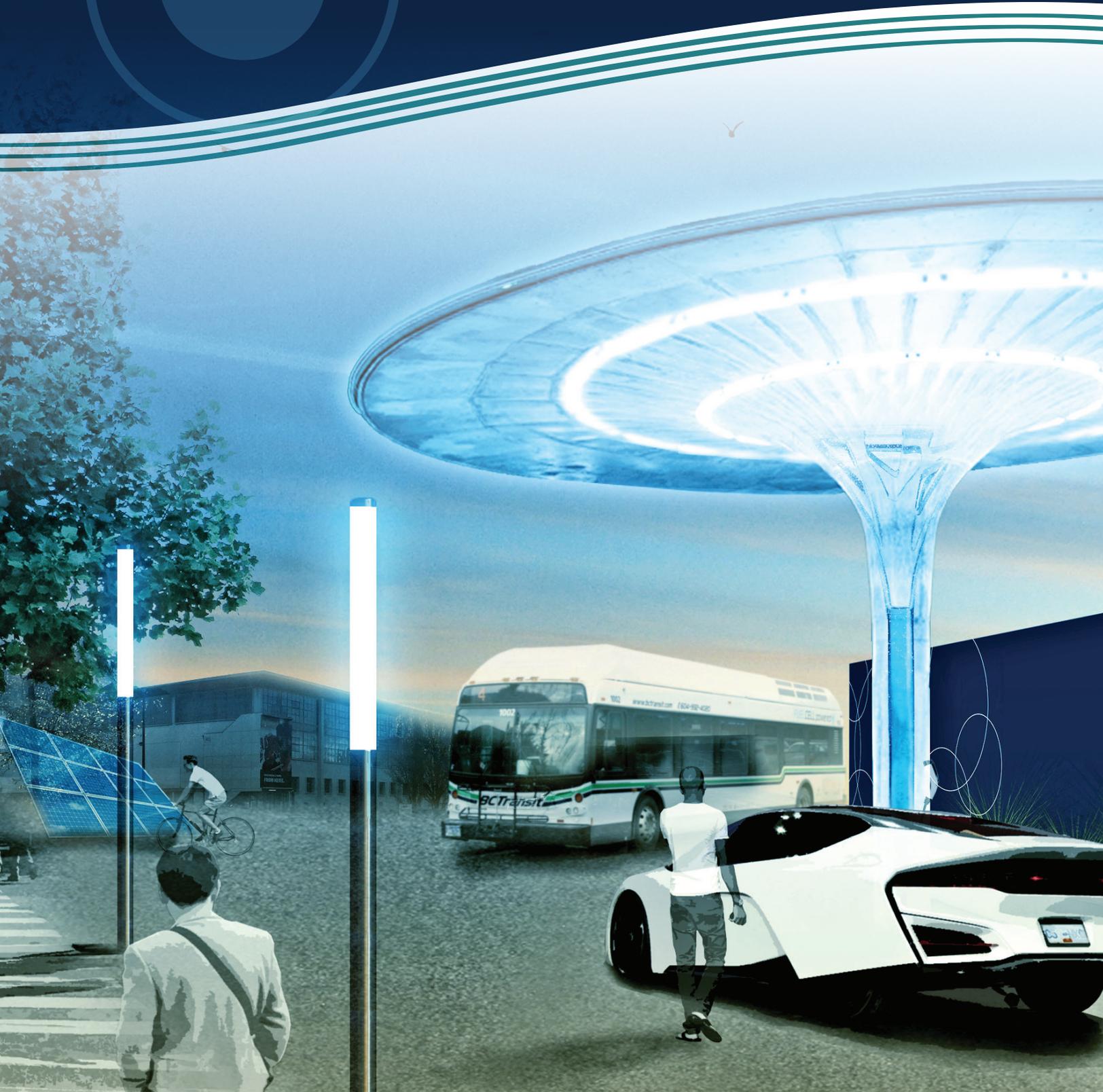


# HYDROGEN

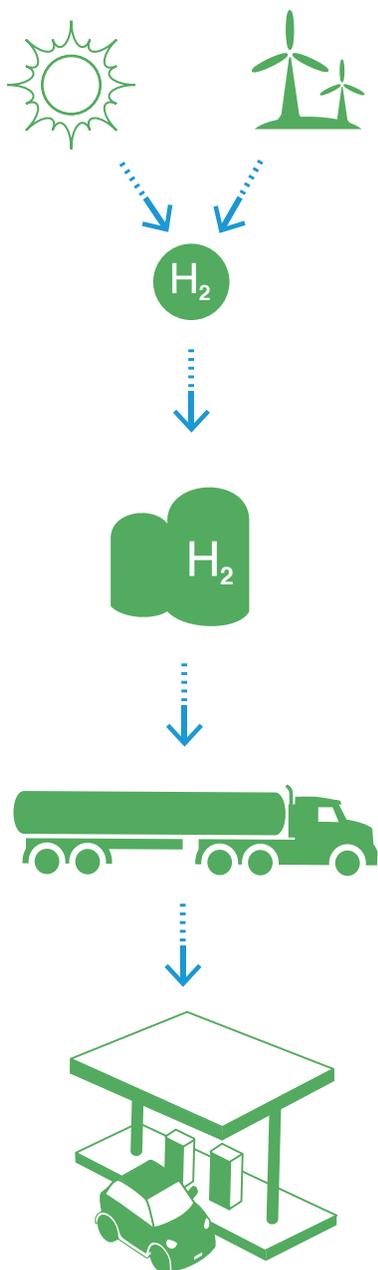


Clean  
Energy  
Research  
Centre

# HYDROGEN

British Columbia is a global leader in research and development for low-carbon mobility. Nevertheless, the transportation sector continues to be the single largest source of greenhouse gas (GHG) emissions in the province. Moreover, the local leadership has not been fully exploited to produce jobs, develop new markets, and build a local supply chain.

The University of British Columbia (UBC) is leading a hydrogen initiative to leverage its research and training capacity, its human, financial and infrastructure capital, and its reputation as a catalyst for regional development.



## PRODUCTION

- Solar to hydrogen
- Wind to water electrolysis to Hydrogen

## REFUELLING

Thermodynamic modelling and experimental testing is being used to study and improve state-of-the-art hydrogen refuelling stations, refuelling process, and onboard fuel storage tanks.

## ENERGY STORAGE

Hydrogen provides a critical pathway to diversify the use intermittent, renewable electricity (e.g., via electrolysis, Power-to-Gas or energy storage schemes, etc.).

## DEPLOYMENT STRATEGIES

Analysis, quantification, mapping, and deployment for low- carbon transportation and infrastructure systems — It will utilize an interdisciplinary approach that takes advantage of existing capabilities in engineering, environmental science, human behavior, and public policy.

# SAFE, EFFICIENT, AND SUSTAINABLE TRANSPORTATION

## **This convergence of advanced technologies will:**

- Enable projects that create local jobs
- Validate the best practices to enable safe hydrogen refuelling
- Train and educate the next generation of technologists, engineers, scientists, and policymakers
- Evaluate the deployment strategies of new low-carbon fuels
- Develop business models that can be exported to other Canadian jurisdictions
- Grow from a regional cluster on the continental West Coast, into a global center of excellence and leadership



# CHALLENGES AND OPPORTUNITIES

Road transportation today is responsible for a significant and growing share of global greenhouse gas (GHG) emissions. In British Columbia (BC), 25% of the total GHG emissions are from the road transportation sector.

Hydrogen, as a low-carbon fuel, can reduce GHG emissions, especially if produced with renewable energy, via electrolysis. However, the cost and efficiency is still a concern. CERC is currently working in novel electrolytic and solar to hydrogen technologies to address this issue.

A number of countries have focused on developing clean, economical, and safe hydrogen fuelling infrastructure for initial rollout of fuel cell electric vehicles (FCEVs). Deploying hydrogen to the transportation sector requires significant capital investment and long-term commitment, but faces high risks of low demand, and poor short-term returns. While cost optimization is a necessity for developing hydrogen fuelling infrastructure, it may lead to solutions that do not fully exploit the environmental benefits of switching to a more sustainable energy system. Therefore, the simultaneous assessment of environmental and economic concerns is required to promote the sustainable development of hydrogen fuelling infrastructure.



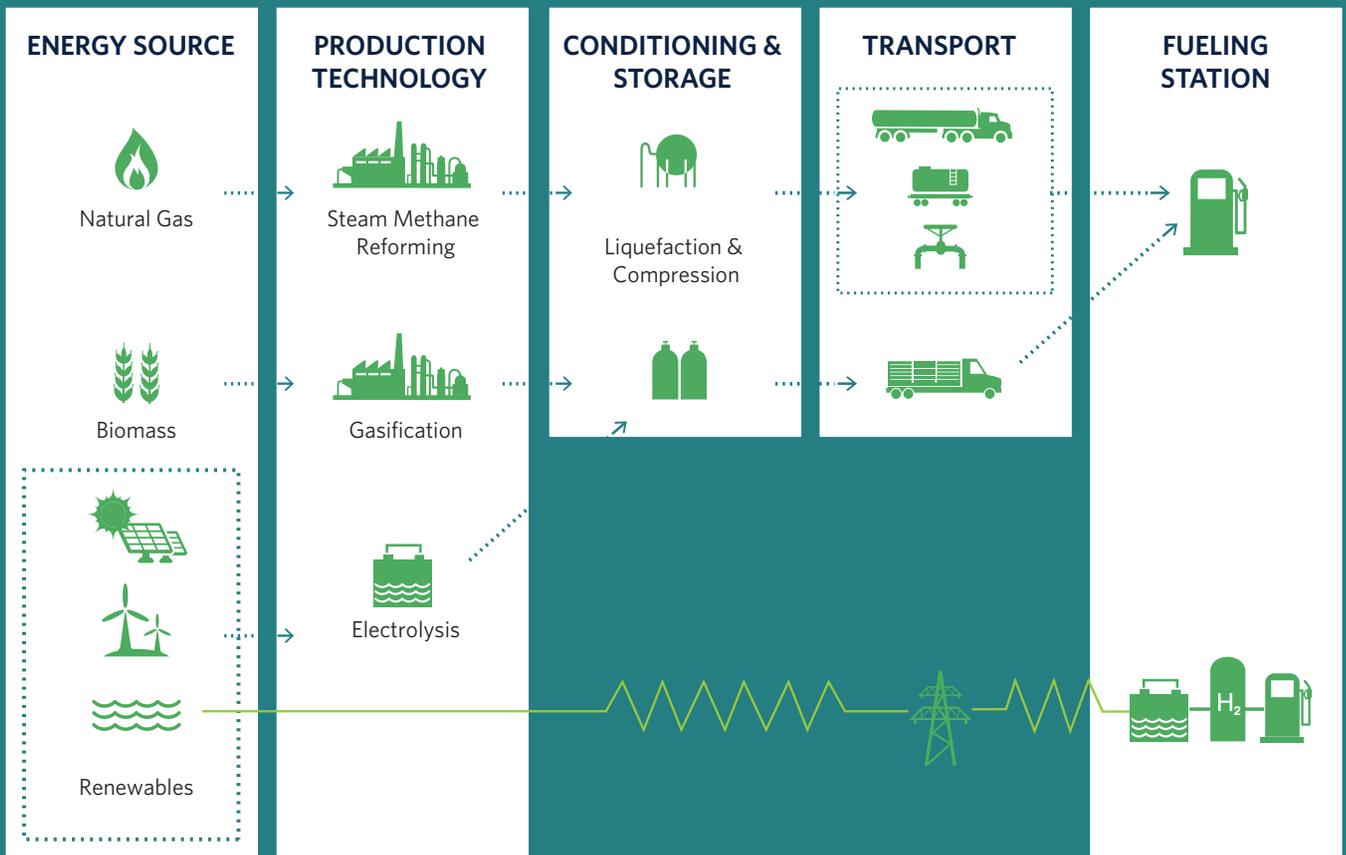
# FEATURE PROJECT

## SUSTAINABLE DEVELOPMENT OF HYDROGEN FUEL SUPPLY CHAIN: THE CASE OF BRITISH COLUMBIA

New technology penetration into the transportation system requires a balance between the vehicle growth and supply chain development. However, sufficient initial fueling or charging network coverage needs to be created well in advance of vehicle rollout. Considering the significant capital investment which will be followed by a long period of underutilization, the new supply chain will face a long period of negative cash flow.

This research aims to design a methodological framework for the sustainable development of the hydrogen supply chain (HSC) in British Columbia for a 30 year time frame, i.e., minimize costs and environmental impact.

The mathematical framework will be able to adopt different rollout policies and incentive plans and update the optimization based on different motivators and constraints.



# THE CERC ADVANTAGE

Sustainable transportation and infrastructure systems cannot be designed with technology alone. They must include social motivators, economic analyses, and policy exploration. The UBC Vancouver campus represents a self-contained city (400 hectares, 50,000 students, 14,000 faculty, and staff). UBC owns and operates its own electricity and gas grids, a fleet of 300 vehicles, and it hosts one of the largest secured wireless networks in a North American university.

## STRONG RELATIONSHIPS

Connections to a diverse group of government and industry partners help maximize both the relevance and impact of our efforts. Some of our partners include:

- AFCC
- Ballard
- Fraunhofer ISE
- Greenlight Innovations
- Hydrogenics
- Hyundai
- HyPlat
- ITM Power
- Johnson Matthey
- Mercedes-Benz
- Total, S.A.

## CITY SCALE

The UBC campus provides the ideal conditions for the combination of research and execution. Some advantages:

- Own provincial jurisdiction municipal Campus and Community Planning
- Campus-wide Secure wireless network
- A large campus area
- Early adopter profiles
- A wide range of conditions from residential to institutional, including a mini-town and highway conditions

## CERC RESEARCH APPROACH

### BREAKTHROUGH TECHNOLOGIES

- Innovative microliquefaction, storage and insulation, sensors, controls and automation
- Game changers

### SYSTEM SIMULATION MODELLING

- Modelling and simulation: economics, thermodynamics, CFD, FEa, etc.
- Validates technological benefits

### PARTNERSHIPS + NEW VENTURES

- Commercialisation of research product(s)
- Work with existing partner companies, new start-ups, and licensing

### EXPERIMENTATION + TESTING

- Bench and lab scale experiments
- Full-scale testing capabilities under development

