro-grid simulator, and smart experimental house.

Prof. Kodjo Agbossou

Ing., Ph.D., MS.IEEE

Chairholder, Hydro-Québec Research TMPERS
Electrical and Computer Engineering Department,
Institute for Hydrogen Research

http://www.lirei.ca
kodjo.agbossou@uqtr.ca



NSERC CRSNG · Hydro Québec · LIREI · FONDATION UQTR

Storage/Safety

Prof. Pierre Bénard

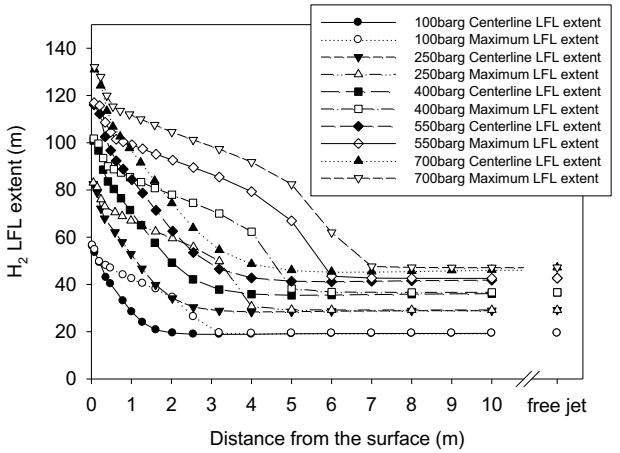
Chemistry, Biochemistry & Physics Department

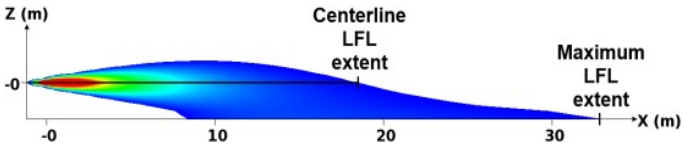
Pierre Bénard - Hydrogen Research Institute (irh.ca)

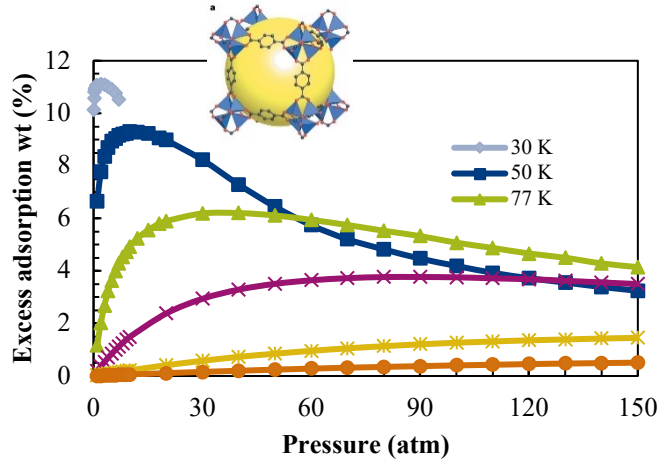
pierre.benard@uqtr.ca

HYDROGEN RESEARCH INSTITUTE

- **Background:** Statistical physics and thermodynamics modeling / Many-body theory of quantum materials
- **Safety:**
  - Context: Hysafe, IEA TCP tasks 19, 31
    - TCP: Technical collaboration programme
  - Effects of obstacles on the flammable extend of hydrogen jets
    - HSL(HSE) Buxton, KIT, Valcartier – (ICHS 2023 in Québec)
  - CFD/fluid mechanics studies of specific contexts (mining, dispensing facilities)
  - Development of reduced models / correlations for safety analysis
  - Toolbox for hazard analysis
    - IEA TCP Task31, KIT, Sandia National Labs
- **Storage/Purification and Separation:**
  - Multiscale approach
  - Quantum Grand canonical Monte Carlo simulation of hydrogen adsorption on nanostructured microporous adsorbents (MOF 5, SWNT, layered graphene)
  - Development of isotherm models (equation of state for adsorption over wide T, P ranges)
  - Thermodynamic modeling of storage and purification systems CFD simulations of storage systems Final thermodynamic state of fast filling of high-pressure storage systems







HYDROGEN RESEARCH INSTITUTE

Expertise:

Thermo-energy optimization of : electric vehicle (EV), fuel cell vehicle (FCV), hybrid electric vehicle (HEV, intelligent and autonomous vehicle (IAV), fleet of fuel-cell vehicles.

Research interests:

Systemic optimization of low carbon footprint intelligent vehicles (battery electric vehicle, fuel cell vehicle, hybrid vehicle).

Research description:

Design and optimization of energy efficiency of electric vehicles by considering the driver behaviour, difficult weather (sliding in winter), energy source thermo-efficiency map. Design of energy efficient autonomous navigation systems.

Current funded research projects:

Canada Chair, NSERC Alliance Grant, MITACS, NSERC Discovery Grant, NSERC Acceleration Grant, Transition énergétique Québec, Noovelia, Fondation UQTR.

Main equipment and infrastructures:

Kia Soul EV, Toyota Mirai FCV, Hybrid fuel cell & battery test bench for autonomous vehicles, hydrogen genset.

Prof. Sousso Kelouwani

Ing., Ph.D., MS.IEEE

Chairholder, Canada Chair on energy optimization of intelligent transportation systems

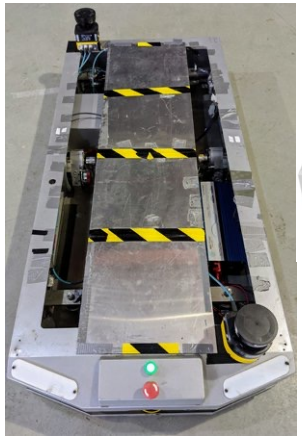
Chairholder, Noovelia-NSERC Industrial Chair on intelligent navigation of industrial autonomous vehicle

Mechanical Engineering Department,

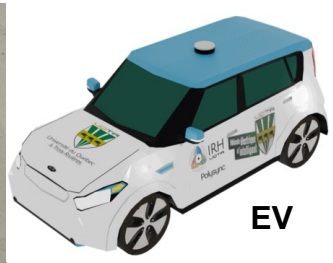
Institute for Hydrogen Research

Autonomous and Electric Vehicles - AutoEV - Hydrogen Research Institute - Hydrogen and Energy Efficiency (irh.ca)

Sousso.kelouwani@uqtr.ca



IAV



EV

FCV

HEV

Transition énergétique Québec

NSERC CRSNG

noovelia

Chaires de recherche du Canada Canada Research Chairs

Canada

FONDATION UQTR

LIREI

HYDROGEN RESEARCH INSTITUTE

Prof. Loïc Boulon

Electrical Engineering Department

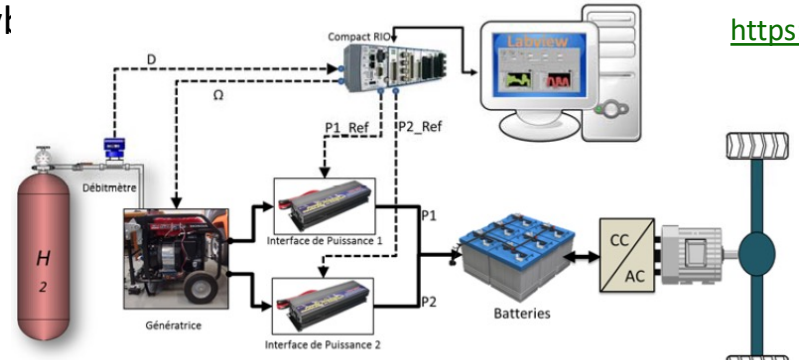
https://www.irh.ca/member/loic-boulon/
loic.boulon@uqtr.ca

Expertise:

Fuel cell systems; batteries;
Design, control and management of hyb
systems.

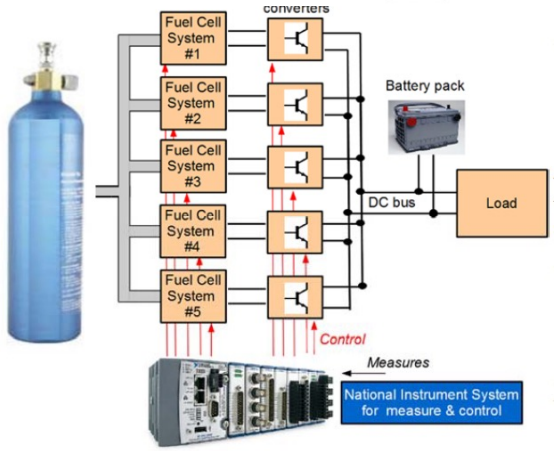
Research interests:

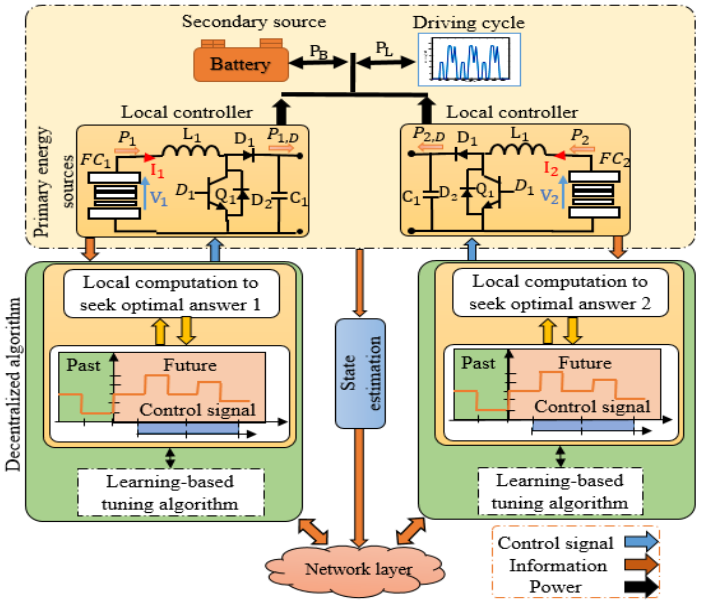
Modular and scalable systems;
Operation in cold climate conditions;
Vehicular and stationnary applications.



Research description:

Our Research focuses on the hardware and software design of hydrogen-based systems. A special attention is put on the suitability for the climatic (winter), economic (SMB, tier one supplier, utilities, etc) and geographic (far north remote areas) Canadian contexts.





Current funded research projects:

Senior Chair in Energy Sources for the Vehicles of the Future;
ICE based vehicle conversion to H2 technologies;
Battery pack design (2nd life).

Main equipment and infrastructures:

Fuel cell test benches, programmable AC & DC load (up to 10kW), thermal chamber (down to -40°C), various fuel cell systems and battery packs, various National Instrument data acquisition and control systems.

HYDROGEN RESEARCH INSTITUTE

Expertise:

Power electronic conversion for hydrogen systems;
Photovoltaic and wind Renewable energy sources.

Research interests:

Hydrogen production from renewable energy sources;
Power electronic converters for hydrogen systems.

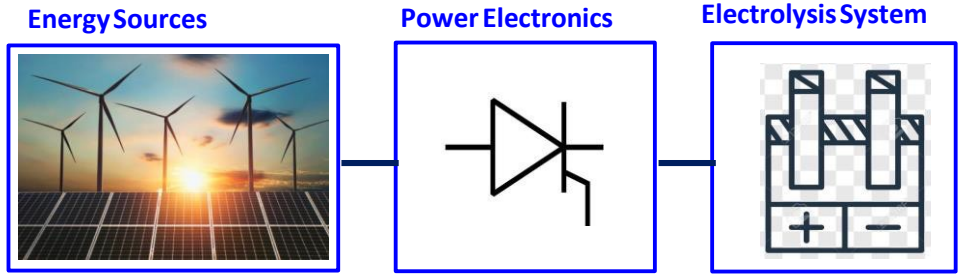
Prof. Mamadou L. Doumbia, Ing. Ph.D.

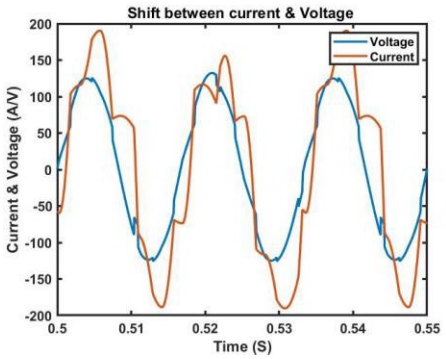
Electrical and Computer Engineering Department
www.genieelectrique.ca
www.grei.ca
Mamadou.doumbia@uqtr.ca

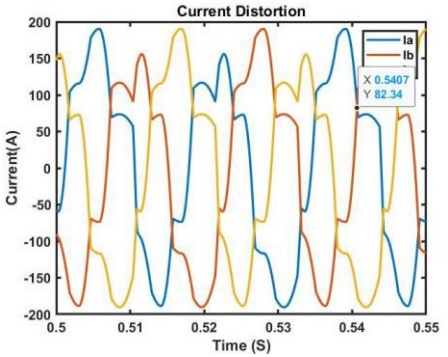
GREI Groupe de recherche en électronique industrielle

Research description:

Our research focuses on: (i) Power electronic converters design for hydrogen based systems; (ii) Investigation of the impact of power electronic converters on systems stability, flexibility, performance, and lifetime, particularly regarding the power quality and harmonics distortion; (iii) Variable renewable energy sources for hydrogen production; (iv) System design and simulation, definition of testing methods to conduct performance analysis of existing/new power electronic components and TEAof electrical systems.







Current funded research projects:

- MITACS: Power quality and performance analysis of power electronic components for water electrolysis hydrogen production system (end 2023);
- MITACS: A Simulation Tool for Power Quality of Electric Submersible Pumps (ESP-PQST) (end 2025).

Main equipment and infrastructures

- Power Electronic Converters Test Bench;
- Adjustable Speed Drives Test Bench;
- Electrical Energy Conversion and Power Quality Research Lab

HYDROGEN RESEARCH INSTITUTE

Expertise:

Hydrogen storage, metal hydrides, gaz-solid interactions, material characterization, neutron diffraction, hydrogen embrittlement

Prof. Jacques Huot

Department of Chemistry, Biochemistry and Physics
Hydrogen Research Institute

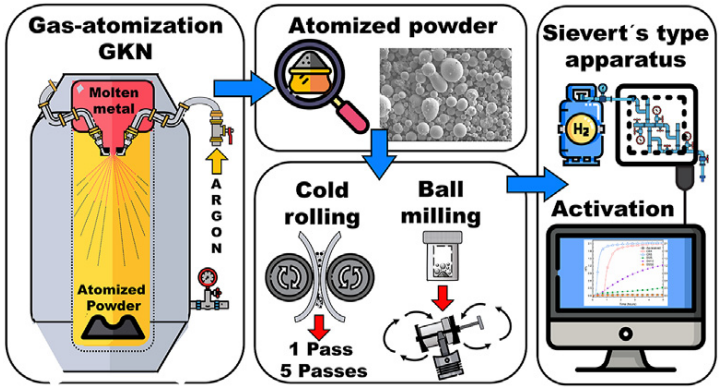
https://www.irh.ca/member/jacques-huot/Jacques.huot@uqtr.ca

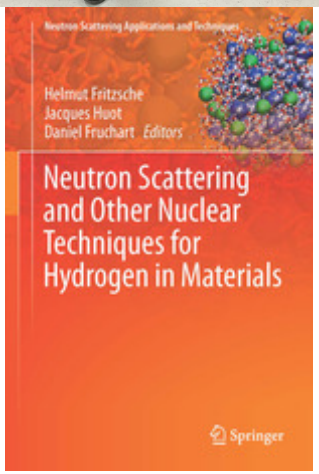
Research interests:

New metal hydrides, effect of mechanical deformations on metal hydrides, High entropy alloys, hydrogen embrittlement.

Research description:

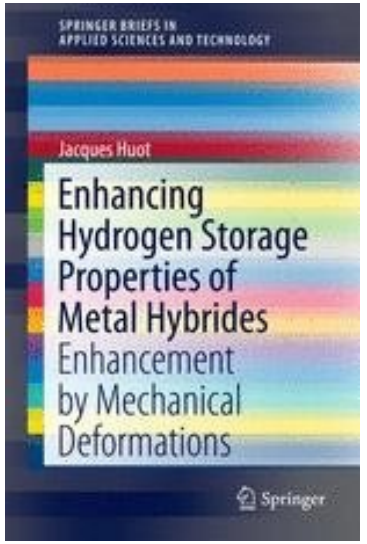
Development of low-cost metal hydride (TiFe).
Study of hydrogen embrittlement in steels.
Effect of mechanical deformations on metal hydrides.
High entropy alloys for hydrogen storage.

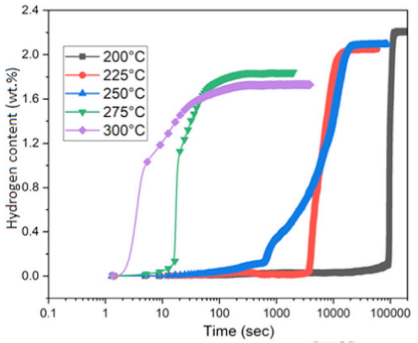




Current funded research projects:

NSERC discovery grant, Quebec-Israël grant, Quebec-South Korea grant, Quebec-India grant. MITACS grants





Main equipment and infrastructures (UQTR)

XRD, Hydrogen titration systems, DSC under hydrogen, Potentiostat/galvanostat, Devanathan-Stachuski cell, SEM, EDS

HYDROGEN RESEARCH INSTITUTE

Expertise:

Simulations, density functional Theory (DFT), solid state physics, chemistry, phonons, electron dynamics, excited states phenomena

Prof. Gabriel Antonius

Chemistry, Biochemistry & Physics Department

www.irh.ca/research/materials-science/materials-simulation/

gabriel.antonius@uqtr.ca

Research interests:

Hydrogen storage materials; Catalysts for hydrogen production; Molecular catalysts Batteries & supercapacitors; Photosensitizers; Low-dimensional materials

Research description:

Our group assists the development of novel materials though numerical simulations. We focus on materials for energy storage and hydrogen production. These include molecular and solid-state catalysts for the production of and conversion of hydrogen, metal hydrides for the storage of hydrogen, and electrode materials for the storage of electricity in batteries and supercapacitors.

Current funded research projects:

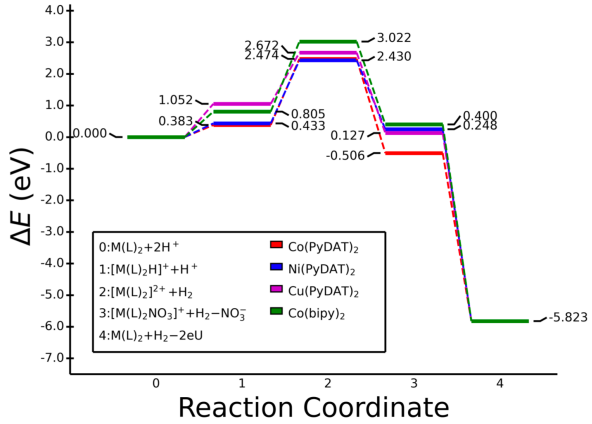
NSERC-Discovery: Electron-phonon coupling phenomena in low-dimensional materials

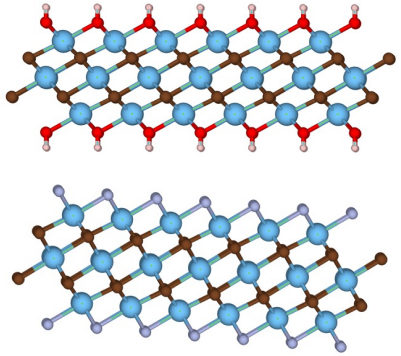
RQEI: Catalyst materials for hydrogen production

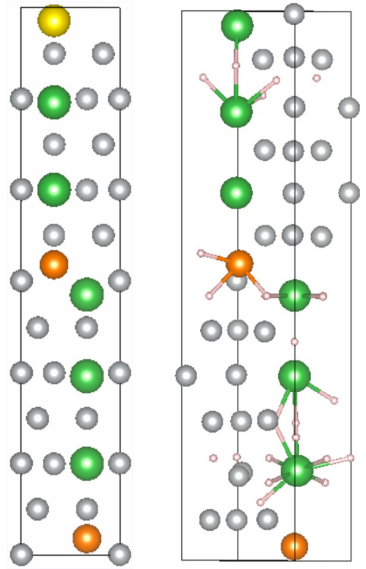
Main equipment and infrastructure:

compute • calcul CANADA

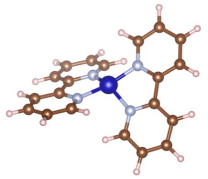
Calcul Québec



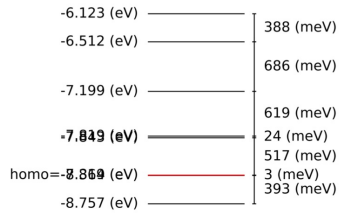




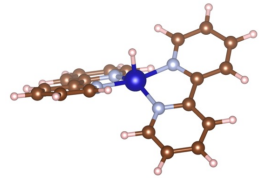
$[Co(bpy)_2]^{+2}$



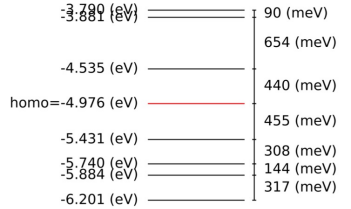
etot=8.845 eV



$[Co(bpy)_2H]^{+}$



etot=−12.155 eV



HYDROGEN RESEARCH INSTITUTE

Expertise:

Simulations, Modelling, Energetic Macroscopic Representation (EMR), Energy management strategies, Real time performance estimation for energy sources monitoring (BMS, Thermal management, etc.)

Research interests:

Power distribution in Hybrid automotive systems, Real time battery performances estimation under extreme operating conditions, Cross-sector partnerships for the energy transition

Research description:

Our research focuses on the modeling, the simulation and the experimental testing of hybrid energy sources for automotive applications. On another hand, we develop strategic cross-sector partnerships to design an efficient academic « **energy transition** » program

Current funded research projects:

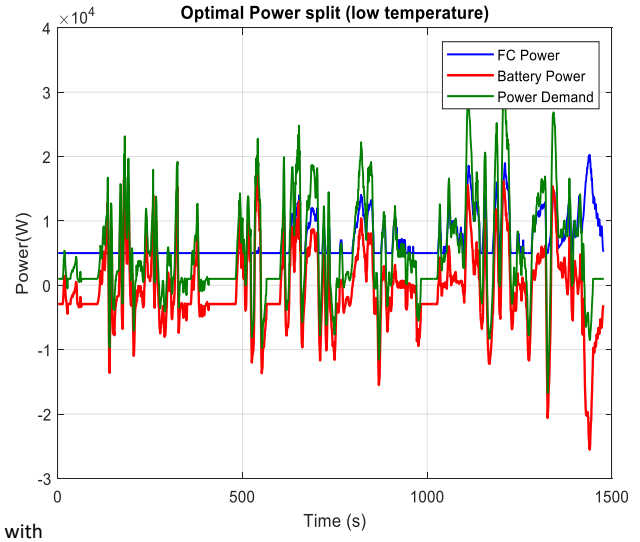
MES : The optimization of the academic « energy transition » program to address the current labor shortage.
MELCCFP- RQEI – Escouade Énergie : Collaboration agreement for the structuring of the green hydrogen and bioenergy sectors in Québec

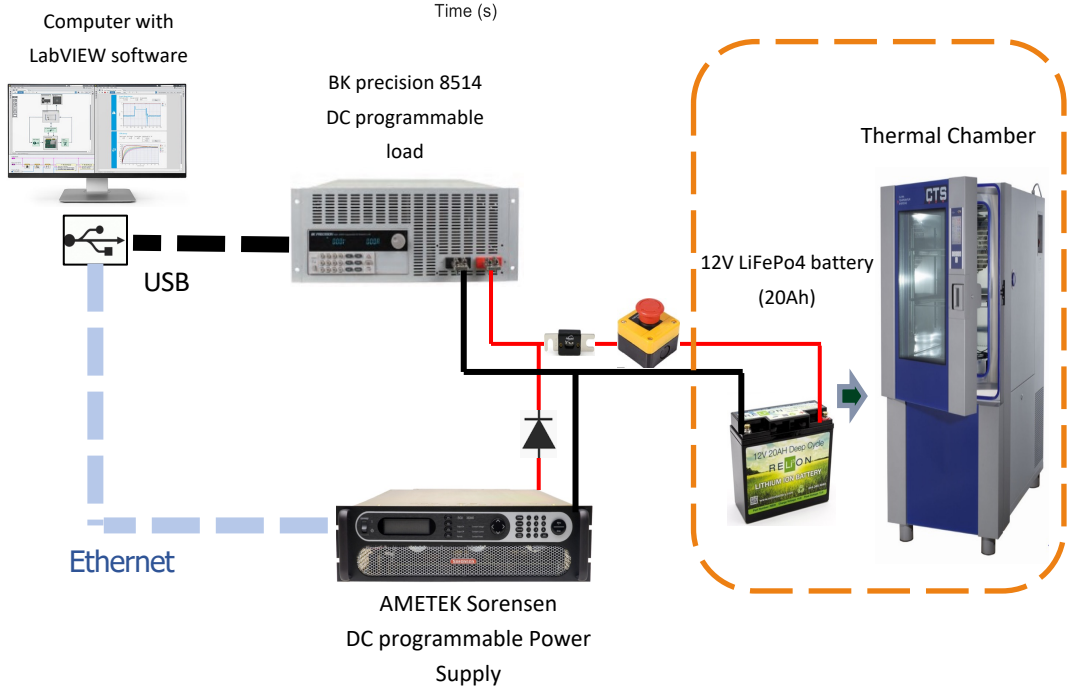
Main equipment and infrastructure:

Fuel cell + battery test benches, programmable AC & DC load (up to 10kW)

Prof. Nassim Noura

Electrical and computer engineering department
linkedin.com/in/nassim-noura-phd-81390489
nassim.noura@uqtr.ca





HYDROGEN RESEARCH INSTITUTE

Prof. Martin Bolduc

Mechanical Engineering Department
linkedin.com/in/martin-bolduc-6a257027
Google Scholar https://g.co/kgs/yv4xKT2
martin.bolduc2@uqtr.ca

Expertise:

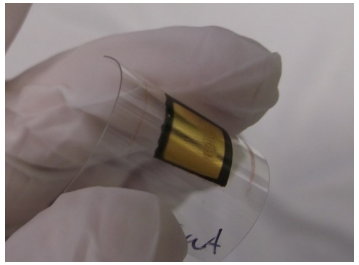
Smart Sensors; Flexible Hybrid Electronics; Printable Materials; Photonics Processing; Laser-Material Interactions; Modeling; Micromachining; Opto-Mechanical Testing; Thermodynamics

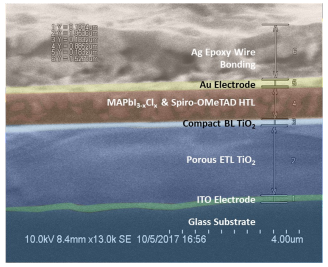
NSERC Green Electronics Network

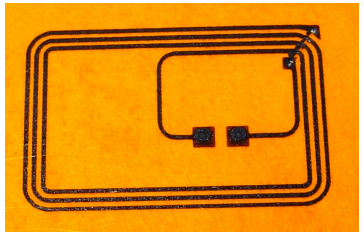
intelliFLEX INNOVATION ALLIANCE

Research interests:

Eco-Friendly Printable Materials for Flexible Smart Sensors and Batteries

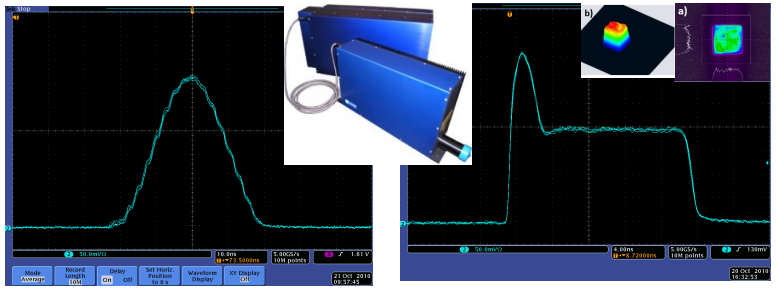






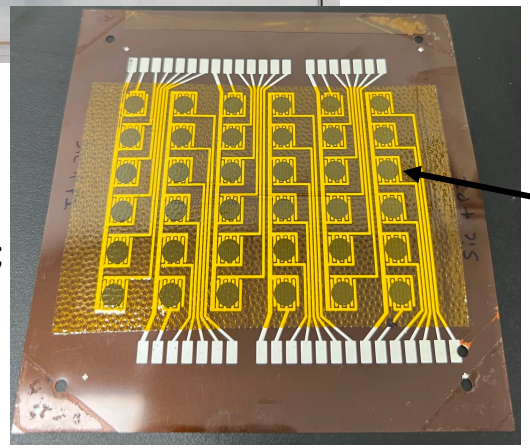
Research description:

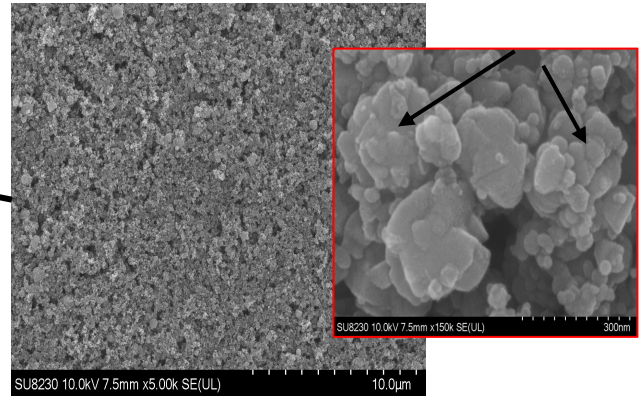
NSERC Discovery Research Program - Development of novel approaches in the fabrication & integration of printed materials for flexible sensors



Current funded research projects:

Canada CFI - Hybrid Integrated Systems
NSERC Alliance - Flexible Sensors for Disruptive IoT & RFID
NSERC CREATE - Advanced Materials Microfabrication
NSERC Strategic Partnership - Green Electronics GreEN
MITACS - Printed Metamaterial Lenses
MITACS - Demonstration of an intelligent sport sensor





Main equipment and infrastructures:

Nanosecond Pulsed Laser with Micromachining Scanning Platform; Inkjet & Aerosol-jet Printers; Opto-Mechanical Tester for Flexible Hybrid Electronics; Plasma Systems for Surface Treatments; Oven Reflow System; Photonic Flash-lamp for Post-Treatment

HYDROGEN RESEARCH INSTITUTE

Expertise:

National Research Council Canada | Conseil national de recherches Canada | INNERGEX | INNOVATION.CA | Québec

Fuel Cells; Electrolysers; Electrochemistry; Sono(electro)chemistry; Energy materials

Prof. Bruno G. Pollet FRSC

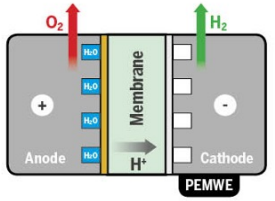
Chemistry, Biochemistry & Physics Department

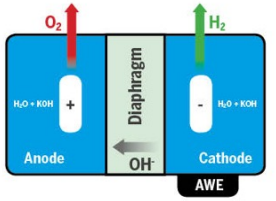
www.irh.ca/member/bruno-g-pollet/

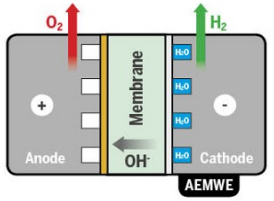
bruno.pollet@uqtr.ca

Research interests:

Low-temperature fuel cells (PEMFC & AEMFC) & electrolysers (PEMWE, AEMWE, AWE & SWE); Electrocatalysis; OER; HER; ORR; HOR; N2RR; CO2RR; Power ultrasound; Sonochemistry; Sonoelectrochemistry; System integration; Prototyping

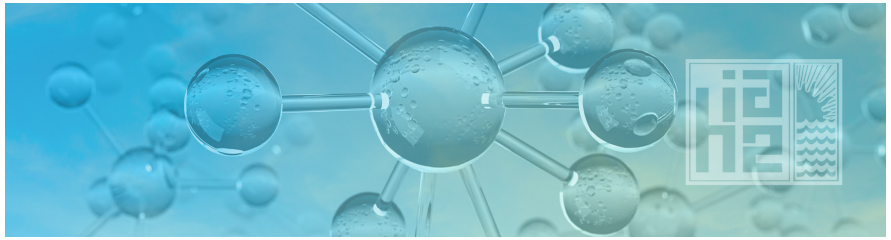




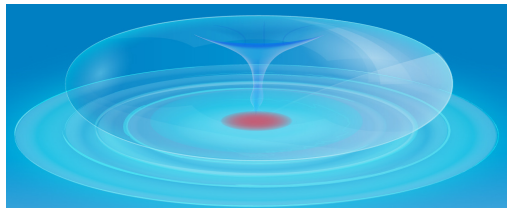


Research description:

Our research focusses on (i) the use of ultrasound for the generation of hydrogen & other value-added products from pure, waste and saline waters as well as organics based on biomass, and (ii) the production of novel hydrogen storage, electrolyser and fuel cell materials, e.g., metal hydrides, (non-) PGM electrocatalysts and electrodes



GREEN H_2YDROGEN LAB UQTR

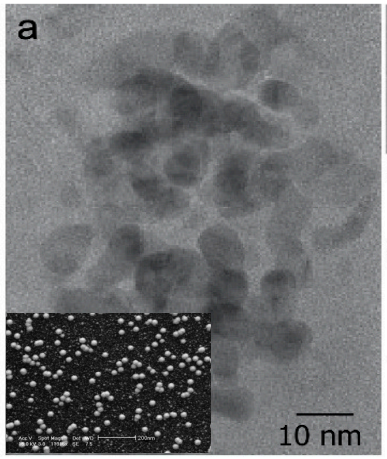


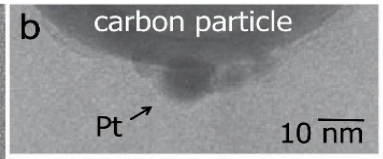
Current funded research projects:

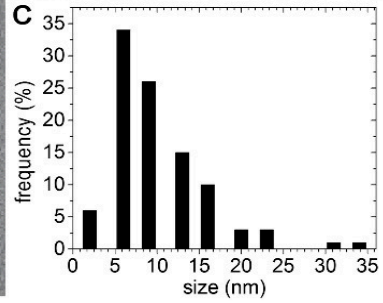
-NSERC CRC 1: *Green Hydrogen Production* (end: 2028)

-Innergex/MEI: *Green Hydrogen Production* (end: 2026)

-RCN SANOCEAN: *Probing the electronic properties of nickel oxide (NiO) as electrocatalyst for renewable and sustainable electrolytic hydrogen production* (end: 2024), and other projects related to electrolyser materials & systems







Main equipment and infrastructures (UQTR + NTNU):

-Electrochemistry: Potentiostats, RRDE, EIS & PEMFC-WE/A(EM)WE test stands

-Ultrasonic: Ultrasonic baths, ultrasonic probes & sonoreactors

-Analytical/Physical: GC/HPLC/MS/NMR/ICP/UV-vis/PSA/TEM/SEM/XRD/XPS etc

-Access to several infrastructures: $0.5m GreenH2Lab, $2m UMR, $5m HRI etc

JOINT WORKSHOP

Sustainability of Hydrogen Technologies

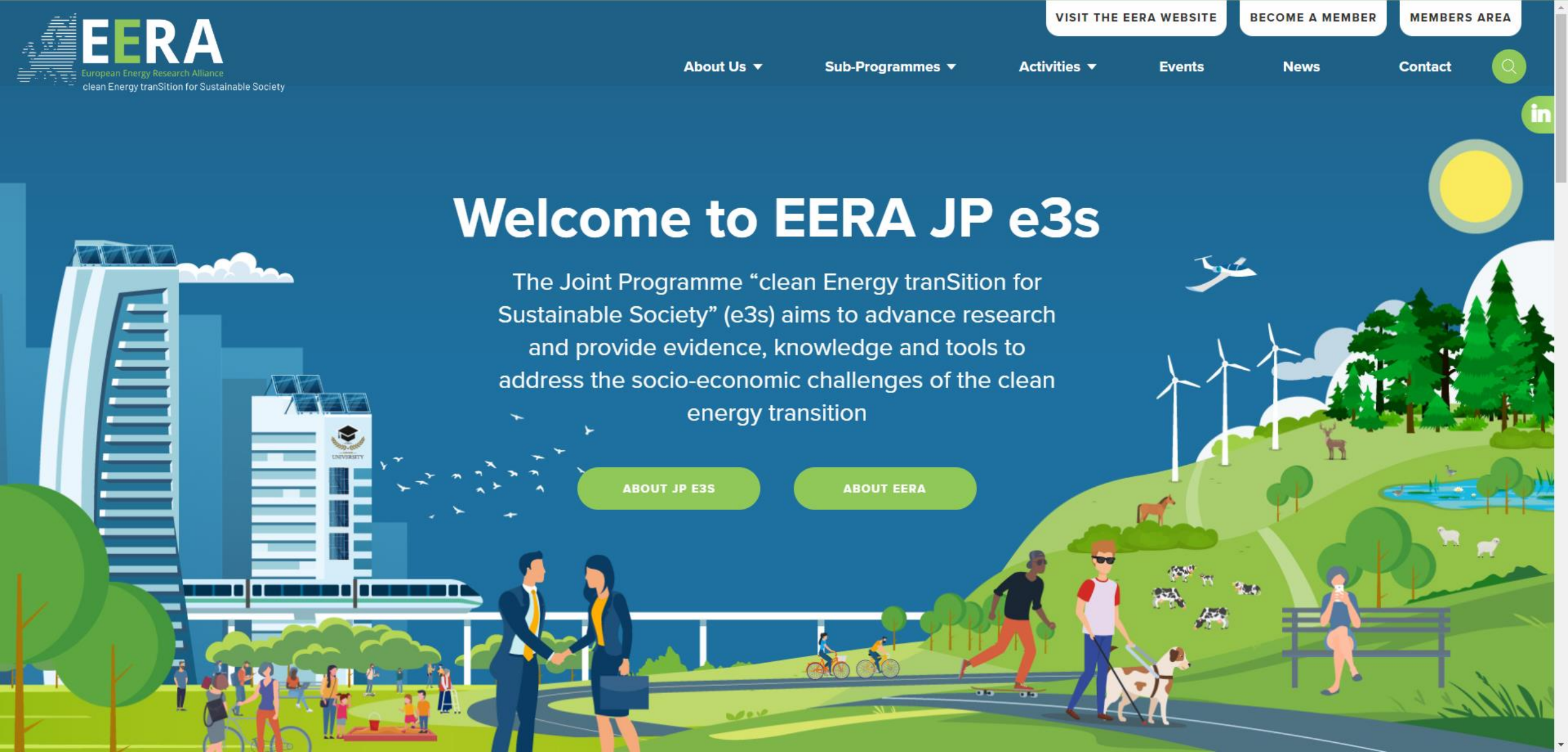
Marcello Baricco, Alessandro Sciullo

University of Turin, Torino, Italy

Starting point

- Request from ExCO to promote connections among JPs
- Relevance of hydrogen technologies in the next future
- Need of evaluations of possible impacts of hydrogen technologies on the society

https://www.eera-fch.eu/



https://www.eera-e3s.eu/

Contents

- Summary of Hydrogen Technolgies (JP FCH)
- Summary of Sustanability (JP E3S)
- Possible impacts of Hydrogen Technogies (JPs FCH-E3S)
  - Environmental Impacts
  - Economic Impacts
  - Social Impacts
- Actions necessary to manage hydrogen in the energy transition
  - Technological aspects (JP FCH)
  - Socio-economic aspects (JP E3S)

Scheme

- Joint workshop on “Sustainability of Hydrogen Technologies”.
- Invited lectures
- Possible contributions from participants (tbd)
- Possible publications (tbd)
- Duration: half a day – one day
- Date: March 2025
- Location: Torino or Bruxelles (EERA office)

Next steps

Formation of a **small working group** with **a main contact** person for JP and **a couple of support** members.

1. by the end of April 2024, half a page to clarify (even in a rough way) the themes of the event
2. by the end of May 2024 (based on 1) internal call to the JPs to form the small group
3. from June 2024, kick off of the activity to start discussing about the organization of the event
4. In Autumn 2024, call for abstracts, for contributions, internal to EERA and/or open externally
5. Event in March 2025

Side activites

- Possibly join the Worshop with an “in presence” Governing Board Meeting for both JPs (or al least for one of them).
- Strategies to engage people from the JPs
- External impacts: IEA, CHP, H2 working groups, etc.
- Communication - Social