Battery-Electric Trucks

As an option to decarbonize Long Haul Trucking in Eastern Canada

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A bit of background

Innovative Vehicle Institute (IVI) :

- Research center that has been dedicated to EVs and Autonomous vehicles for >25 years
- R&D projects are at the core
- Fleet deployment projects for the first units of new technologies

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A bit of background

Plug-in Fleet Project :

- 3 years large-scale demonstration project for class 6-8 BEV HD Trucks
- Emphasis on <160 km radius with Return to Base (RTB) applications

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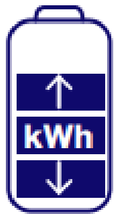
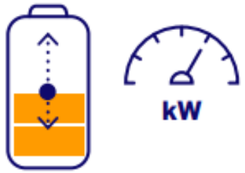
State of the market

- As of December 2022, 70 BEV trucks are registered in the province of Quebec
  - Mostly used for LTL, regional haul, roadwork, 3PL, etc
- All major legacy truck manufacturers now offer electric trucks
  - Volvo, Peterbilt, Kenworth, Freightliner, International, etc.
- In Quebec, the early movers have now been operating 1 or 2 electric trucks for about a year. We are roughly 3 years behind California, in terms of project sizes and involvement levels
- BEV trucks are roughly 10 years behind light-duty EVs
- Long haul is not here yet. In the next decade, it will be made possible « without much more effort », or « naturally »

Current specs





- Class 8 trucks are currently delivered with 350-600 kWh batteries
- They require 150 – 250 kWh/100 km
- Can yield in a 250 km – 450 km range

- Current max. charging power are approximately 150 kW (up to 250 kW for some)
- Charging times for 80% SOC are about 60-120 min

- Payload and elevation gain have a major impact on range
- Payload is affected by battery weight – but not everyone operates at max. payload
- Preliminary data shows that winter does not affect range nearly as much as in LD EVs

Icons : Hydro-Quebec and rigi.tech

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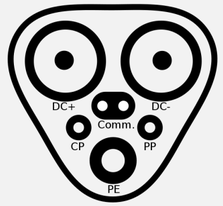
Future specs

- Battery energy density (kWh / kg) is progressing fast
- Megawatt Charging System (MCS) is being discussed



- High-level parity outlook on various parameters (compared to diesel) :

CLASS 7 AND 8 CBEV PARITY VS. DIESEL SYSTEM (NACFE)

		NOW	2020	2025	2030	BEYOND
WEIGHT	Tare Weight				Parity	
	Typical Freight Weight		Parity			
	Max Freight Weight				Parity	
COST	Initial Cost					Parity
	Net After All Factors			Parity		
	Operating Cost			Parity		
	Residual Value Used Market				Parity	
	Residual Value Salvage/Repurposing				Parity	
MAINTENANCE EFFORT	Service Center				Parity	
	Remote Diagnostics		Parity			
	Breakdown Recovery				Parity	
VEHICLE LIFE	10-Year Service Life			Parity		
	Max Life Before Obsolete					Parity
RANGE	Typical Daily Range			Parity		
	Max Daily Range				Parity	
ELECTRICITY AVAILABILITY	Yard “Fueling”			Parity		
	Truck Stop “Fueling”					Parity
	“Fuel” Pump			Parity		
	“Refill” Time					
GENERAL	Overall Technology Maturity					Parity
	Safety		Parity			
	Environment		Parity			

Key: Comparison to ‘Equivalent’ Diesel Baseline: Worse Parity Better

Source : NACFE’s Guidance Report « Electric Trucks : Where they make sense » - 2018

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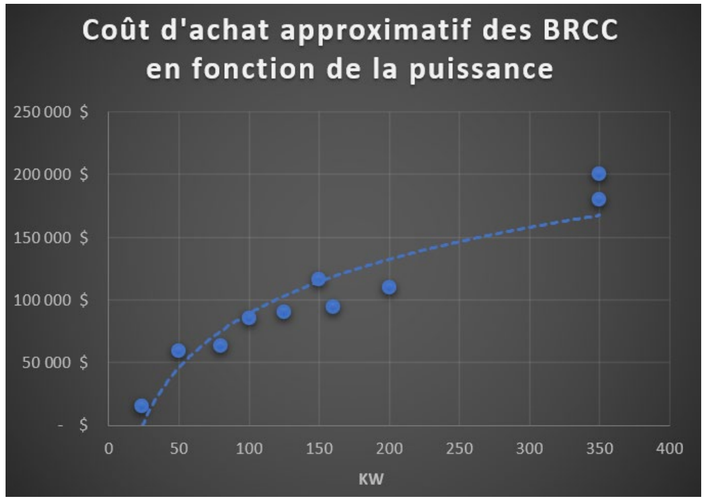
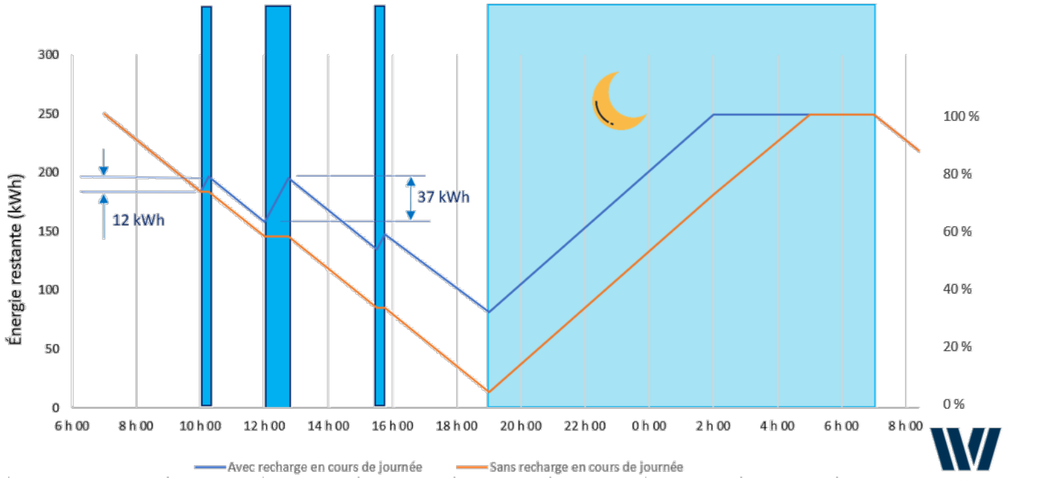
Charging BEV HD Trucks

Source : NFI Industries

- **Fleet-operated chargers**
  - Relatively high costs
  - Installation may require to own the building
  - It is now easy to find resources for help in the procurement and installation process.
  - Software to manage EV operations are on the rise
  - Privately owned stations may be used for opportunity charges



DCFC stations approx. prices by charging power
Source : IVI



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Charging BEV HD Trucks

- **Public/shared charging stations**
  - Multiple startups, pilot projects and shared stations hubs are currently underway
  - Both from public charging network and private fleets, there is a will to deploy hubs

Source : Hydro-Québec

Electric Island, Oregon
Partly owned by DTNA and PGE
Source : IVI

Source : WattEV

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Strengths

- BEV trucks are **already on the road** (mainly for regional haul)
  - Long-haul trucks will come to market « by themselves », following battery development
- Upfront **costs are no longer a big issue**. Subsidies…

  …Currently cover almost all of the cost difference

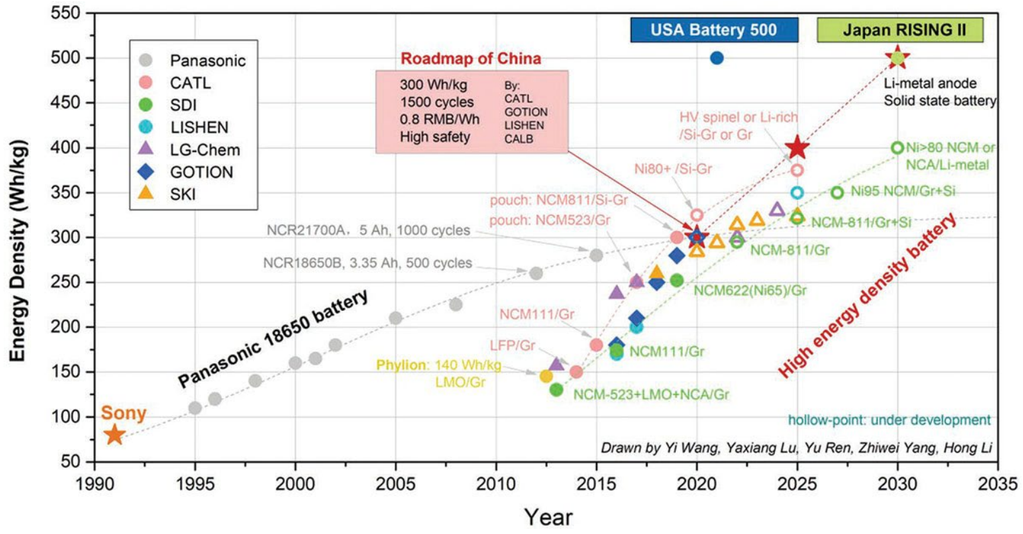
  …Cover pilot projects and internal hours, as well as consultancy (if applicable)
- Private charging station deployment, although not as easy as it seems, is now a **broadly covered topic** and there is a complete mesh of documentation, vendors, service providers and consultants to support it
- **Charging is easy**. Park, plug, confirm charging, go home.
- **Simple vehicle architecture** compared to ICE, Hydrogen or Hybrid

Weaknesses

- **Charging time** is the main hurdle
  - Most operators expect the same refuling time as for conventional trucks, no matter the ROI of a solution, as a whole
- **Payload « penalty »** of around 4 000 lbs.
- Chargers are **new assets** to manage and maintain
- **Demand charges** ($/kW) will become highly considerable for larger charging stalls
- There is a steep **learning curve** for managing large EV fleets and chargers

Opportunities

- Public/shared charging stations are coming in North America
- Battery density (kWh/kg) is improving, slowly reducing the payload « penalty » and allowing a higher range
- Battery prices are getting lower every year
- The grid is getting cleaner every year



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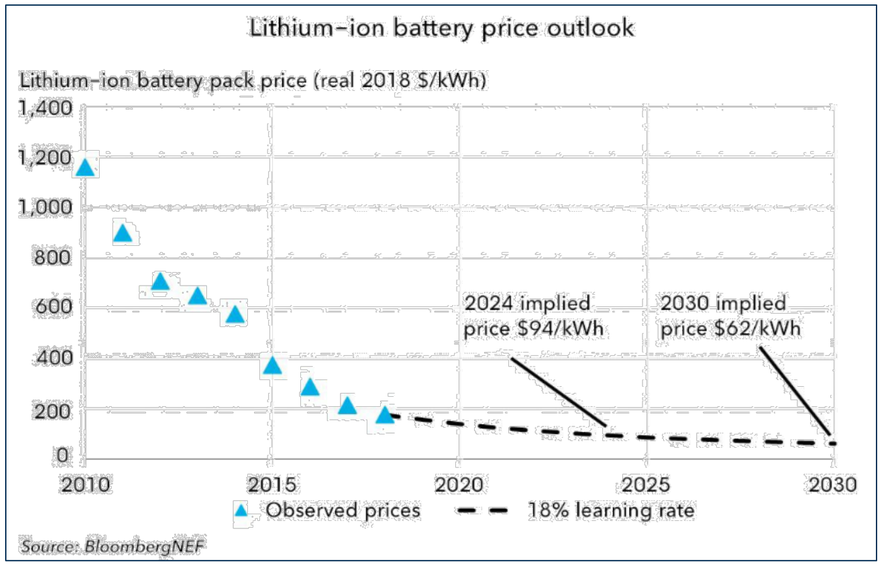

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Threats

- There is a lot of misinformation around EVs leading to a slower adoption
- Very dependent on the battery supply chain
- The labour shortage is currently a problem that is blocking certain fleets from taking on innovative projects such as an energy transition
- The amount of marketing around new EV technology leads many to think that the next leap in technology is around the corner
- Long haul is not the « Low-hanging fruit » for OEMs

Recommendations for decision makers

- Push for purpose-built public charging hubs at already existing truck stops along main corridors
- Maintain subsidies year-round with no dead zone between program editions
- Continue pushing to bring more dedicated HD EV Trucks maintenance and repair programs to the HD truck mechanics

www.ivisolutions.ca
www.pluginfleetproject.ca

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Flotte
rechargeable
Camions lourds