



DECARBONIZING LONG-HAUL TRUCKING IN EASTERN CANADA

A COMPARISON OF TECHNOLOGIES ON THE A20-H401 HIGHWAY CORRIDOR BETWEEN QUÉBEC AND WINDSOR

Chair in Energy Sector
Management
HEC MONTRÉAL

PROJECT COLLABORATOR
CPCS
accelerating
the green
economy

PREPARED FOR

Québec

WORKSHOP PROGRAMME

April 25th, 2023 – 8:30 a.m.-12:45 p.m. Eastern Time
(Round Tables on April 26, 27)
Zoom Webinar

OBJECTIVE

The Chair in Energy Sector Management at HEC Montréal (Chair) and CPCS are carrying out, in collaboration with the Government of Québec a technoeconomic study comparing Class 8 technologies to decarbonize long-haul trucking, with a focus on the Autoroute 20 and Highway 401 corridor between Québec City and Windsor. The four class 8 technologies considered include:

- 1) Electric road system with overhead conductive transmission (ERS-OCT)
- 2) Battery electric trucks
- 3) Hydrogen fuel cell electric trucks; and
- 4) Renewable natural gas trucks (RNG)

The workshop aims to explore and validate with experts from industry, government, academic and professional both the larger decarbonization context and the important parameters to consider in the analysis. The key objective is two-fold:

- 1) validate data and assumptions that will be used in the simulations to compare the techno-economic potential of identified new-zero technologies for long-haul trucking.
- 2) highlight the strengths, weaknesses, opportunities, and risks associated with the different technologies in the context of Eastern Canada.

The workshop consists of two parts: 1) a **scoping conference** on April 25 to lay out the context and state of long-haul trucking in Eastern Canada, followed by 2) **round tables** held on April 26 and 27 to discuss key issues both technical specific to the technologies, and more broadly regarding decarbonizing freight from a systemic perspective (i.e., logistics, intermodally). Participants will be asked to participate at the scoping conference and only ONE of the four round tables (see description below).

BACKGROUND AND ISSUES

Compared to passenger transport, initiatives to decarbonize freight are limited due to the complexity of the sector and lack of access to transparent data. The challenge is compounded by the fact that its emissions are growing rapidly relative to all personal vehicles. Between 1990 and 2019, freight transport emissions increased by 144% in

Quebec and 130% in Ontario, compared to 28% and 38%, respectively, for personal transportation. The freight sector alone emits 12 Mt CO₂e in Quebec and more than 18 Mt in Ontario, or nearly 15% of Quebec's emissions and 11% of Ontario's emissions. It could surpass personal transportation by 2030. Semi-trailers (Class 8b) account for the largest share (78%) of the kilometers travelled by Class 8 heavy vehicles in Canada. Industry reform, both technological and logistical, is needed to reverse these major trends.

To date, few studies have assessed the feasibility (cost-benefit) associated with the potential of decarbonization technologies in long-haul trucking in Canada along the prominent trade corridor through Ontario, Quebec and into the Northeastern United States (US). In addition, net-zero technologies in this sector often require long-term planning due to infrastructure that go beyond provincial and national borders. It is therefore relevant to explore net-zero options in a broader context that includes Quebec, Ontario and US stakeholders, to encourage further collaboration and use of common analytical tools and data to take informs decision and actions in this sub-sector towards achieving net-zero goals by 2050.

The lack of transparent, rigorous comparative studies of different decarbonization technologies for Class 8 freight transport in Quebec and Ontario, and more broadly in the North American context, limits the effectiveness of government and private actions in this sector. This project will contribute to filling part of this this gap and reduce some of the risks associated with technological and logistical choices by providing more complete information based on a review of the costs and technological issues associated.

The study aims to provides **transparent data and assumptions on the technologies, with full references, to allow others to use and update the data, and the simulation model developed, for further studies in the future.**

Results of this study can be used in future work, including to review the technologies within a more systemic approach for decarbonizing long-haul freight (e.g., optimized freight logistics, intermodally and business models) and to assess the impacts of different technological choices on overall electricity and energy demand and on reaching GHG reduction targets based on different pathway scenarios (e.g., University of Windsor's Carbon Free Corridor Initiative from Montreal to Chicago; calibrating E3 model, such as NATEM implemented by ESMIA, with the data from the simulation; contribution to the Energy Modelling Hub Common and Open Platform).

Tuesday, April 25, 2023 [8:30 a.m. – 12:45 p.m.]

SCOPING CONFERENCE (Zoom)

The scoping conference aims to prepare participants for discussions in the round tables (see below).

8:30

Opening remarks (15 min)

Johanne Whitmore, Senior Researcher, Chair in Energy Sector Management, HEC Montréal

CPCS modeling approach

Nick Roberts, Senior Consultant - Transportation, CPCS

8:45

Part 1. General Overview (1h)

State of long-haul freight transportation (20 min)

- **Dr Pierre-Olivier Pineau**, Professor, Chair in Energy Sector Management, HEC Montréal
- **Michael Roeth**, Executive Director, North American Council for Freight Efficiency and Trucking Lead at the Rocky Mountain Institute

Government Perspectives — Federal, Quebec and Ontario (30 min)

- **Jordan Wolfe**, Deputy Director, Zero Emission Trucking Program, Transport Canada
- **Alain Lemieux**, Senior Policy and Program Advisor, Québec's ministère des transports et de la mobilité durable
- **Carolyn Kim**, Senior Director, Communities & Decarbonization Group, Pembina Institute

Question period (15 min)

9:50

10-minute break

10:00

Part 2. Technoeconomic Overview - Trucks and Infrastructure (1h15)

Hydrogen Fuel Cell Trucks (15 min)

Rymal Smith, Owner/Partner, Change Energy Services

Renewable Natural Gas Trucks (15 min)

Francisco Doyon, Advisor development of natural gas for vehicle (NGV), Énergir

Overhead Conductive Transmission Trucks with dynamic charging (15 min)

Dr David Cebon, Professor of mechanical engineer and Director of Centre for Sustainable Road Freight, University of Cambridge

Battery Electric Trucks (15 min)

Charles Trudel, Technological Application Group Manager, Innovative Vehicle Institute

Question period (15 min)

11:15

15-minute break

11:30

Part 3. International Perspectives and Lessons (1h15)

How to minimize cost uncertainty (15 min)

Dr Matteo Craglia, Transport Analyst & Modeller, OECD - International Transport Forum

Decarbonizing logistics, intramodality, efficiency (15 min)

Dr Maja Piecyk, Professor of logistics, University of Westminster

US – Canada cross border challenges and energy demand on grid (15 min)

Dr Georgiana Vani, Sessional instructor with the Department of Civil and Environmental Engineering and Research associate with the Cross-Border Institute, University of Windsor

US – Natural Renewable Energy Laboratory (15 min)

Dr Arthur Yip, Researcher, National Renewable Energy Laboratory

Question period (10 min)

12:45

End of webinar

Wednesday, April 26 (table #1, 9:00 to 11:15 a.m. / table #2, 1:00 to 3:15 p.m.)

Thursday, April 27 (table #3, 9:00 to 11:15 a.m. / table #4, 1:00 to 3:15 p.m.)

ROUND TABLES (MS Teams)

The round table will be conducted by videoconference on invitation only. Confirmed participants will be assigned to only ONE of the four tables, and a Zoom link will be sent to them to join their table. The workshop will bring together stakeholders from various decision-making levels from academia, government, private and professional sectors. Each table will be composed of 10-15 participants who will have 15 to 20 minutes per question to discuss their recommendations. Answers noted will aim to represent **points shared by the group**. Discussions will follow the Chatham House rules¹ and will be highlighted in a workshop report and used to validate data and assumptions for the modelling work by CPCS.

9:00 a.m. Facilitator's opening remarks

[1:00 p.m.] Operating guidelines for the round tables

9:15 a.m. Round tables

[1:15 p.m.]

1. After reviewing the **Backgrounder**, what are your top 3 comments or recommendations to improve our study methodology?
2. What is the timeline for technological (trucks and infrastructure) maturity and widespread commercial availability of different new zero emission class 8 trucks coming to market in Eastern Canada?
 - What are the main technological challenges in the context of cold climates (-25°C)?
 - What external conditions can promote or hinder the adoption of one technology over another (e.g., OEM, markets trends and drivers, lobby, politics, competition, logistics, final energy cost and supply)?
3. What are your perspectives on the costs and expected trends of:
 - Infrastructure costs for RNG and hydrogen fueling stations, infrastructure maintenance per year
 - BEV, OCT and FCEV trucks price ranges
 - RNG costs (\$/GJ) in Ontario and Quebec
4. Are you satisfied with the current state of government policies and actions (federal, provincial, cross-border) to accelerate the decarbonization of long-haul road freight at the Eastern Canadian and provincial levels? What are top 3 key issues that explain your answer?
5. Given that each technology presents different potential and risks, what actions should governments take to support them (e.g., transparent test-pilot projects, policies, regulatory, financial)? Should the government have a technology-neutral approach? Do you have examples of best practices?
6. What are the top 3 needs (e.g., data access and transparency, studies, pilots, measures for improved efficiency, learning, training, capacity-building), that are a priority to support fleets and business owners in the early phase to reach net-zero transition by 2050?

¹ Chatham House Rule: Participants are free to use the information received, but neither the identity nor the affiliation of the speakers, nor that of any other participant, may be revealed.

7. [Optional] How can improving efficiency, intramodality and logistics in freight be a leverage to support net zero long-haul freight technologies?
8. [Optional] What type of interregional collaboration could help different stakeholders (industry, government, research) better work together to accelerate reaching net zero goals in long-haul freight (e.g., acceleration labs, expert committees, networks, forums, annual meeting, platform)?

11:10 a.m. Conclusion and next steps

[3:10 p.m.]

11:15 a.m. End

[3:15 p.m.]

Workshop Backgrounders

CPCS and HEC Montréal, 2023. *Decarbonizing long-haul trucking in Eastern Canada: A comparison of technologies on the A20-H401 highway corridor between Québec City and Windsor - Workshop Backgrounder - Review of proposed modelling parameters.*

CPCS and HEC Montréal, 2021. *Decarbonization of long-haul trucking in Eastern Canada: Simulation of the e-Highway Technology*, <https://energie.hec.ca/canada-ehighway/>

Other recommended readings

OECD-ITF, 2022. *Decarbonising Europe's Trucks: How to Minimise Cost Uncertainty*, www.itf-oecd.org/decarbonising-europes-trucks-minimise-cost-uncertainty

German Federal Ministry of Digital Affairs and Transport, 2022. *An Overall Approach to Climate-Friendly Commercial Vehicles - Towards zero emissions road logistics by means of alternative drivetrains*, www.bmdv.bund.de/SharedDocs/EN/Documents/overall-approach-climate-friendly-commercial-vehicles.pdf?__blob=publicationFile

De Bruycker, 2023. *Transport de marchandises au Canada et rôle du rail : Présentation du secteur et enjeux pour la décarbonation*, <https://energie.hec.ca/cgse-hec-re012023/>

ANNEX 1 | Speaker biographies

Opening remarks



Johanne Whitmore is Senior Researcher at the Chair of Energy Sector Management at HEC Montréal. She is an energy systems and management specialist. Her research focuses on the effectiveness of measures to achieve the energy transition and decarbonization of economies. She has been involved in research on these issues for nearly 20 years, and her expertise is used in the private, government and academic sectors. She was vice-president of Transition énergétique Québec's Stakeholders Table and a member of the scientific committee of the first study measuring the circularity of Quebec's economy. She holds a Master's degree in Science (environmental geography) from the University of Ottawa and executive training in Management and Sustainable Development from HEC Montréal.



Nick Roberts is a Senior Consultant at CPCS. He holds a dual master's degree in finance and management from leading business universities in Europe, and an undergraduate degree in mechanical engineering from the University of Waterloo. Nick has a strong technical understanding of the latest zero emission technologies used in a variety of fleet applications, including freight transportation and trucking. He has led analysis on several complex business cases covering the transition to low carbon and zero emission technologies and assessed total cost of ownership. Nick has developed financial models and scenario planning tools for forecasting fleet adoption plans, related infrastructure investment, impacts to operations, maintenance and GHG emissions. He has recently led a market study of the trucking industry in Canada to help identify decarbonization opportunities and the strategic role for energy suppliers.

Panel 1. General Overview



Dr. Pierre-Olivier Pineau is a Professor at the Department of Decision Sciences at HEC Montréal and holds the title of Chair in Energy Sector Management. He is a specialist in energy policy, particularly in the field of electricity. He has published numerous articles on the energy sector that explore the links between energy and certain aspects of sustainable development. He regularly makes appearances in the media to analyze energy news. He has produced various reports for the government or public bodies. In 2021, he was appointed a member of the Government of Quebec's Advisory Committee on Climate Change. He is a CIRANO Fellow and a member of CAEE and CIRODD



Mike Roeth is the Executive Director of the North American Council for Freight Efficiency and is the Trucking Lead for RMI. He has worked in the commercial vehicle industry for over 35 years, and his specialty is brokering green truck collaborative technologies into the real world at scale. In October 2021, Mike was named an Industry Influencer by FleetOwner and awarded the SAE 2020 L. Ray Buckendale Lecturer. He has a BSc in Engineering (Ohio State University) and a Master's in Organizational Leadership (Indiana Institute of Technology). He served on the second National Academy of Sciences, Engineering, Medicine Committee on Reducing Fuel Consumption and GHG Emissions of MHDV, is a Department of Energy Merit Reviewer and past Chairman of the Board for the Truck Manufacturers Association.



Jordan Wolfe is Deputy Director, Zero Emission Trucking Program at Transport Canada. He has nearly 16 years of experience with the Government of Canada, including tours of duty across each of the Central Agencies and more than 5 years with Transport Canada's Innovation Centre. Before joining the Government, Jordan spent several years working for the United Nations Educational, Scientific and Cultural Organization in Europe. He holds an advanced Bachelor in Labour Studies and Economics and a master's in public administration, where he was awarded the Governor General's Gold Medal for Academic Merit.



Alain Lemieux is Senior Policy and Program Advisor at the ministère des Transports et de la Mobilité durable. With more than 20 years of experience in the road freight transport sector, 16 of which more specifically in environmental issues. He is the designer and manager of the Écocamionnage program and participates in several working groups concerning the decarbonization of truck transport. He holds a bachelor's degree in economics from Laval University (2001).



Carolyn Kim is the Senior Director of the Pembina Institute's communities and decarbonization group. She brings 15 years of policy and planning experience from the public, private and non-government sectors to the role. Carolyn is a skilled collaborator, bringing organizations together to accelerate low-carbon solutions in Canadian cities and communities. In 2019, Carolyn initiated Pembina's Urban Delivery Solutions Initiative to tackle freight emissions. She holds a master's degree in public policy from the University of Toronto and a bachelor's degree in urban and regional planning from Toronto Metropolitan University.

Panel 2. Technology Overview - Trucks and Infrastructure



Ry Smith (P. Eng) is owner and partner of Change Energy Services. He is a specialist in the design, modeling and analysis of gaseous fuel stations and systems, assessing their technical, economic, and environmental attributes. With 33 years of experience in the assessment and development of high-pressure gaseous refuelling station projects



Francisco Doyon (P. Eng) is since 2018 advisor for the development of natural gas for vehicle (NGV) at Energir. He is responsible to educate various stakeholders and to ensure the commercial relations with various partners in this developing market such a commercial fleets, dealers/OEM and refuelling infrastructure operators. He holds a DESS in Management (HEC Montréal, 2013) and a bachelor's degree in mechanical engineering (École Polytechnique de Montréal, 2010).



Dr. David Cebon is a Professor of Mechanical Engineering in Cambridge University and a Fellow of the Royal Academy of Engineering. He is Director of the Centre for Sustainable Road Freight and leads Cambridge University Engineering Department's Transport Research Group. His research covers the mechanical, civil, and materials aspects of road transport engineering. He has authored or co-authored more than 150 peer reviewed papers on the dynamics, safety, and environmental performance of heavy goods vehicles. He has a strong current focus on energy vectors.



Charles Trudel is Technological Application Group Manager at the Innovative Vehicle Institute. A graduate in mechanical engineering from ÉTS in 2016, Charles joined the Innovative Vehicle Institute in 2019 as a project manager. In 2022, he took on the challenge to lead the technological applications group, in charge of electric vehicle implementation and technology deployment projects. Versatile, curious and a great communicator, Charles has developed expertise in the deployment of electric vehicle fleets as well as in consulting services for private companies and municipalities. His writing skills have contributed to the success of some of the reference guides produced by IVI.

Panel 3. International Perspectives and Lessons



Dr. Matteo Craglia is a Policy Analyst and Modeller at the International Transportation Forum (ITF) of the OECD. His work focusses on energy technologies in the transport sector and he leads the development of ITF's energy and CO₂ emissions model. Prior to joining the ITF, Matteo worked at the IEA on energy efficiency and decarbonising transport. Matteo is a British and Italian national and holds a PhD in Engineering from the University of Cambridge.



Dr. Maja Piecyk is a Professor in Logistics at the University of Westminster. She is a former Deputy Director of the Centre for Sustainable Road Freight, an EPSRC-funded research centre between Westminster, Heriot-Watt and Cambridge Universities. Her research interests focus on the environmental performance and sustainability of freight transport operations. Much of her current work centres on city logistics, CSR, GHG auditing of businesses and forecasting of long-term trends in energy demand and environmental impacts of logistics. She is currently leading the University of Westminster's input to the EPSRC-funded Centre for Sustainable Road Freight and Decarbonising the UK's Freight Transport network.



Dr Georgiana Vani is a sessional instructor with the Department of Civil and Environmental Engineering at the University of Windsor and research associate with the Cross-Border Institute. She earned a PhD from the University of Windsor in Civil Engineering with a focus in transportation and the quantification of network robustness and criticality. Her research interests lie in freight transportation engineering, with a specific focus on emerging technologies, including connected and autonomous vehicles (CAVs) and smart infrastructure.



Dr. Arthur Yip is a Researcher in the Transportation Energy Transition Analysis group at the U.S. National Renewable Energy Laboratory (NREL). He has developed and applied the TEMPO, ADOPT, and TITAN models in various analyses about decarbonizing medium and heavy duty vehicles in the U.S. and optimized charging for passenger EVs. His expertise is in modeling and simulation of transportation & macro-energy systems, focused on technology choice and market adoption, spatial, demographic, and temporal disaggregation, and vehicle-grid infrastructure. He holds a PhD in Engineering and Public Policy, Carnegie Mellon University; MS in Technology and Policy, Massachusetts Institute of Technology; BSc in Chemical Engineering, University of Waterloo.