CANADIAN URBAN TRANSIT RESEARCH & INNOVATION CONSORTIUM (CUTRIC)

CONSORTIUM DE RECHERCHE ET D'INNOVATION EN TRANSPORT URBAIN AU CANADA (CRITUC)

CUTRIC · CRITUC

Burlington Transit Electric Bus Modelling

Burlington - #1 in Maclean's Best Communities in Canada Listing 2020

BURLINGTON TRANSIT

CUTRIC · CRITUC

Pan-Canadian E-Bus Phase I :

Pan-Canadian E-Bus Phase I : Project Launches

Brampton Transit

Brampton to receive $11 million for world's 1st compatible electric bus network

The city will be receiving 8 new electric buses complete with overhead charging systems

NOTICE TO READERS: Register now to support your local journalism!

Electric buses to hit Newmarket routes next year

Riders can expect smoother, quieter ride, exposure to less fumes and possibly lower fares

NEWS Aug 21, 2019 by Teresa Latchford Newmarket Era

YORK REGION TRANSIT

NEWMARKET Hydro

Newmarket-Tay Power Distribution Ltd.

TransLink's battery-electric buses hit the road in Metro Vancouver

TRANSLINK

BC Hydro

CUTRIC · CRITUC

E-Bus Phase I : Project Steering Committee Partners

Transit Systems

Brampton Transit

York Region Transit / VIVA

TransLink

OEMs

NovaBUS
Driven by your city

New Flyer

ABB

Siemens

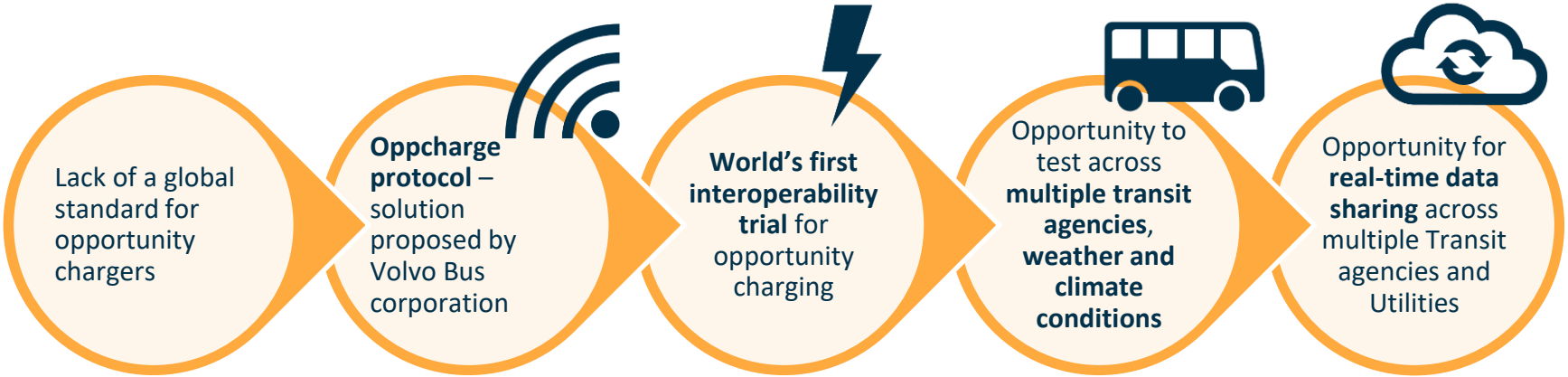
Utilities and Others

Newmarket Hydro

Viriciti

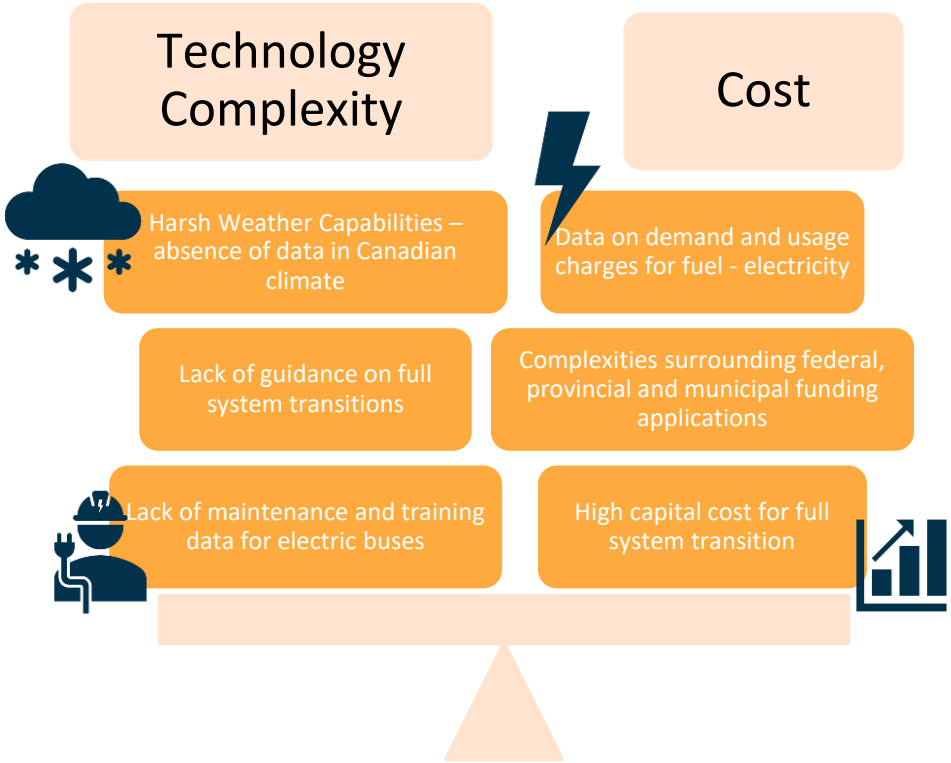
CUTRIC · CRITUC

E-Bus Phase I : Opportunities



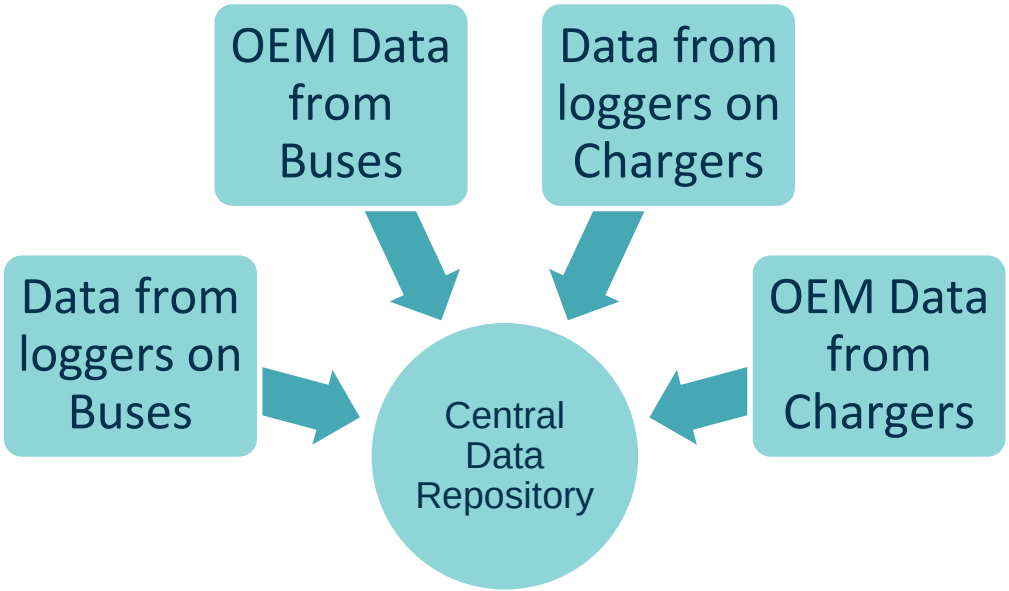
CUTRIC · CRITUC

E-Bus Phase I: Challenges



CUTRIC · CRITUC

E-Bus Phase I: Solutions – Real Time Data Sharing



- Real time data sharing
- Analytics for operational improvements
- Sharing of best practices

CUTRIC · CRITUC

Next Steps : ACES Big Data Trust

Expanding on E-Bus phase I

Automated
Connected
Electric
Shared

Leveraging both funding and Supercluster, AI and analytics talent

Dual Headquarters

Ontario

Quebec

Multiple OEM Partner project proposals

- Feeding Data into trust

Application to FedDev Ontario - Ongoing

- Startup Funding

SIF Stream 5 Funding

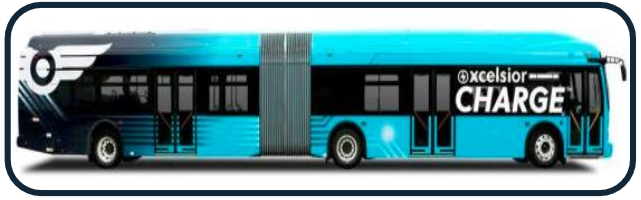
- Potential start-up funding

CUTRIC · CRITUC

Pan-Canadian E-Bus Phase II & Innovation P3© : Consultation Phase

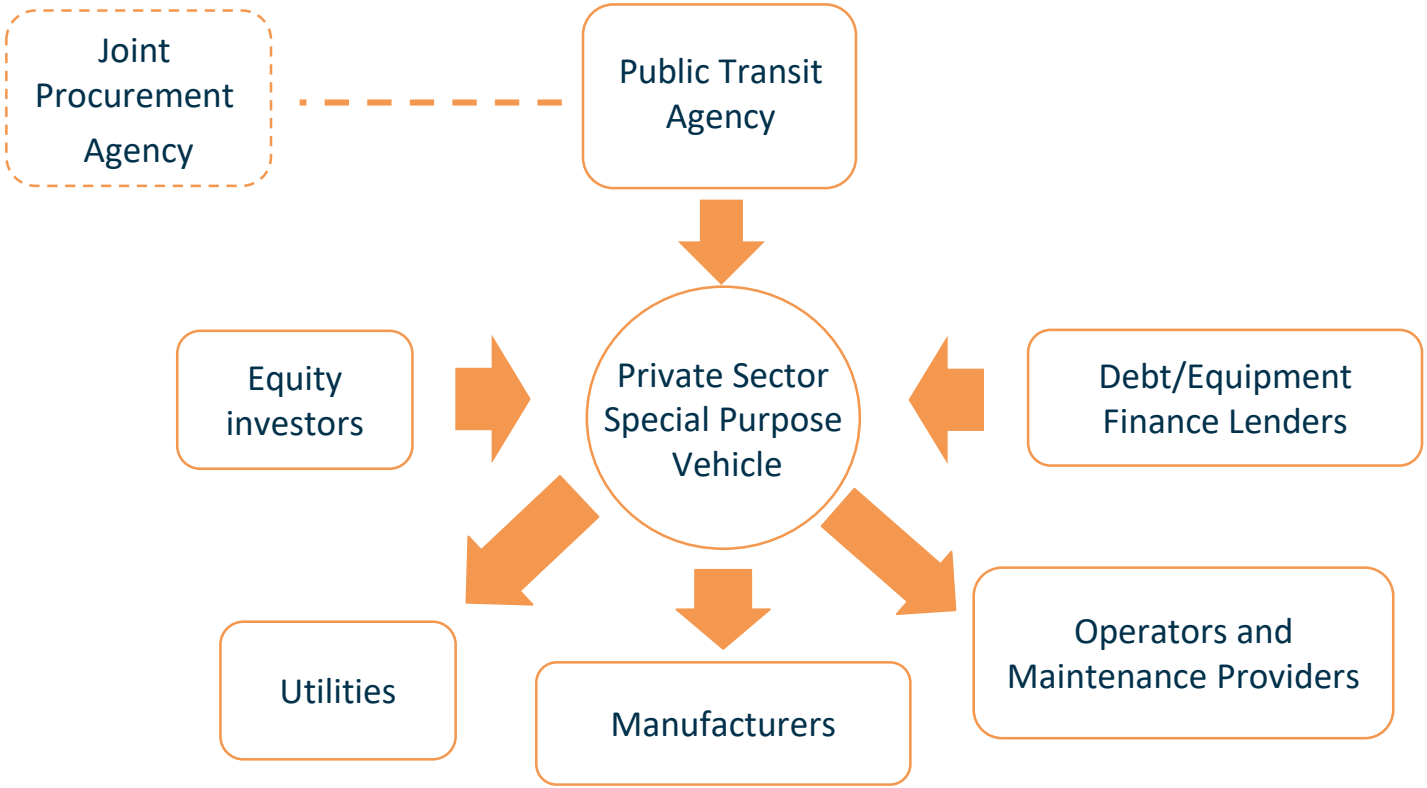
E-Bus Phase II : Consultation Process

Interoperability Focus	• SAE J3105 and J1772 compliant
Partners	• “Coalition of the willing” • Exploratory Phase
Procurement Approach	• Innovation P3©
Charger Standards	• 450 – 600 kW overhead chargers • Energy storage integration • Smart control enabled plug-in charging



CUTRIC · CRITUC

E-Bus Phase II : Innovation P3©



CUTRIC · CRITUC

Cost Profile

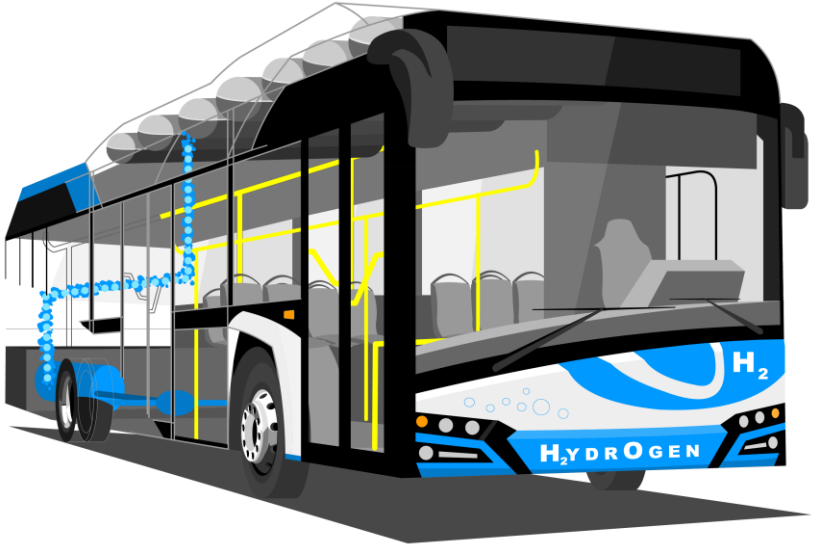
- Battery Electric Buses - C$800K - C$1.0M
- Opportunity Chargers - ~C$1.0M
- In depot Chargers - C$200K - C$250K
- Facility Modifications (garage refurbishment) – C$250K+

CUTRIC · CRITUC

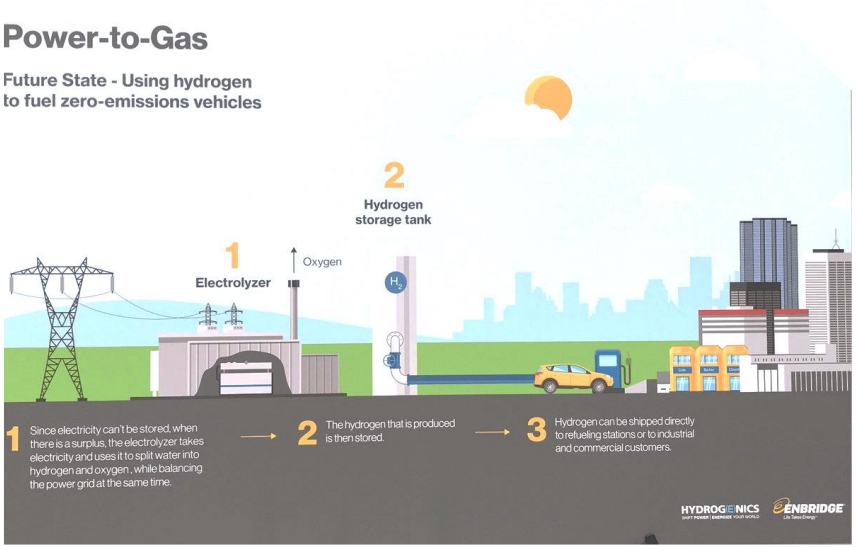
Pan-Canadian Hydrogen Fuel Cell Electric Vehicle Demonstration & Integration Trial

Project Opportunities

Environment - Technology - Economy



FCEBs



Surplus Electricity to Hydrogen

CUTRIC · CRITUC

Key Participants

Project Partners

MiWAY

BALLARD

NEW FLYER

HYDROGENICS
SHIFT POWER | ENERGIZE YOUR WORLD

ENBRIDGE

Advisors/Observers

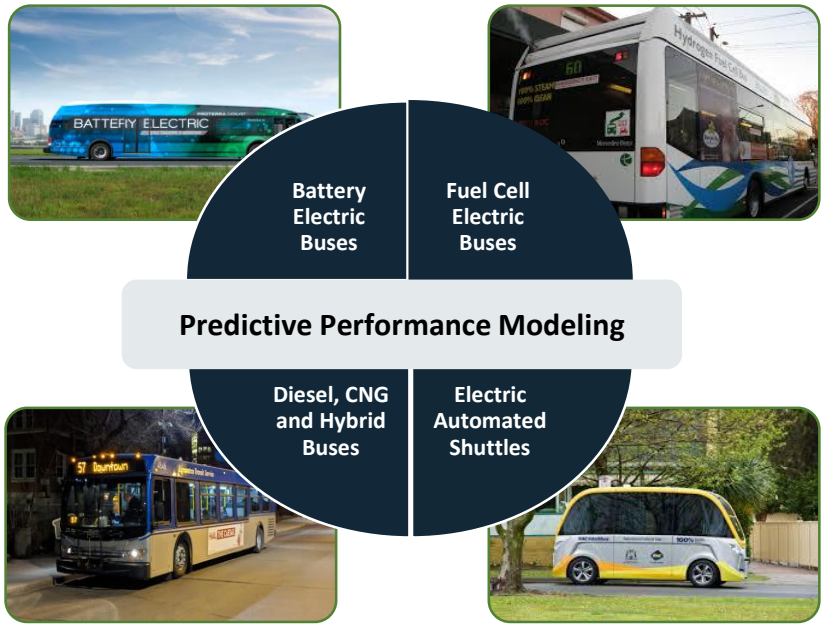
Brampton Transit

YORK REGION TRANSIT \ VIVA

CUTRIC · CRITUC

CUTRIC's Rout∑.i™ Modeling – Capabilities

- Predict time to charge BEB (on route and depot)
- Calculate actual electricity costs in local jurisdictions
- Predict state-of-charge (SOC) of battery onboard bus
- Predictive bus or AV shuttle energy consumption analysis

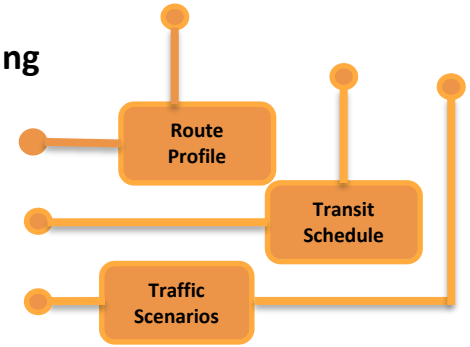


- Predict time to fuel for H2 fuel cell bus (FCEB)
- Assess suitability of route/block for electrification
- Recommendation for BEB, FCEB, e-LSAs selection
- Charging and route schedule analysis
- Calculate actual GHG reductions

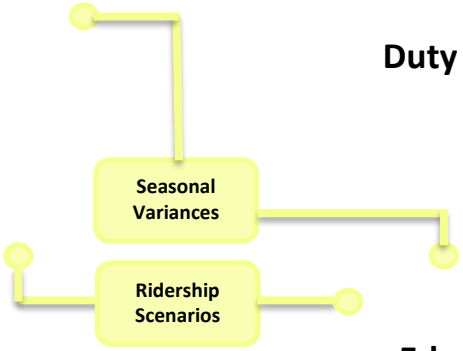
CUTRIC · CRITUC

Rout∑.i™ Modeling Methodology

GIS Modeling

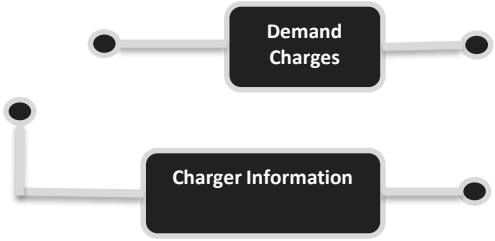


Duty Cycle Generation

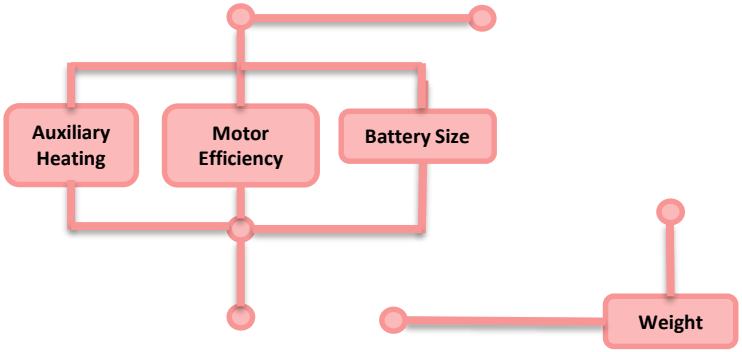


Rout∑.i™

Charging Schedule Analysis



E-bus/H_2 Modeling



CUTRIC · CRITUC

Rout∑.i™ Modeling – Milestone Projects

CUTRIC · CRITUC

Burlington Transit Electric Bus Modelling

Route 4 map

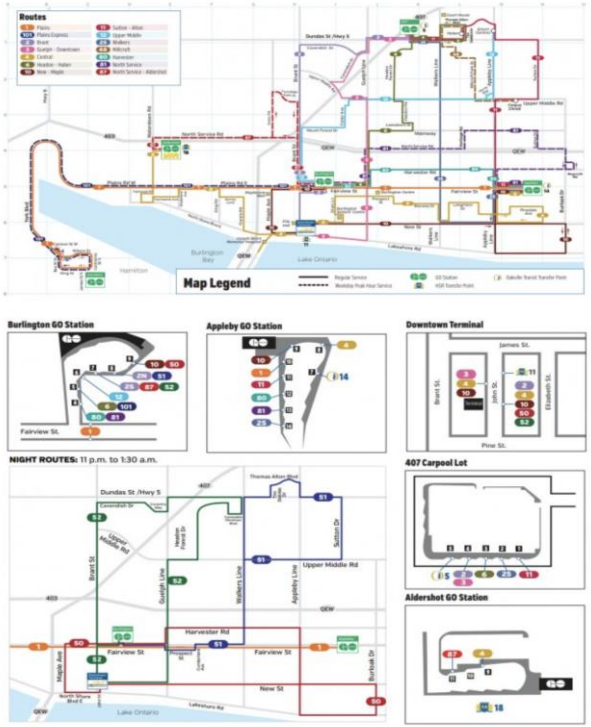
CUTRIC · CRITUC

Burlington Transit Electric Bus Modelling

Route 10 map

CUTRIC · CRITUC

Burlington Transit: Full System Electric Bus Modelling



CUTRIC · CRITUC

Burlington Transit Modelling – Objectives

Energy Analysis (BEB Technology Performance on BT System)

Economic Analysis

GHG Emissions Analysis

Schedule Optimization

Opportunity Charger Analysis

Ease of Electrification

CUTRIC · CRITUC

Variables Considered

Route Analysis Variables

- Electric bus: 400 kWh and 600 kWh (40 ft and 60 ft)
- Charging system options/strategies: TBD
- High-powered rapid charging (e.g., 450 kW, 600 kW)
- Low-powered slow charging (e.g., 80 kW, 150 kW)
- Distance to depot

Economic Variables

- Cost of Ontario electricity grid
- Cost of diesel

Vehicle Performance Variables

- Topography
- Average speed
- Average acceleration/deceleration
- Ridership (real-time)
- Stop location
- Schedule of stops (time of use)
- Vehicle weight
- Auxiliary load
- Coefficient of rolling resistance
- Motor and electronics performances
- Congestion of inter-linked routes at station stops

CUTRIC · CRITUC

Ontario Messages: CUTRIC Outreach Goals

1. **P3 and Building Green Transit**

- Support CUTRIC's framework development for an innovative public-private partnership model, **Innovation P3©** to help launch a York Region-Brampton-Burlington-Oshawa-Guelph Battery Electric Bus Integration Project & the MiWay Hydrogen Fuel Cell Electric Bus Integration Project.

2. Better Data, Better Procurement

- Ensure respect for taxpayer dollars through superior procurement decision-making by supporting CUTRIC's (publicly controlled) **ACES Big Data Trust** ("Autonomous, Connected, Electric & Shared" Big Data Trust).

CUTRIC · CRITUC

Thank You

CUTRIC · CRITUC