

Overview of the Hydrogen Rail Status in Canada

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➤ Overview

- Rail Transportation in Canada
- Innovation Centre
- Transport Canada's Clean Rail Programs
- Transport Canada's Research and Regulatory Work
- Other Hydrail Initiatives in Canada
- International Engagement

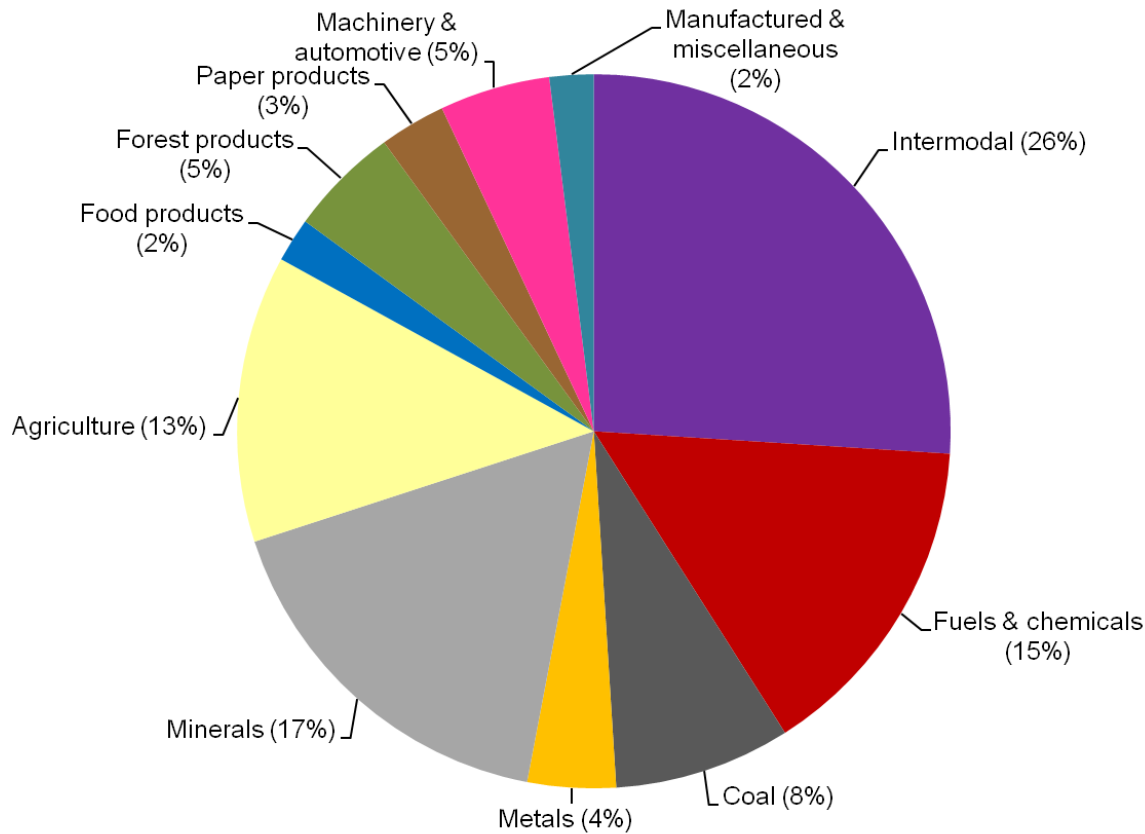
➤ Overview of Rail Transport in Canada



- Large and well developed coast-to-coast rail system that transports mainly freight
- 49,422 km (30,709 miles) of track
- Sector is dominated by CN, CP and VIA Rail, which are regulated by the Railway Safety Act

➤ Freight Rail Transport in Canada

Commodities Transported by Rail (2017)



50+ regional short line railways

Moves more than 900,000 tonnes of goods every day

➤ Passenger Rail Transport in Canada



- 4.0 M passengers/year (majority along Quebec City-Windsor Corridor)
- Serves 450 communities
- Some rural and tourist services offered by regional railways
- 12,500 km network

➤ Urban Rail Transport in Canada

Toronto	 	Ridership: 205,000 Network size: 450 km
Montreal		Ridership: 87,000 Network size: 234 km
Vancouver		Ridership: 11,000 Network size: 69 km

- Canada's 3 largest urban areas are served by commuter rail systems
- Three Canadian cities currently have light rail systems in operation (Calgary, Edmonton and Ottawa)
 - Several new light rail systems are under construction and expected to open by 2025 (Edmonton, Waterloo, Toronto)

➤ Transport Canada's Innovation Centre

Our Vision

“To enable bold and innovative transportation solutions that enhance the safety, security, accessibility, and environmental performance of transportation in Canada.”

In January 2018, Transport Canada launched the **Innovation Centre (IC)** –a transportation innovation Research, Development & Deployment (RD&D) organization tasked with:

- driving an integrated departmental approach to transportation innovation;
 - partnering in new ways with government, industry and academia; and
 - leveraging emerging technologies for the benefit of all Canadians.
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- Air, Marine, Road, Rail

► Transport Canada Rail RD&D Themes



Grade crossings and trespassing



Service efficiency and capacity



Energy environment and climate change



Infrastructure and rolling stock

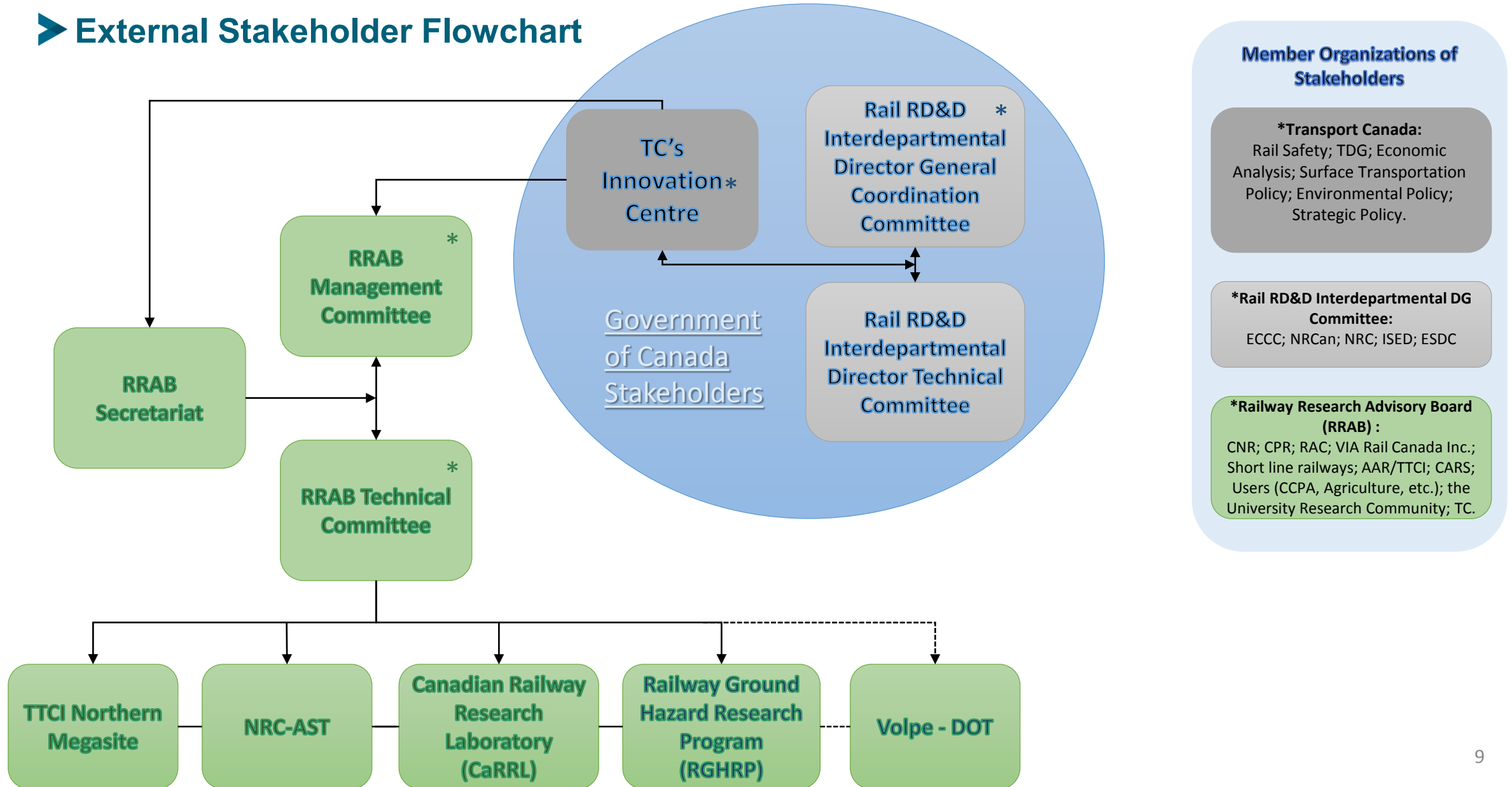


Human factors



Ground hazards research & Cold weather operations

External Stakeholder Flowchart



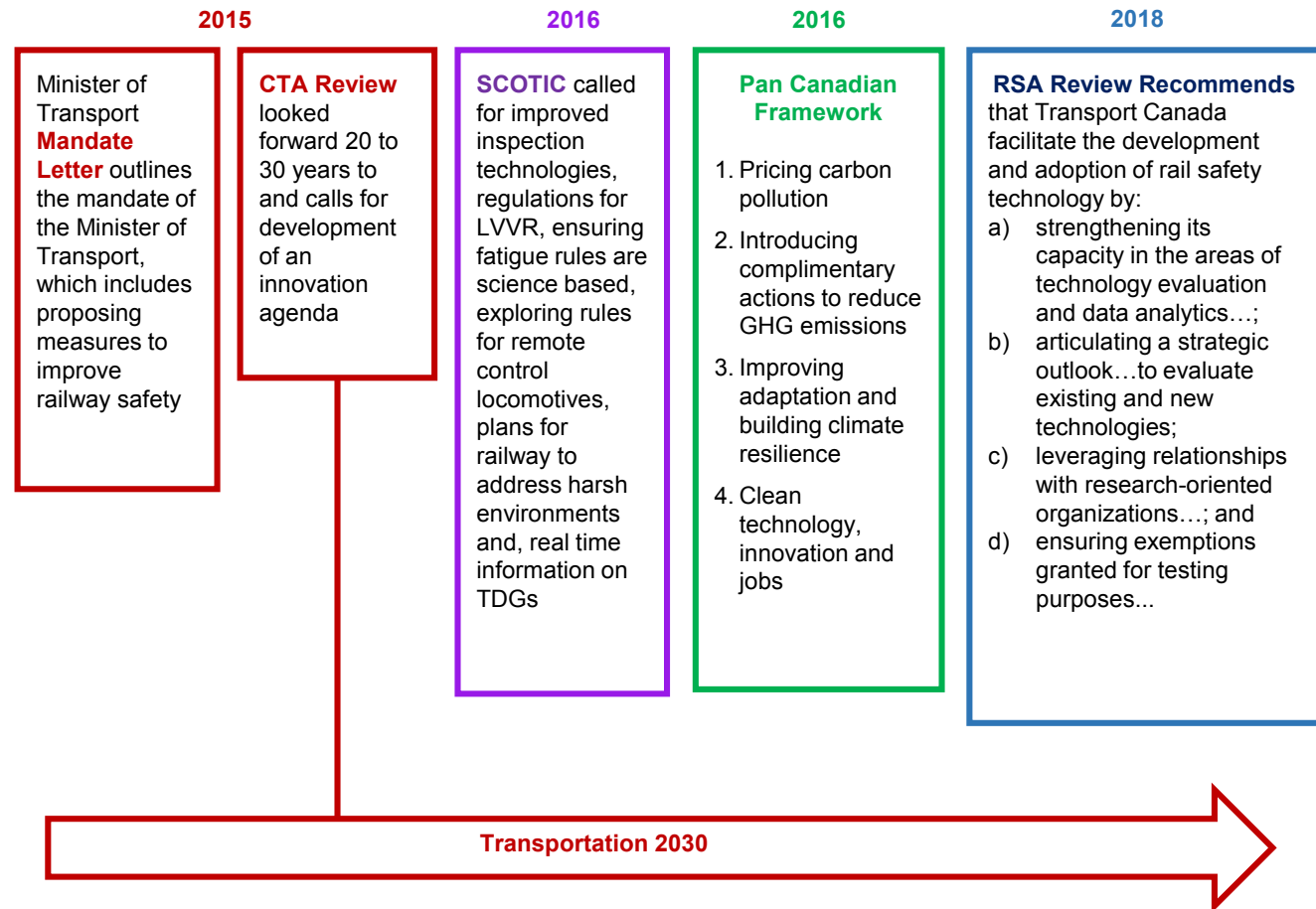
Member Organizations of Stakeholders

- *Transport Canada:**
Rail Safety; TDG; Economic Analysis; Surface Transportation Policy; Environmental Policy; Strategic Policy.
- *Rail RD&D Interdepartmental DG Committee:**
ECCC; NRCan; NRC; ISED; ESDC
- *Railway Research Advisory Board (RRAB) :**
CNR; CPR; RAC; VIA Rail Canada Inc.; Short line railways; AAR/TTCI; CARS; Users (CCPA, Agriculture, etc.); the University Research Community; TC.

➤ Drivers for Areas of Rail Research

Implementing an objective-based RD&D program by:

- Supporting safety and environmental regulatory development through research, testing and evaluation
- Advancing early TRL projects & bridging the commercialization gap through applied research
- Informing policy development
- Addressing key industry concerns and knowledge gaps related to new technologies/processes
- And supporting industry uptake of emerging technologies and processes to benefit the inspectorate and oversight of rail operations in Canada.



➤ Clean Transportation Programs

- **Clean Rail Academic Grant (2011-2018)**

- The Clean Rail Academic Grant is a program that supported the Government of Canada's efforts to reduce rail sector emissions and support research of new and emerging technologies
- It provided a grant of up to \$25,000 towards 10 academic research programs that are developing emission – reduction technologies and practices
- On July 2018, an investment of \$25,000 for a University of Toronto project called Hydrail for Clean Rail Transport was funded
- The University of Windsor was also funded for researching an experimental diesel engine capable of running on blends of hydrogen and diesel fuel

- **Clean Transportation System Program**

- The Clean Transportation System is a program similar to the Clean Rail Grant, that manages and funds R&D projects for specifically the rail, marine, and aviation transportation.
- The program objective is to provide funding for projects that will help improve the environmental performance of Canada's transportation system
- Up to \$1,500,000 in program funding over the next 3 years.

➤ Metrolinx Hydrail Feasibility Study

- Metrolinx completed the investigation on the feasibility of using a hydrail system for the GO passenger rail network in the Toronto and Hamilton Area
- Study determined whether it is technologically feasible and economically beneficial to use HFCs as a power source for electrifying the GO rail service
- **Findings**
 - Technically feasible to build and operate the GO Transit network using hydrogen fuel cell powered rail vehicles
 - Overall lifetime costs of building and operating a hydrail system is equivalent to a conventional overhead electrification system
 - Complexity of this system presents a different set of risks, as compared to conventional electrification
- **Recommendations**
 - More exploratory work needs to be undertaken to reduce risks and gain better understanding of the beneficial opportunities
 - Begin developing designs for refueling and hydrogen production systems
 - Work with regulators to clarify the safety rules that will apply to the hydrail System



➤ Hydrogen Regulatory Work

- Transport Canada's Rail Safety group is currently assisting Metrolinx and their contractors in the development of standards
- Regulatory work will be conducted to determine the regulations that can be used or are applicable to a hydrail project, and identify gaps
- A risk analysis will determine what is needed to mitigate

➤ CSA Group Hydrail Research

- Research project on developing a roadmap consisting of standards and codes for hydrogen rail applications including trains and refueling stations
- Consultation with the United States and Canadian stakeholders, industry experts, and CSA's technical committees and subcommittees
- Transport Canada participated in the 2018 North American Hydrogen Codes and Standards Forum (August 2018).
- Natural Resources Canada and Transport Canada to work together with CSA

➤ Rail Innovation in Canada scan – CUTRIC

Theme – Energy, Environment and Climate Change

Project Challenge:

In the previous few years, Energy and Environment research and development was implemented through Transport Canada's Clean Rail Program with the goal to reduce rail sector emissions. The growing trend to develop and support more efficient, safer, and greener technologies, has created a desire for the Canadian rail industry to move into this direction.

Objective:

Promote and introduce environmentally sustainable rail transportation innovations with short to medium term and medium to long term projects. The research will focus on: new propulsion systems for locomotives; alternate fuels; light-weighting of materials; and optimized operational efficiencies. CUTRIC would like to probe Canadian rail innovation leaders to help provide research and development direction for Transport Canada to advance a greener and more sustainable rail transportation system.

Scope and Solution:

CUTRIC will conduct four focus group sessions on rail innovations covering alternative propulsion, energy efficiency, and alternative materials. While the fourth session will examine operational optimization and integrated mobility. These group sessions will provide a variety of research topics and potential new technologies to further collaborative development and industry uptake all in support of an environmentally sustainable rail system.

Stakeholders and Partners:

- CUTRIC, Academia, Rail Industry, Technology Developers and manufacturers

Project Timeline: June 2018 – 2019

Value of the Study:

- A list of ten evaluated and potential technology innovation projects will be developed in rail-based transportation to further promote the goal
- Advancement of safer, greener, and more sustainable technologies and reduction of emissions



➤ Lignin Derived Drop-In Renewable Diesel Fuels for Rail Applications

Theme – Energy, Environment and Climate Change

Project Timeline: February 2014 - Ongoing

Project Challenge:

Transportation is one of the largest sources of air pollutants and greenhouse gas (GHG) emissions in Canada, alternative fuel solutions are needed to address this issue.

Objective:

Assess the feasibility of using lignin-derived diesel fuels as drop-in biofuels in order to reduce emissions from the rail sector.

Scope and Solution:

Current renewable diesels are produced from edible sources, including canola oil, soya oil and other lipids, which can have a negative impact on food prices. However, lignin is a highly abundant source that has no effect on food prices, and is readily available to be mixed with fuels to reduce transportation emissions of non-biogenic greenhouse gases and criteria air contaminants. The lignin-derived feedstock can be processed to create a diesel fuel fraction which meets all but one CGSB 3.18 locomotive fuel specification, but will have research and testing conducted to improve the quality of the fuel in order to meet that specification.

Stakeholders and Partners:

VIA Rail, Canadian Pacific, Canadian National Railway, and CRB Innovations Inc.

Value of the Study:

- Lignin can easily be found in soft and hard woods, plants and grasses, and will not affect food prices.
- Expected to be useable as renewable diesel fuels which can be blended in different concentrations with normal fossil diesel fuels.
- Acceleration for the development of technologies to convert lignin into “drop-in” biofuels.



➤ Rail Electrification Study



- The Government of Canada is working towards cleaner transportation and has set an economy-wide target to reduce greenhouse gas emissions by 30% below 2005 levels by 2030
- To support this clean transportation initiative, a rail electrification study is conducted to examine the feasibility of electrifying freight rail operations in Canada
- The costs, challenges and environmental benefits to electrification and early opportunities for deployment of this technology will be identified
- The rail industry has shown interest and reached out to Transport Canada to conduct this study
- A work plan, overview of rail electrification technologies, and a summary review of the industry drivers for exploring electrification of the freight rail sector
- The final report of this study is currently in progress

> eTV: Hydrogen Fuel Cell Vehicle Testing



2016 Toyota Mirai

Environmental Performance (Winter 2018)

Partners: Argonne National Laboratory Advanced Powertrain Research Facility (ANL-APRF) & Environment and Climate Change Canada Emissions Research Measurement Section (ECCC-ERMS)

Energy Consumption and Performance

- Using the SAE J2572 Recommended Practice for Measuring Fuel Consumption and Range of Fuel Cell Vehicles as a baseline, measure vehicle level hydrogen consumption;
- Record performance data and calculate efficiency on varying drive cycles at ambient temperatures ranging from -7°C to 35°C with a stretch goal of testing a cold start at -18°C ;
- Record performance envelopes and analyze synergies between the fuel cell system and the hybrid system (including fuel cell system idle);
- Generate an efficiency map of the fuel cell system; and,
- Make data publically available as a reference for researchers, national laboratories, standards committees, industry, and academia.

Safety Performance (Summer 2019)

(PMG Technologies, National Renewable Energy Laboratory)

Non-Intrusive Testing

- In accordance with Global Technical Regulation (GTR) No. 13 requirements, conduct test procedure for vehicles equipped with hydrogen gas leakage detectors.

Crashworthiness Testing

- Conduct CMVSS 301/Fuel System Integrity, Storage System Specifications, Electric Vehicle Safety and CMVSS 305 – Electric Powered Vehicles: Electrolyte Spillage and Shock Protection.

➤ Studying Germany's Hydrail Railways

- The Innovation Centre's Chief of Rail and Aviation RD&D travelled to Germany to meet with government, industry, and suppliers
- A trip on the Coradia iLint hydrogen fuel cell powered train was taken after a presentation from Alstom
 - Overall a 100 km round-trip
 - Train development was from the collaboration between Alstom and Hydrogenics in Ontario
- The hydrogen fueled rail facility was explored
 - Train station, wagons, train seating and standing areas for passengers



Thank You!

For any further inquiries, please contact:

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