



Canada

# IRENA INNOVATION DAY

23-24 March 2022 • Canada



# IRENA INNOVATION DAY

## DAY 2 Welcome

WEDNESDAY, 23 MARCH 2022 • 9:00 – 9:15 EDT / 14:00 – 14:15 CET

## **Martina Lyons**

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**Associate Programme Officer  
Innovation and End-Use Sectors  
IRENA**



# IRENA INNOVATION DAY

## Session 3: Advancements In Decarbonising On-Road Transport

THURSDAY, 24 MARCH 2022 • 9:15 – 10:30 EDT / 14:15 – 15:30 CET

# IRENA INNOVATION DAY

## Session 3: Scene setting

## **René-Pierre Allard**

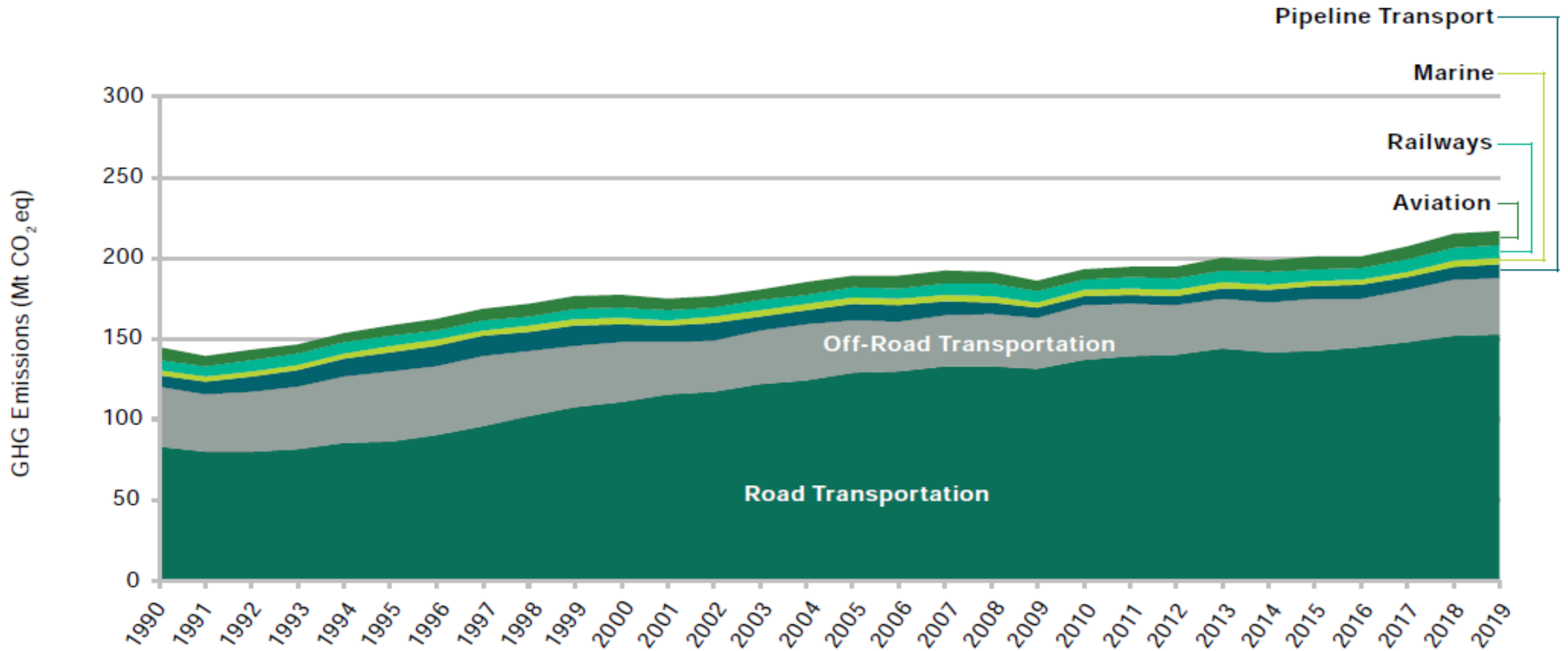
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**Deputy Director, Transportation  
NRCan**





# Canada's Transportation Emissions



Source: National Inventory Report 1990-2019

# Medium and Heavy-Duty Vehicles (MHDVs) in Canada

- Currently over 2.5 million MHDVs on Canadian roads --- essential to Canadian economy, supply chain, public services, health and safety
- ZEVs (e.g. battery electric, hydrogen fuel cell, plug-in hybrid electric) emerging but transition will take effort, coordination, and time, with some areas moving faster than others
- Retrofits and fuel efficiency improvements continue to be important transitional investments to reduce emissions from existing fleets and technologies
- Range of environmental, social and economic benefits to decarbonizing MHDVs (e.g. emission reductions, improved air quality, reduced operation and maintenance costs for owners, etc.)







# Barriers/Challenges to ZEV Adoption

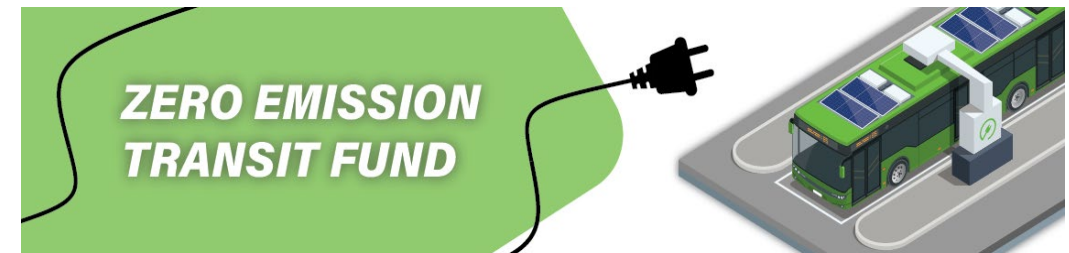
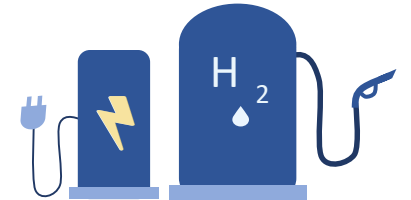
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- High initial capital costs, as well as unknown operational and integration costs (return on investment - re-sell values)
- Range constraints relative to traditional diesel or gasoline-powered vehicles given current lack of widespread charging and hydrogen refueling infrastructure, and related costs
- Limited availability in many segments due to technological readiness
- Concerns regarding safety, reliability, maintenance, etc.
- Regulatory considerations, i.e. weights & dimensions, commercial vehicle safety regimes
- Lack of training, awareness, and need for collaboration to support new technologies, and dual technologies during transition, across the MHDV ecosystem (owners, drivers, dispatchers, shippers and receivers)
- Uncertainty related to benefits and return on investment of fuel saving retrofits



# Government of Canada Measures to Date

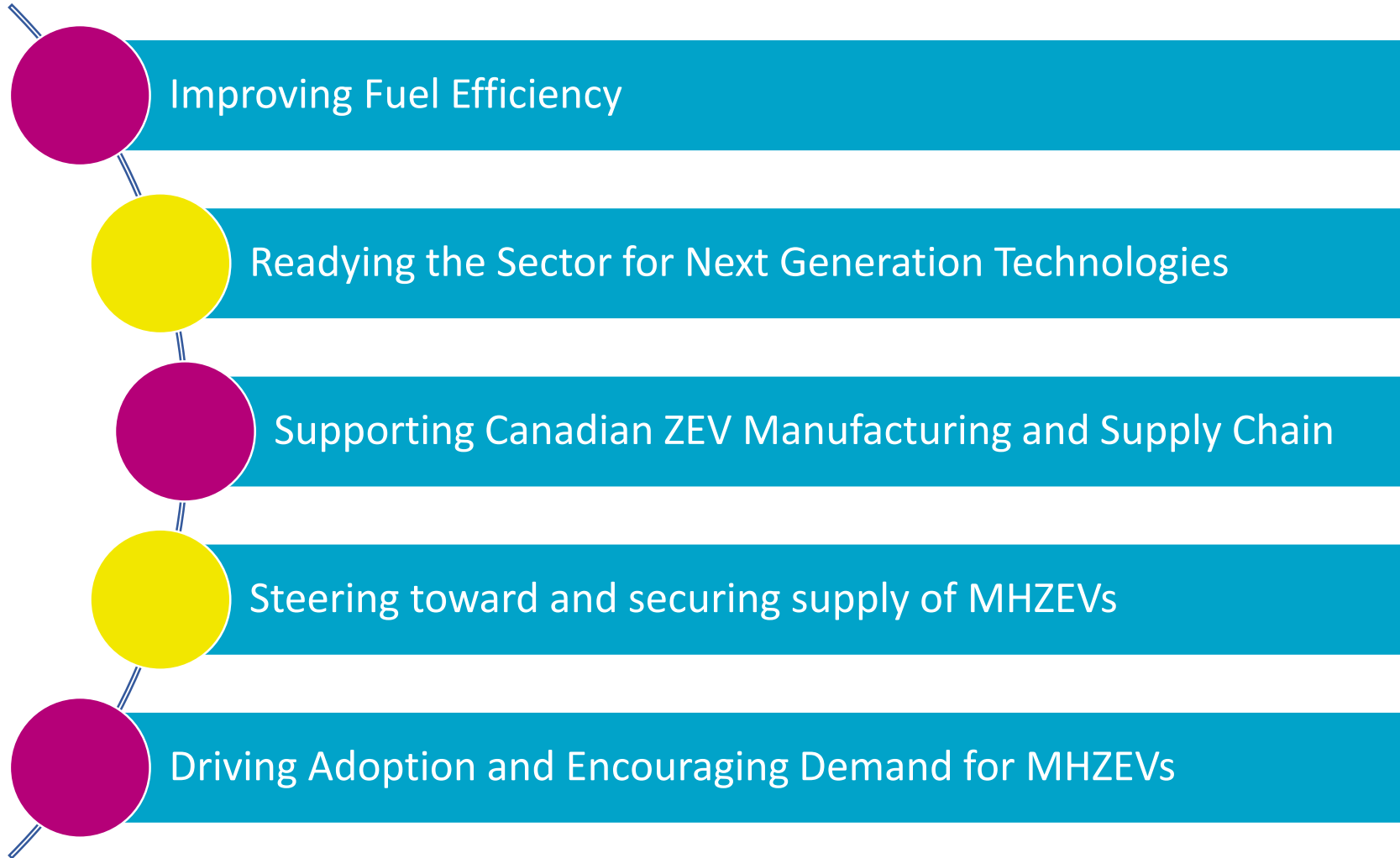
- Carbon pollution pricing
- Heavy-duty vehicle & engine GHG regulations
- Renewable fuel regulations, clean fuel regulations
- Hydrogen Strategy and Clean Fuels Fund
- Strategic Innovation Fund - Net Zero Accelerator
- Energy efficiency programming and Green Freight Assessment Program (GFAP) for MHDV fleets
- 100% tax write-off for business investments in eligible ZEVs
- ZEV infrastructure program (ZEVIP) and related programming
- Investments in research, funding for demonstrations (Electric Vehicle Infrastructure Demonstration Program - EVID)
- ZEV Awareness Initiative
- Investments to electrify transit and school buses (Zero Emission Transit Fund, Zero Emission Buses Initiative)





# Further Action is Required

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# IRENA INNOVATION DAY

**Thank you!**

**René-Pierre Allard  
Office of Energy R&D  
Natural Resources Canada**

## **Arina Anisie**

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**Analyst  
Renewable Energy Innovation  
IRENA**





## Road freight

3 options  
compatible with  
reaching zero  
emissions



### Battery electric vehicles

→ Use electric motors powered by a battery pack, charged with renewable electricity.

### Fuel cell electric vehicles

→ Use electricity produced by fuel cells powered by compressed (green) hydrogen.

### Advanced biofuels

→ Use biomass-based fuel substitutes, such as biodiesels and renewable diesels.

### Current discussion

#### Batteries

- Battery weight
- Drive range
- Impact on power grid

#### H2 fuel cells

- Efficiency
- Costs
- Infrastructure

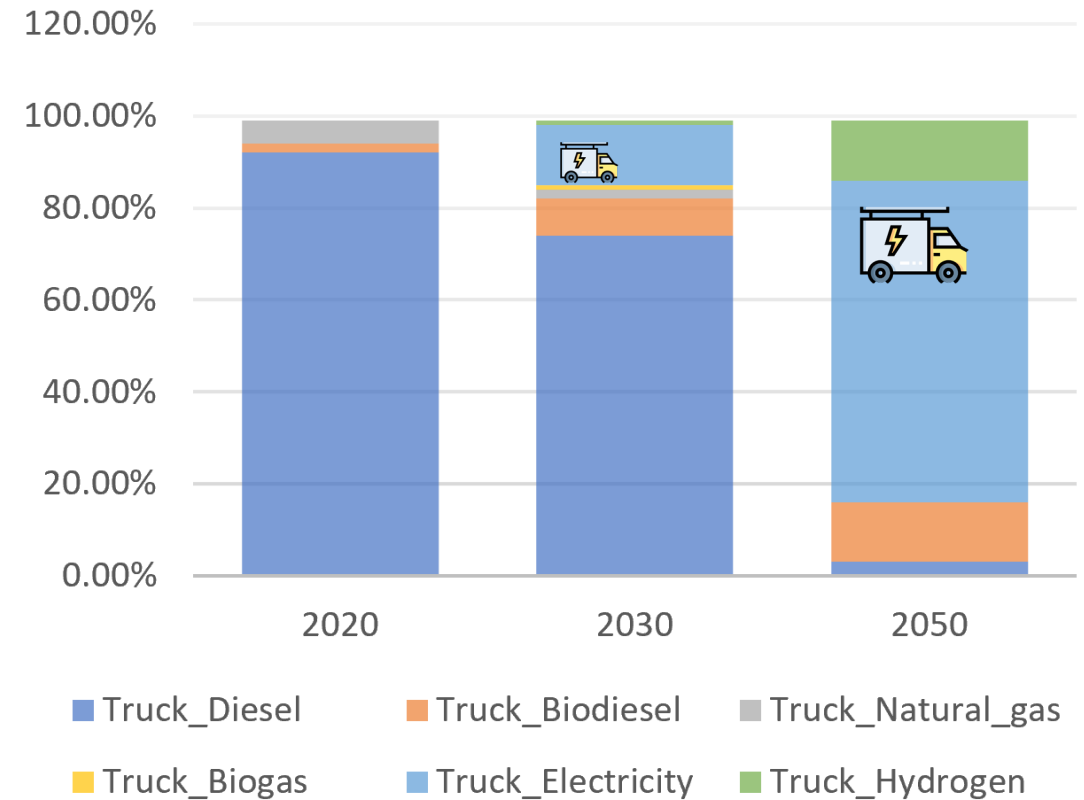
#### Biofuels

- Feedstock availability
- Sustainability

# Road freight to 2050 in 1.5C Scenario

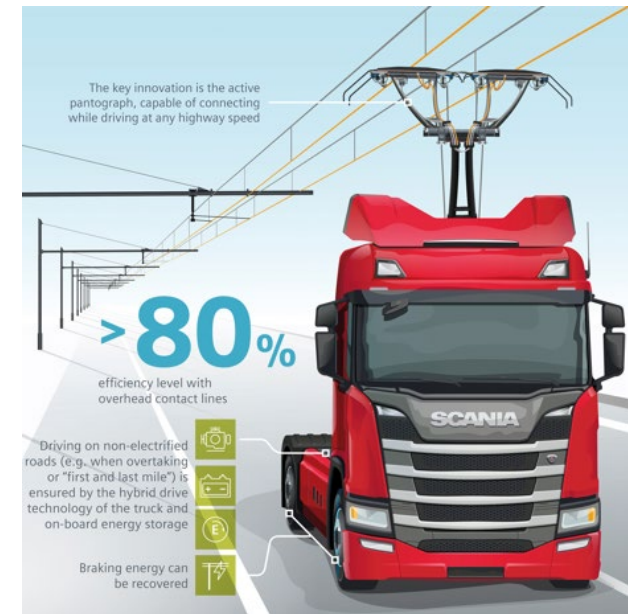
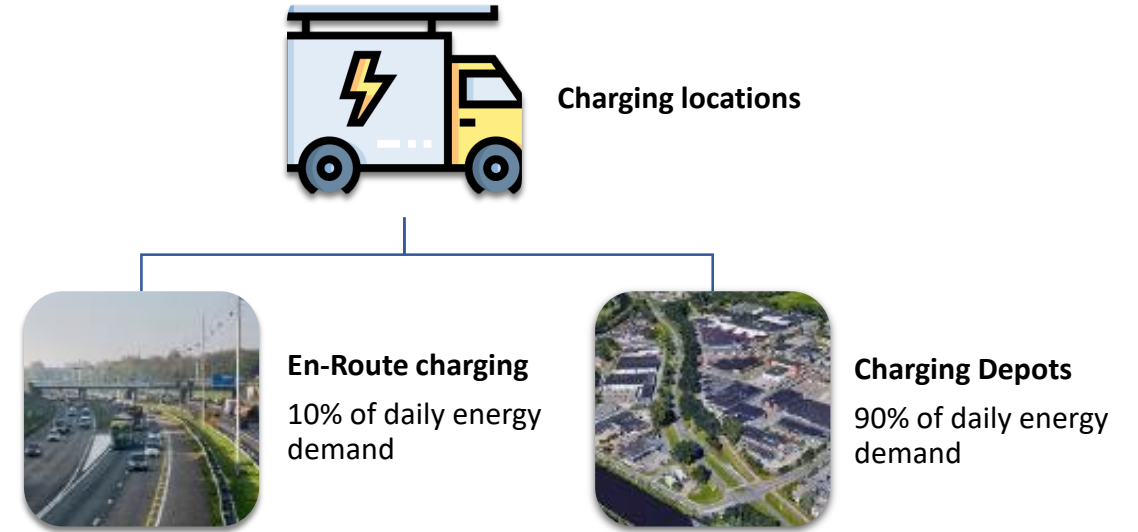
- **2030: 9 million** e-trucks / ~ 3.5 TWh battery capacity / **400 billion USD** in charging infrastructure
- **2050: 60 million** e-trucks / ~ **24 TWh** battery capacity (estimated stationary utility storage 11 TWh)

SHARE OF TOTAL GLOBAL TONNES-KM ROAD FREIGHT ACTIVITY (%)



# Where do HDV charge?

- Main charging locations: **Overnight charging at depot** (80%-90%)
- **En-Route charging** part is only +/- 10% but very important to scale up to longer distances and wider employability of electric trucks
  - Hard to find investors for public chargers for trucks.
- Emerging **hybrid charging systems**: dynamic and stationary
  - Reduce simultaneous charging at depots
  - Potential smaller batteries for e-trucks





# Impact of Charging E-trucks on Power Systems

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**Charing nominal capacity:** 1MW charging point for e-HDV = the peak load of 1,500 households.

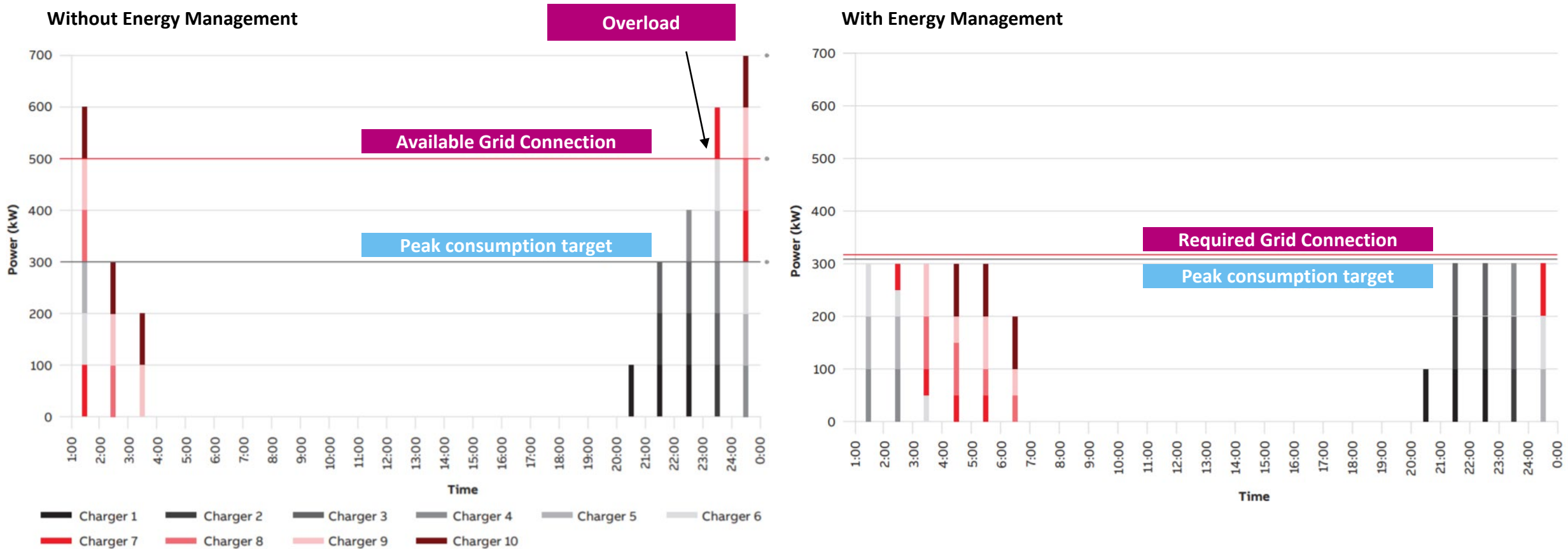
**Investments:** a truck service station along highways requires average > 1 M EUR investment. 400 stations in France around half a billion EUR (cables and posts)(Enedis)

**Planning:** Time needed for the work 1 to 3 years

**Regulation:** E-trucks might not be so sensitive to changing charging behavior via compensation such as ToU tariffs

**Location:** Location of depots should consider power grid availability

Example EV Site Solution: Bus Depot, 10 buses, 300kWh Battery, 10x 100kW chargers

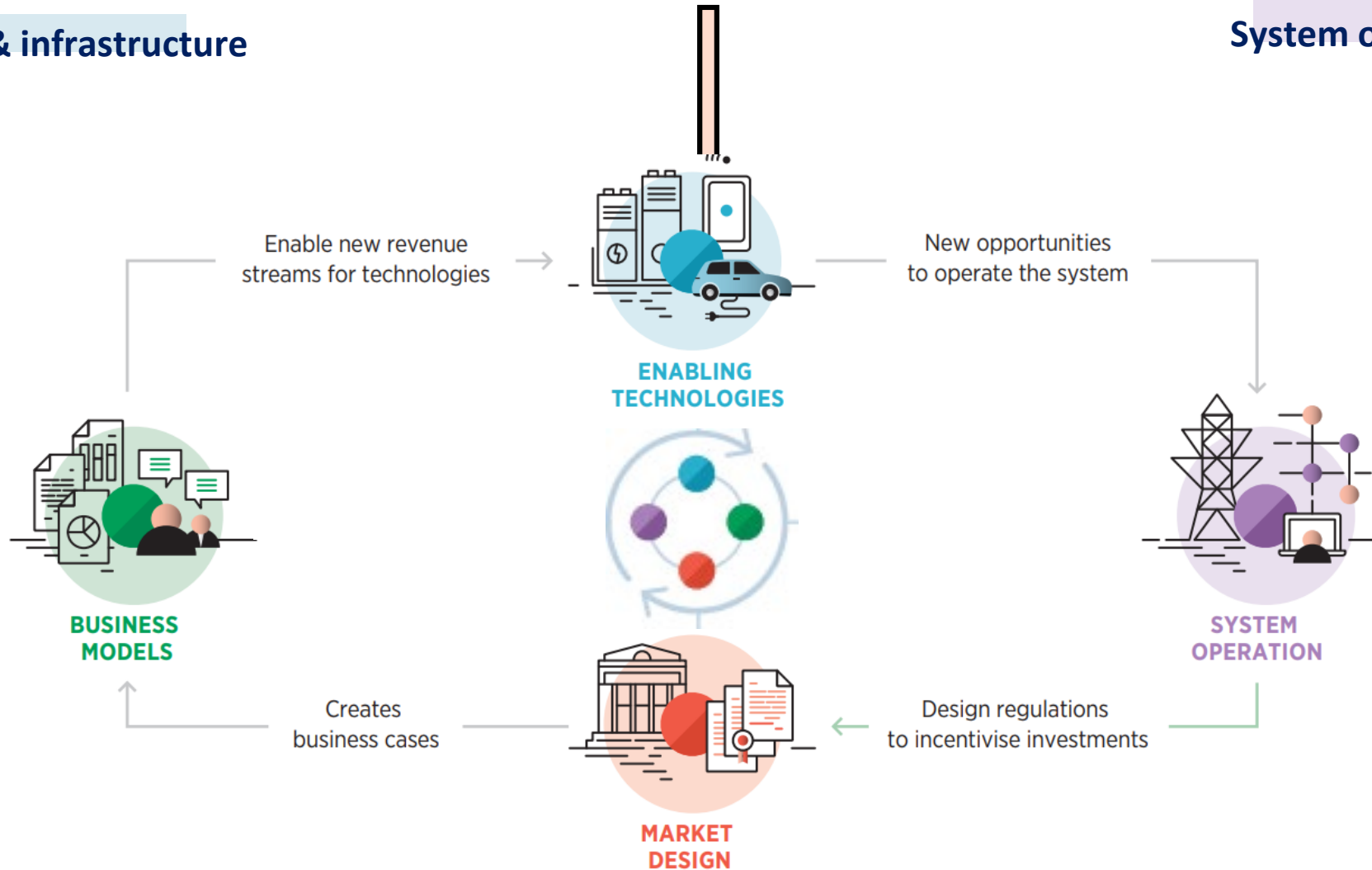


**Energy storage systems and load management reduce the need for distribution grid and transformer expansion**

# Systemic innovation for smart charging of e-trucks

Technology & infrastructure

System operation & planning



Market design & regulations

Business models

# Systemic innovation for smart charging of e-trucks

## Technology & infrastructure



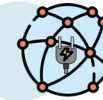
### EV Model Evolution

- Volvo developing eTrucks models



### Charging infrastructure

- **Private depot charging:** DHL-Volvo Pilot project for depot charging (started in 2021)
- **Public depot charging:** Tranzero initiative - building the Nordic region's first public station for electricity and hydrogen for HDV
- **En-route charging:** 1700 charging points over next 5 years
- **Overhead charging:** pilot projects in Sweden and Germany (ELISA project)



### Digitalization

- IoT for EV charging app, monitor charging function: Volvo Connect Portal & MyTruck app
- Digital twins, AI: **CiLoCharging** for smart energy management

## System operation & planning

Europe

## Market design & regulations

## Business models

# Systemic innovation for smart charging of e-trucks

## Technology & infrastructure



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### Charging infrastructure

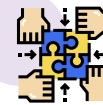
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## System operation & planning



### Cross-sectoral cooperation and integrated planning

- Reel project (public and private sector) - test electrification of HDV transportation in Sweden



### Clean Highway Corridors

- Germany: ELISA project - overhead line system to charge hybrid trucks



### Management of flexible EV load

- ASSURED project: energy storage systems and charging management strategies
- CiLoCharging: smart energy management to integrate HDV in the distribution service

Europe

Market design & regulations

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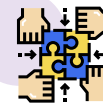
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Europe



### Standardisation and interoperability

- Charging System Standard – DC charging for HDV covering cables, cooling, communication and interoperability
- ASSURED project - testing interoperability of high-power solutions for urban heavy-duty vehicles (charge different types of vehicles with same infrastructure: plug in, overhead and wireless charging)



### Smart tariffs and other system flexibility provision mechanisms

- Early stage pilot projects (ASSURED project)

## Market design & regulations

## Business models

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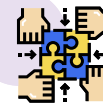
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### Ownership and operation of publicly available charging station

- Tranzero initiative



### EV load peak-shaving using distributed energy resources

- ABB – EV Site Solution



### Logistics as a Service

- Init Project Germany

## Market design & regulations

## Business models



# How to prepare for electric trucks?

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**Grid operators:** integrate EV growth including heavy duty trucks in investment plans and long-term planning. Proactive approach needed!

**Local governments:** work together with the local grid operator in the energy transition to integrate grid reinforcements and substations in destination plans, especially close to logistic areas. Consider charging hubs combined with on-site RE generation, and stationary battery as buffers to manage peak demand.

**National governments:** strategic approach needed for a public fast charging network for electric trucks. Include an efficient grid integration that supports growth over time.

**All stakeholders: Co-operate and plan together for a smart integration approach**



# IRENA INNOVATION DAY

**Thank you!**

**Arina Anisie**

**Innovation and Technology Centre**

**IRENA**

# Session 3: Decarbonising On-Road Transport - PANEL

## Moderator



**Francisco Boshell**

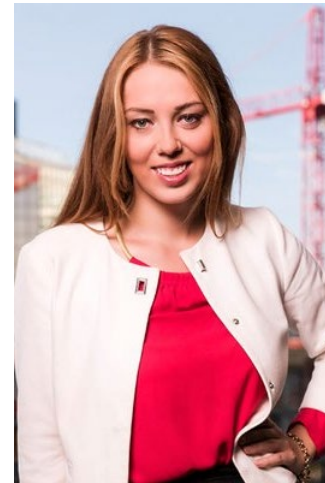
Analyst  
RE Standards & Quality  
Infrastructure  
IRENA

## Panellists



**Mathieu Larivière**

Senior Manager  
NRCan



**Amanda Mesluk**

Senior Manager  
AMTA



**Josipa Petronic**

President & CEO  
CUTRIC



**Hussein Basma**

Associate Researcher  
ICCT

**Mathieu Larivière**

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Senior Manager  
NRCan



## **Amanda Mesluk**

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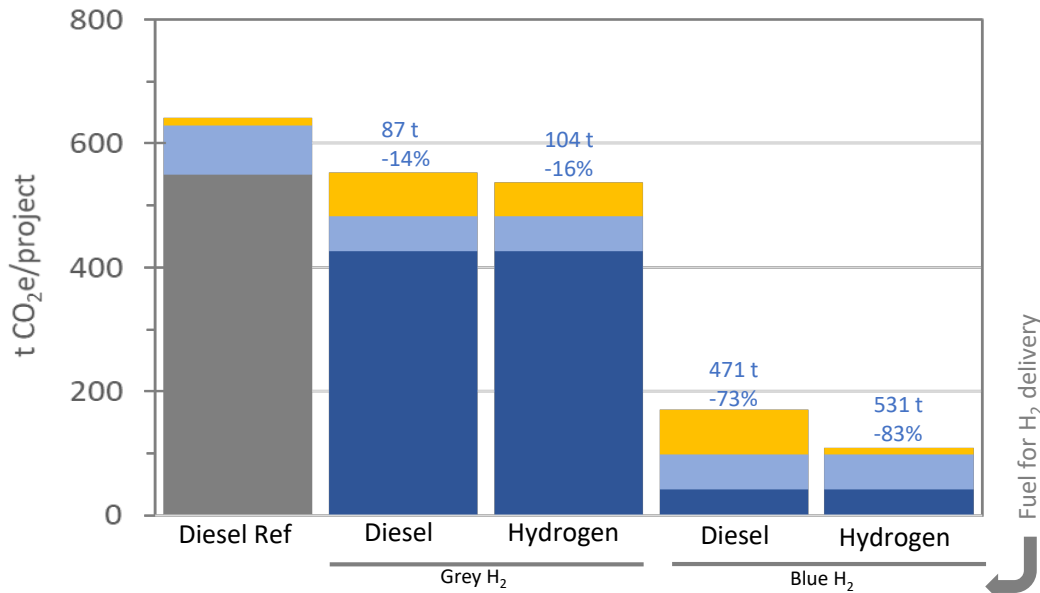
**Senior Manager  
Alberta Motor Transport  
Association**



# Trucking in Alberta

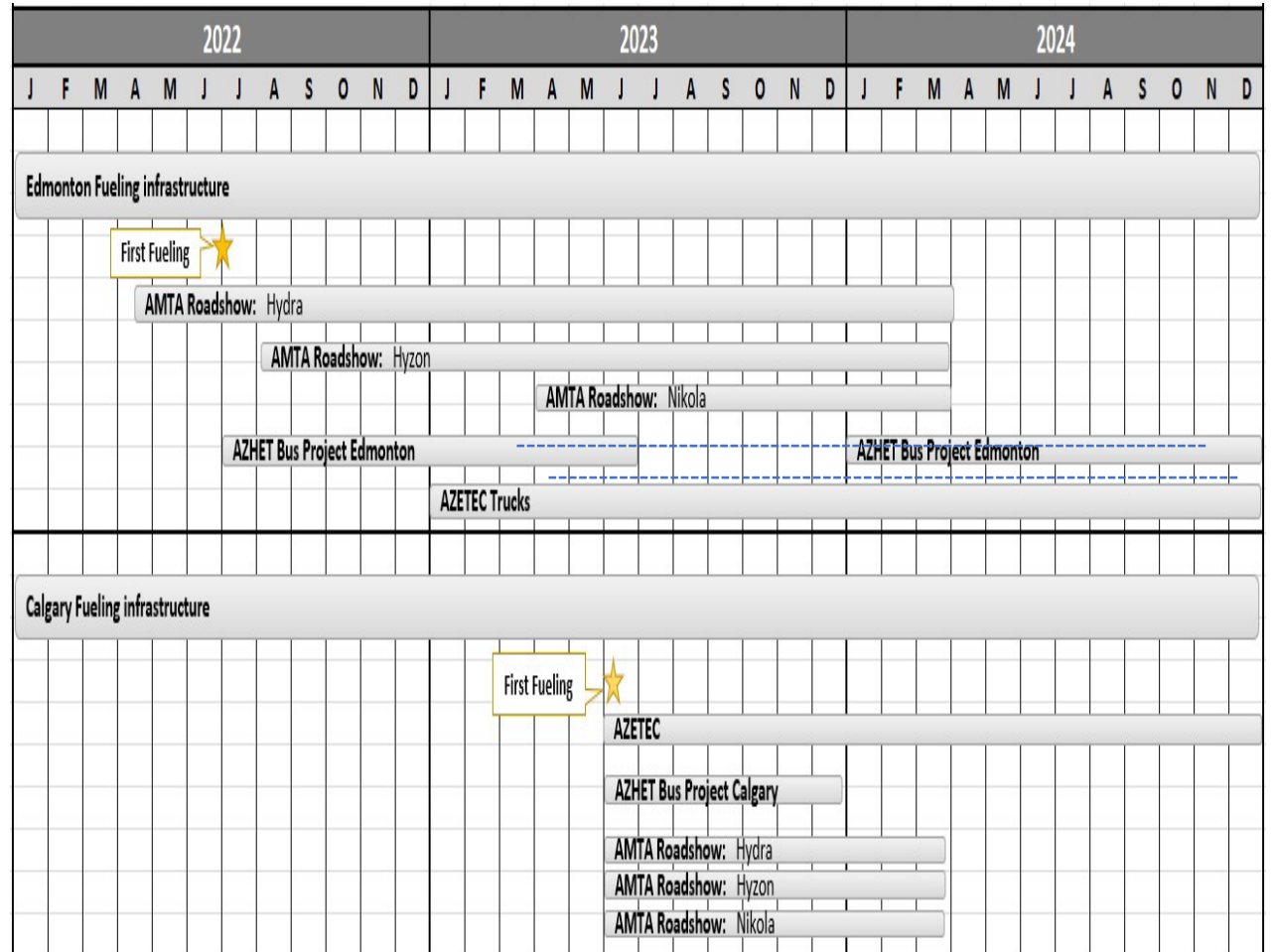
- Trucking is a \$19 billion industry in Alberta
- 5% of Alberta’s GDP
- Alberta’s transportation sector produces 21.5 million ton CO2e greenhouse gas (GHG emissions) annually
- Class 8 trucks are 22% of truck sales and consume 71% of fuel

AZETEC Project Emissions



Tailpipe
  Upstream
  Fuel Transportation
  Hydrogen Production

# Net Zero Mobility Strategy



## The Challenges

### Federal & Provincial Policies

- Industry assistance programming, permitting, customs & importing

### Canadian Weather & Weights

- Technology readiness

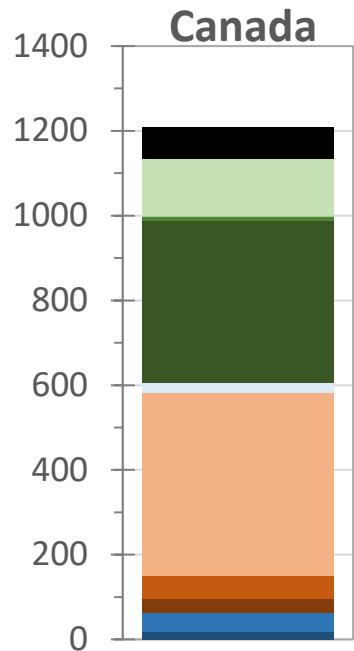
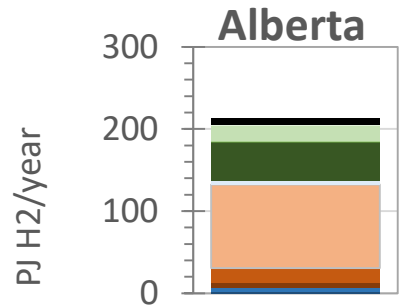
### Market Readiness

- Infrastructure, Fuel, Market demand, Training & maintenance

### Real World Data

- Canadian vehicle performance, GHG avoidance





## The Opportunity

Advancing Net Zero Mobility

Providing Industry with Technology Experiences

Early Market Adoption

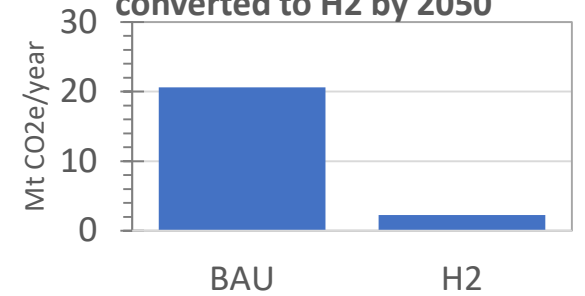
Training & Safety Resources

Industry Reports

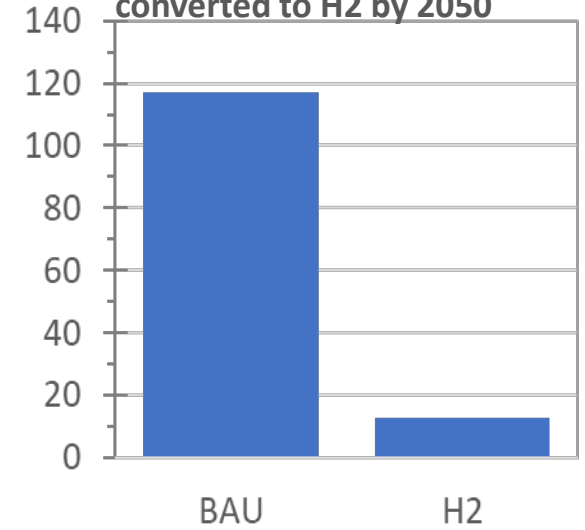
Carrier Tools

Community Awareness

Alberta: GHG Life Cycle for vehicles converted to H2 by 2050



Canada: GHG Life Cycle for vehicles converted to H2 by 2050



# IRENA INNOVATION DAY

**Thank you!**

**Amanda Mesluk**

**Alberta Motor Transport Association**



## **Josipa Petronic**

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**President & CEO  
Canadian Urban Transit Research  
& Innovation Consortium**





## A consortium of transportation innovation leaders

Since: 2015

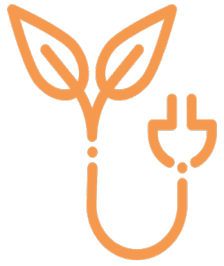
### Members:

130+ (industry, consultancy, utilities, transit agencies, transit operators, government, academia, not-for-profit)

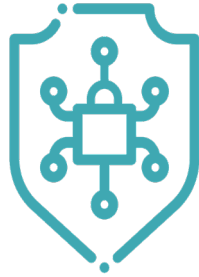
**Focus:** low-carbon smart mobility and technology innovation

**Operations:** British Columbia, Alberta, Manitoba, Ontario, Quebec & Nova Scotia





**Pillar #1:**  
Zero-and low-  
emission  
propulsion  
technologies and  
systems integration



**Pillar #3:**  
Big data for  
mobility analytics

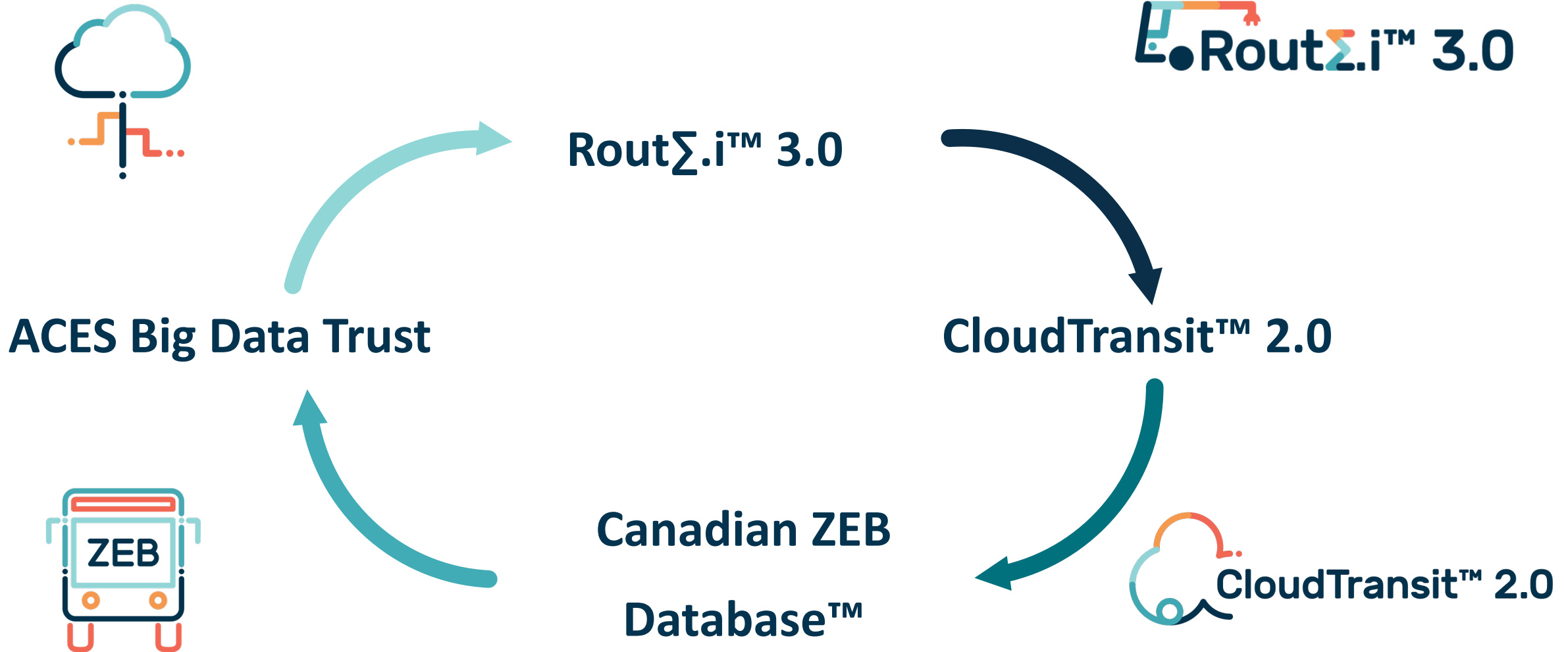


**Pillar #2:**  
Smart vehicles and  
smart  
infrastructure



**Pillar #4:**  
Cybersecurity in  
advanced mobility  
applications

# The Power of Data: CUTRIC Solutions



# The Power of Data: CUTRIC Solutions



**Predictively assess ZEB or AV shuttle energy consumption**



**Recommendation for BEB, FCEB, CNG, e-LSAs selection**



**Calculate actual electricity costs in local jurisdictions**



**Locate optimal locations for opportunity chargers and fuelling stations**



**Predict state-of-charge (SOC) of battery onboard bus**



**Calculate actual GHG reduction from ZEBs, compared with fossil-fuel sources**



**Predict performance success rates for ZEBs considering revenue and non-revenue operations**



**Assess suitability of route/ block/vehicles for electrification**



**Conduct downtime assessments for BEB charging (on route and depot) and FCEB fuelling**



**Assess the ease of electrification**

 RoutΣ.i™ 3.0

 RoutΣ.i™ lite

## Canadian ZEB Database™ Sneak Peak

### British Columbia

- Vancouver

### Alberta

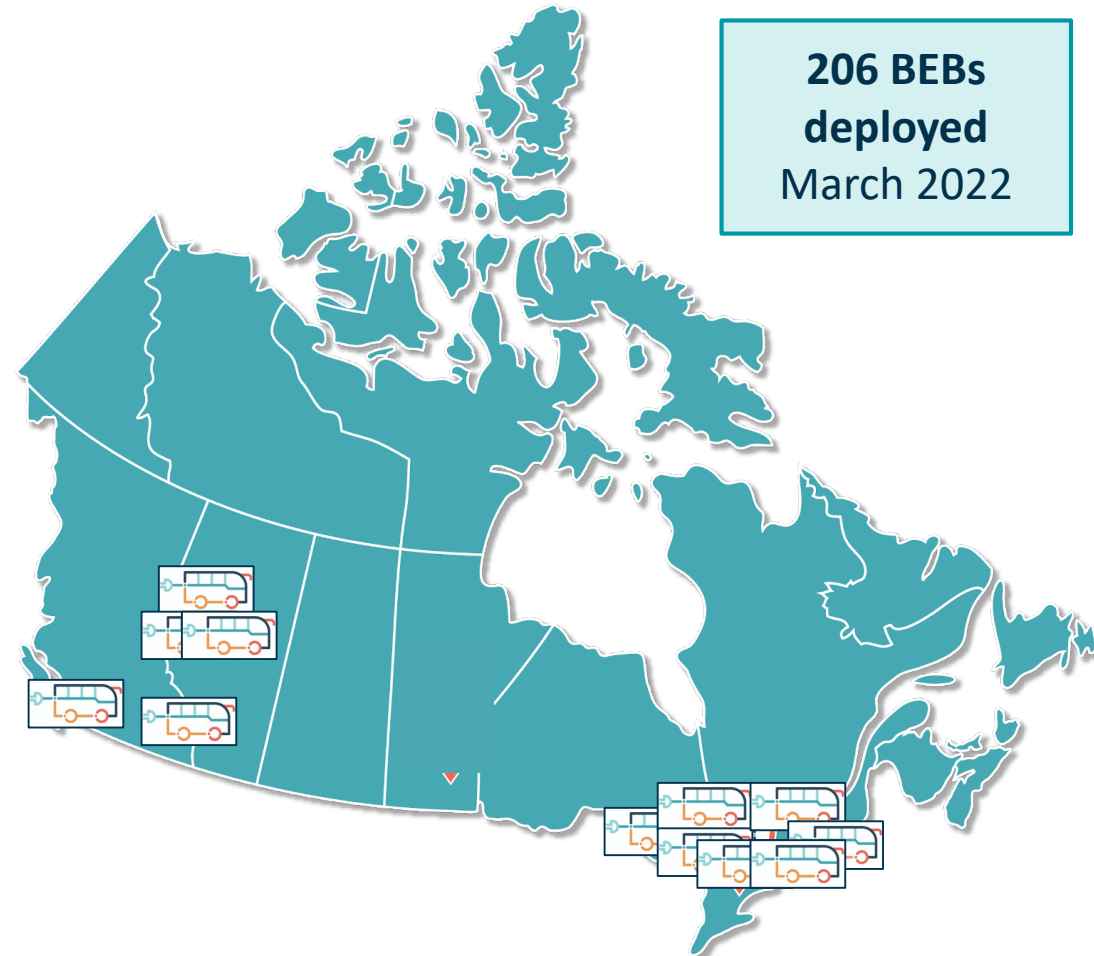
- Bow Valley
- Edmonton
- Grand Prairie
- St. Albert

### Ontario

- Brampton
- Kingston
- Ottawa
- Toronto
- York Region

### Quebec

- Laval
- Montreal



# Pan-Canadian Electric Bus Demonstration and Integration Trial

## Project Overview

**Champion transit agencies:**  
Brampton, York Region & TransLink

**Interoperable & standardised:**  
18 Battery Electric Buses (BEBs) and 7 overhead chargers  
OppCharge™ enabled

**Data driven:**  
Collection of real time asset data and analysis of data to improve operational efficiency



# Pan-Canadian Hydrogen Fuel Cell Bus Demonstration and Integration Trial

## Project Overview

**Champion transit agency:**  
MiWay

**Innovation:**  
10 Fuel Cell Electric Buses (FCEB) powered by local green hydrogen fuel supply chain

**Data driven:**  
Empirical data analysis for first five years of FCEB lifecycle





# IRENA INNOVATION DAY

**Thank you!**

**Josipa Petrunic  
Canadian Urban Transit  
Research & Innovation Consortium**

## **Hussein Basma**

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**Associate Researcher  
International Council on  
Clean Transportation**



# IRENA INNOVATION DAY

**Thank you!**

**Hussein Basma  
International Council on  
Clean Transportation**