

Next Generation Battery for the Grid and EV

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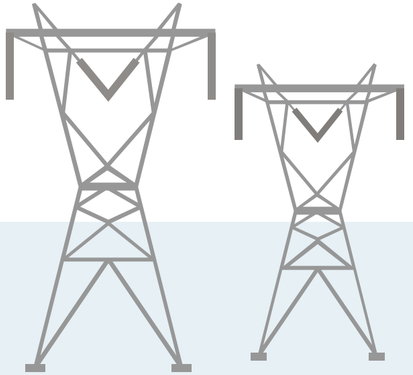
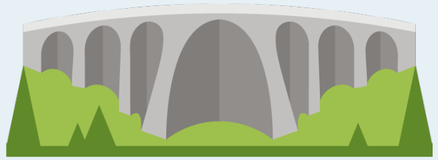
Centre of Excellence in Transportation Electrification and Energy Storage
Hydro-Québec

Hydro-Québec at a Glance



PRODUCTION

- **63** hydroelectric generating stations
- **36,912 MW** of installed capacity

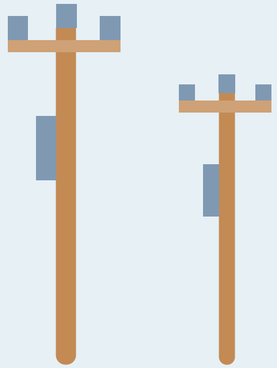


TRANSMISSION

- **34,270 km**
- North America’s most extensive system
- **335** transmission substations
- **15** interconnections with neighboring systems

DISTRIBUTION

- **4.2 million** customers
- **116,260 km** of distribution lines



INNOVATION, EQUIPMENT & SHARED SERVICES

- Over **1,100** projects/year ($2.225 million in 2016)
- Social acceptability: **98.8%**

WORLD-CLASS INNOVATION CENTER

Hydro-Québec Center of Excellence in Transportation Electrification and Energy Storage

State-of-the-art infrastructure

Over 15 labs specializing in battery materials

Patents

550 granted

800

patent applications

Licenses

60

licenses granted

R&D partnerships

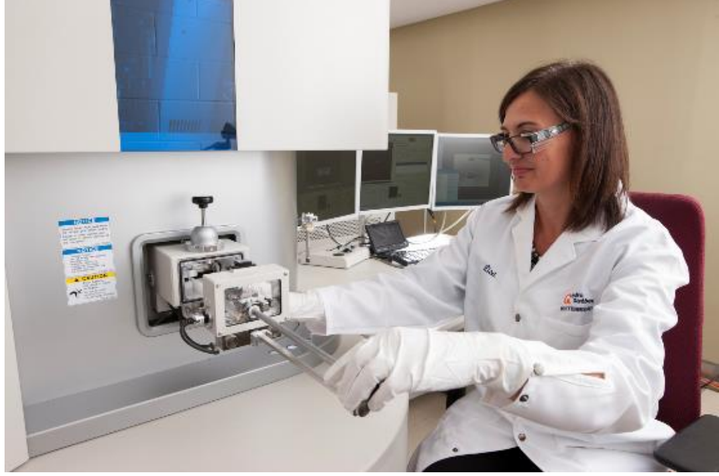
ESSTALION

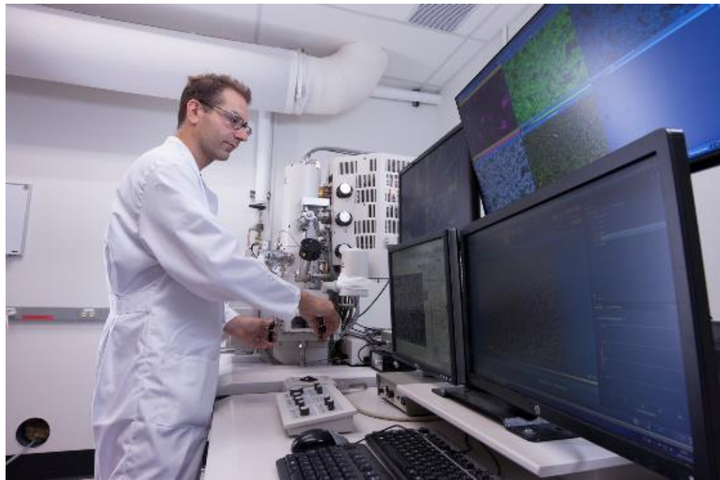
Hydro Québec

muRata

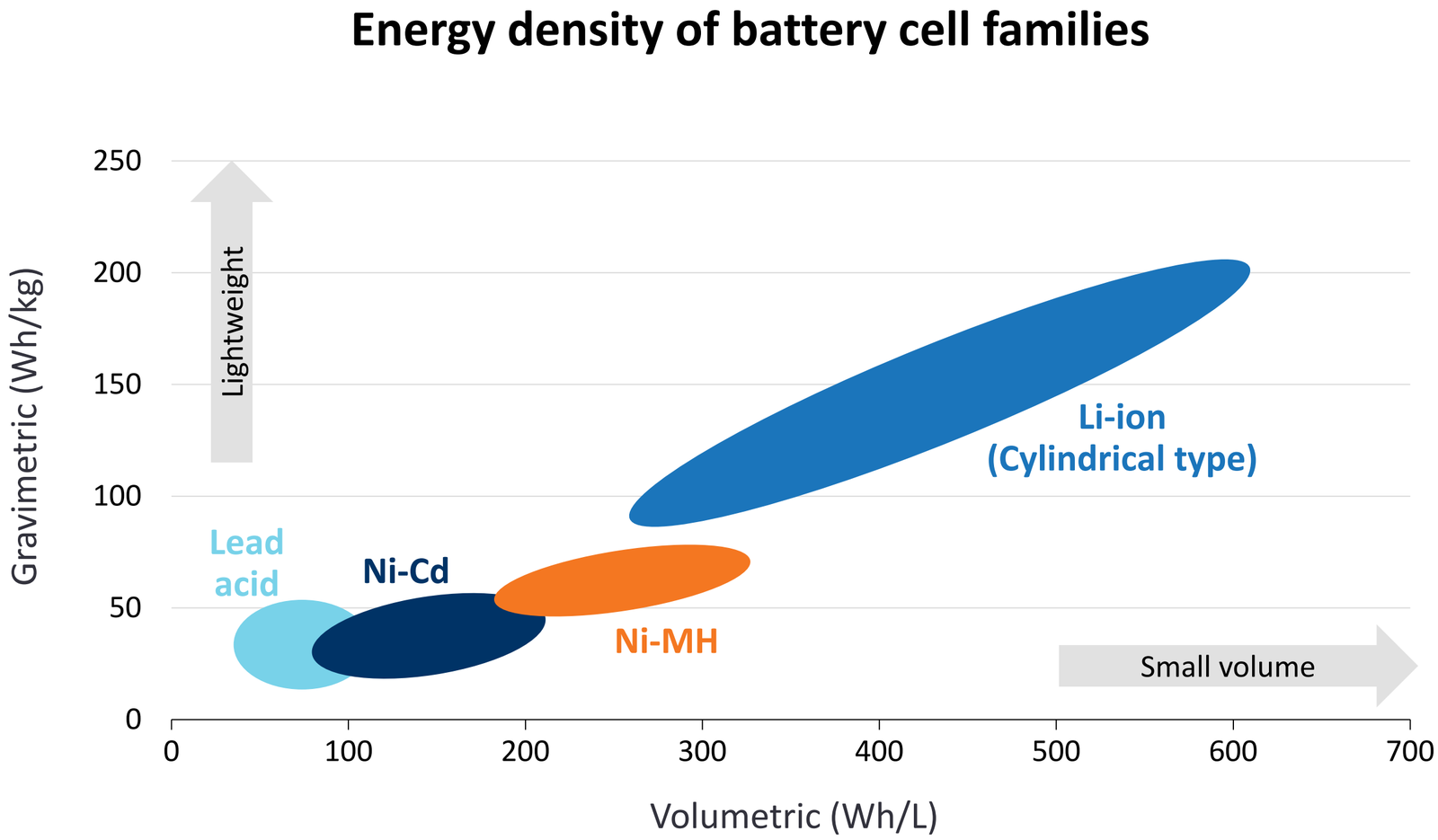
SCE France

Une filiale d'Hydro-Québec



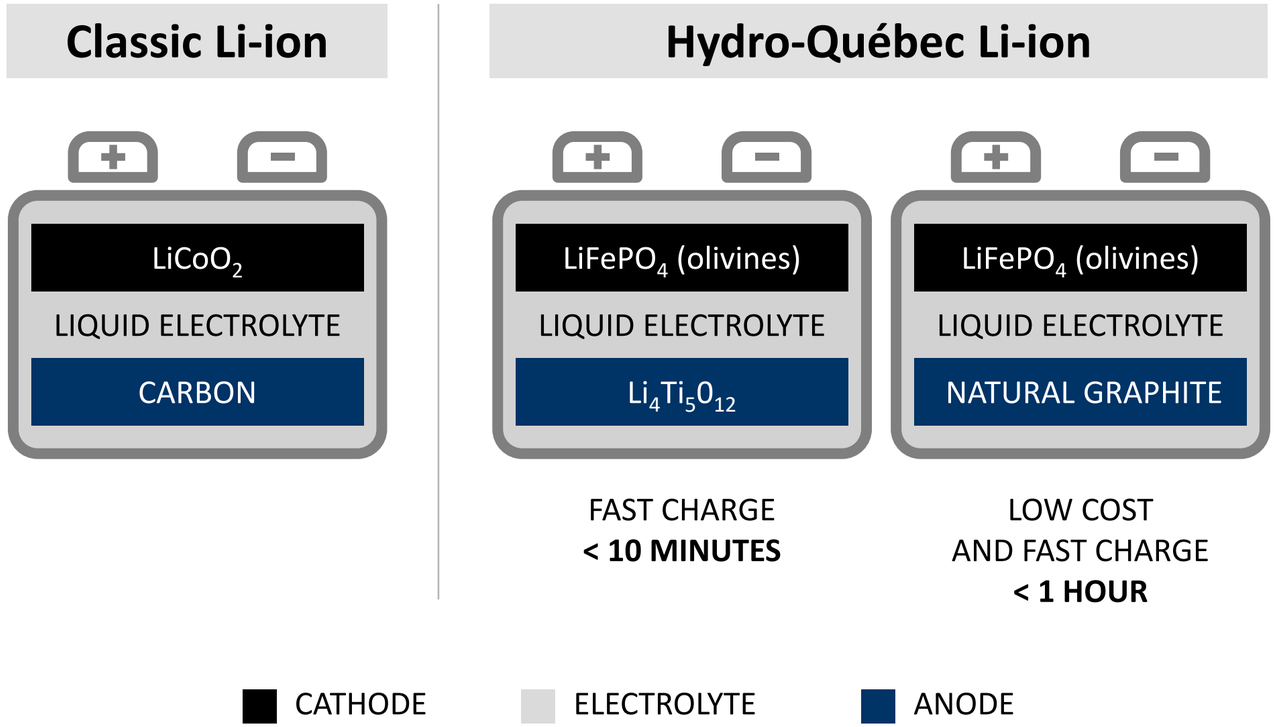


Superiority of Lithium-ion Battery



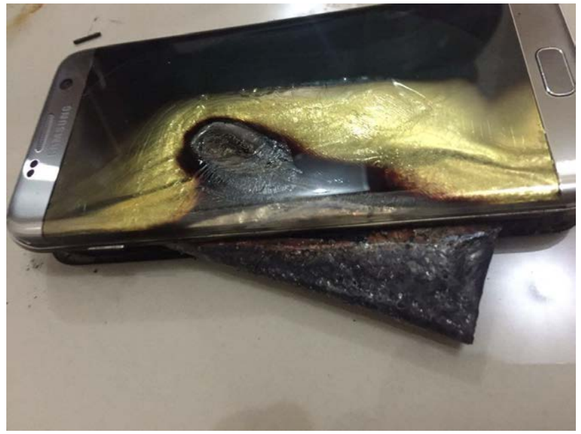
Characteristics of Hydro-Québec Lithium-Ion Batteries

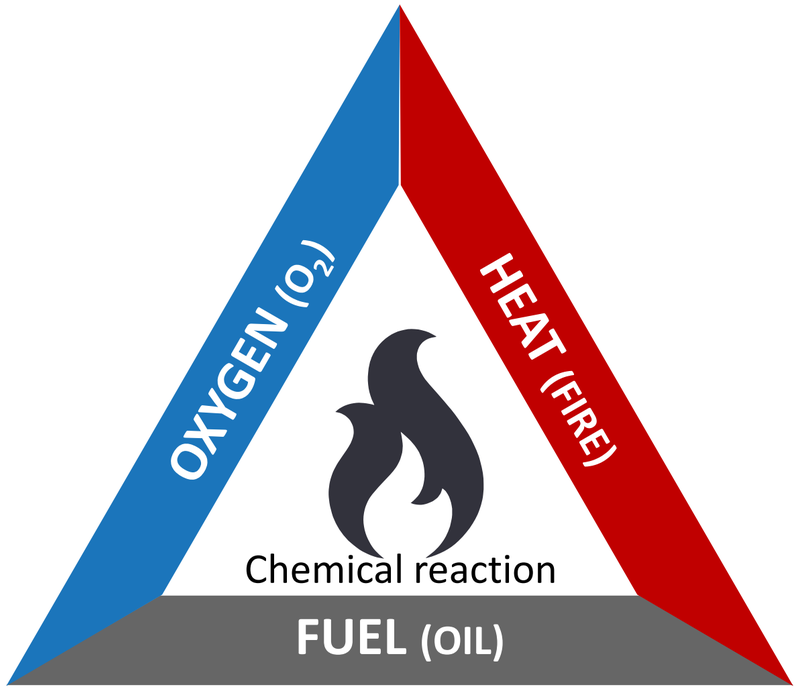
- Safe
- Good cycling performance
- Wide operating temperature range
- Efficient
- High availability
- Eco-friendly



Source: IREQ

Safety (human, $B , reputation)





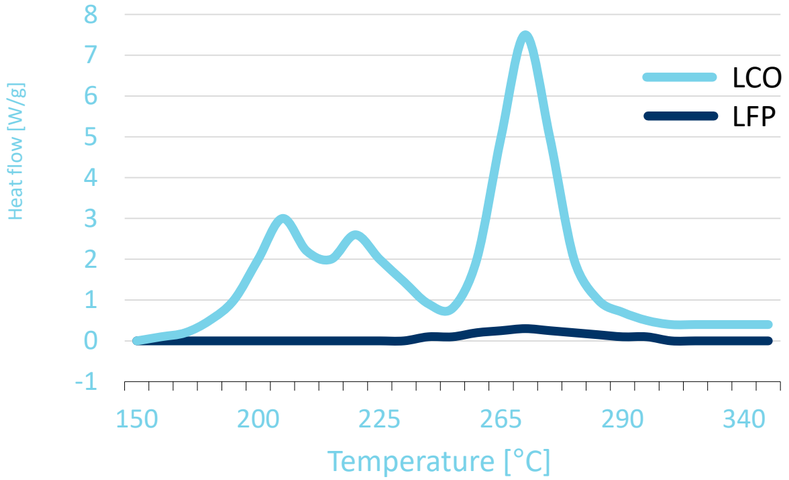
FIRE TRIANGLE

Safety

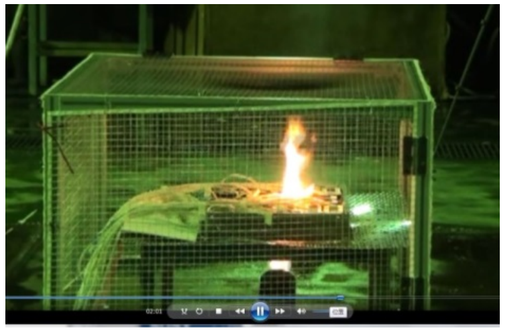
LFP-Gr

NAIL PENETRATION TEST

THERMAL STABILITY



BURNER TEST

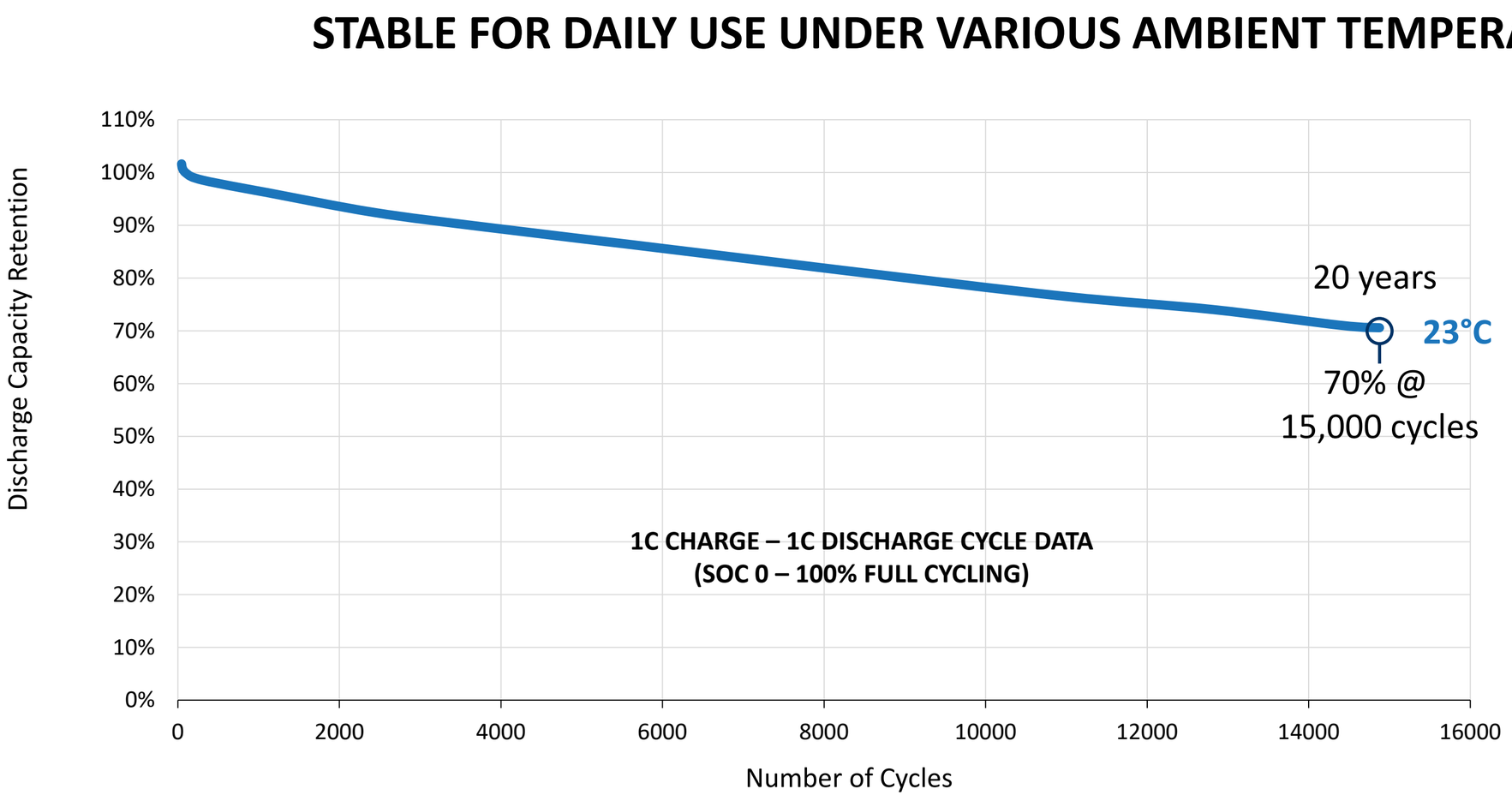


NCM

NAIL PENETRATION TEST

BURNER TEST

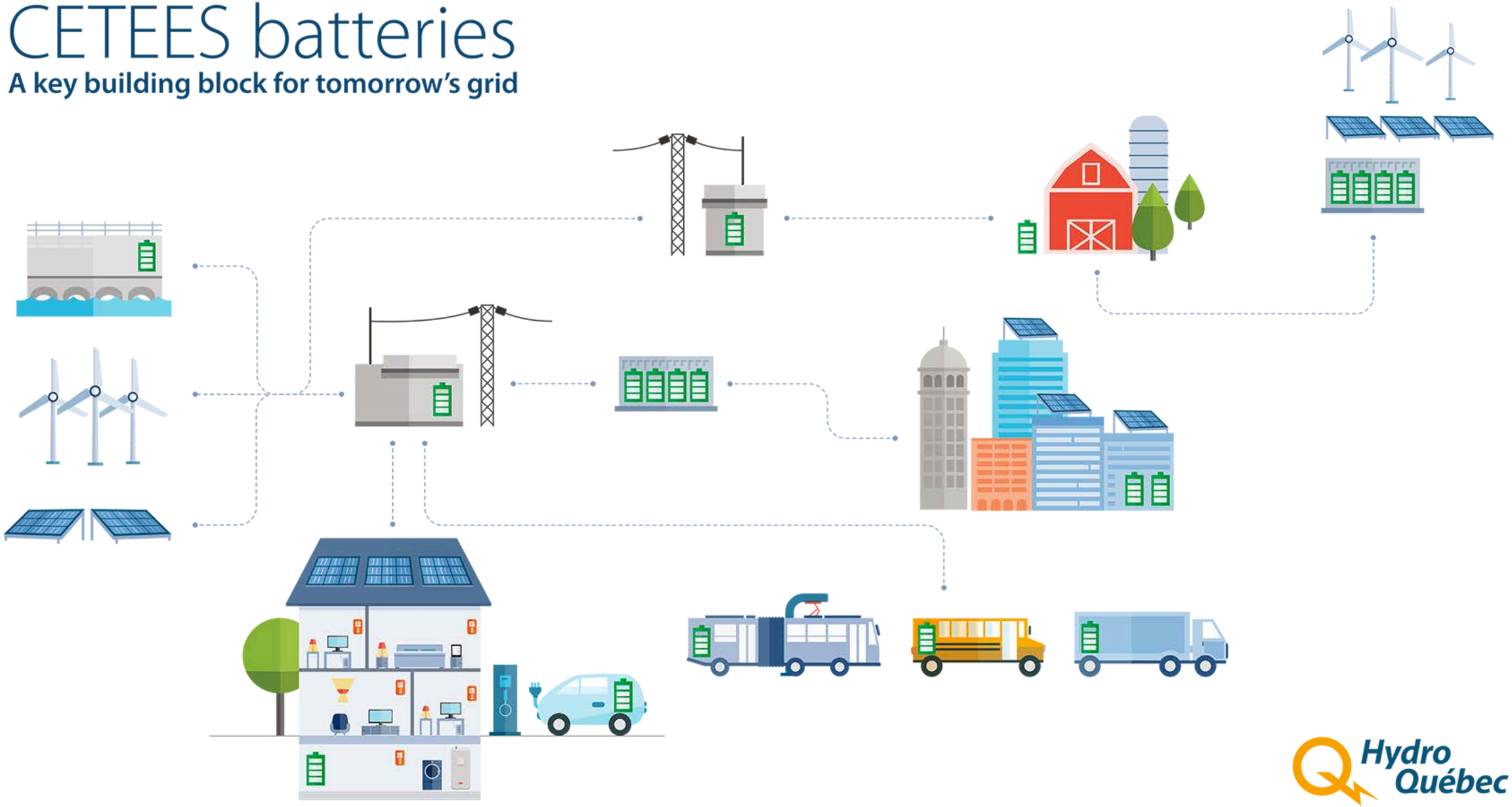
Long Cycle and Calendar Life – LFP/Gr



2 to 3 times more cycles and better calendar life compared with other battery technologies

CETEES batteries

A key building block for tomorrow's grid



Hydro-Québec's 3.6-MWh ESS Tests – 25-kV Test Line

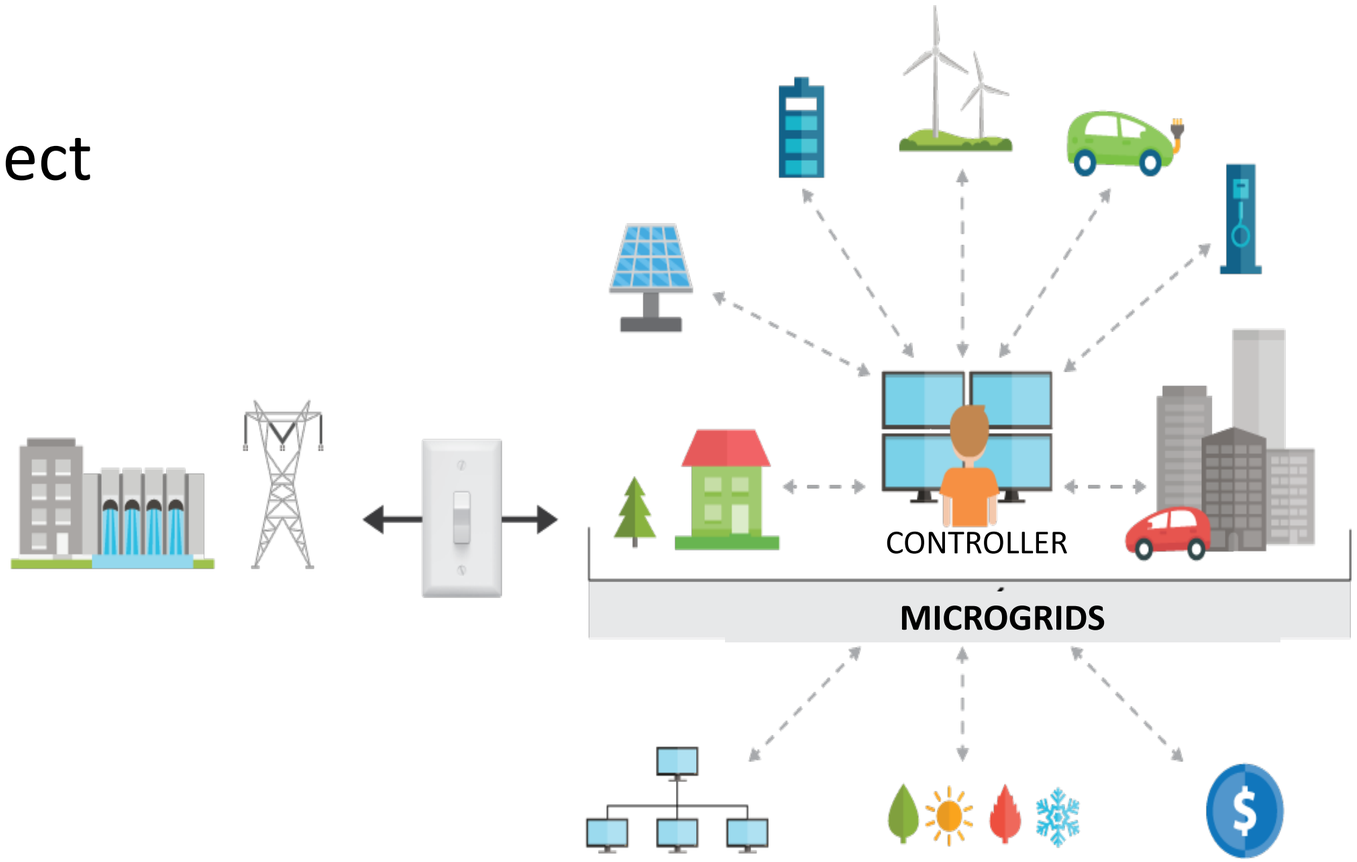
Hydro-Québec's First ESS Connected to Grid

- Hemmingford project with Hydro-Québec Distribution
- Use case: peak shaving
- 2.4 MWh: 1.2 MW LFP/Gr
- Commissioning: 09/2017

Microgrid

Microgrid in Lac-Mégantic

- Implement a demonstration project
  - 30 homes and buildings
- Master new operational models
  - Battery storage (300 kWh)
  - Solar panels (1,000)
  - Home automation
  - Smart charging stations



Off-Grid Genset with ESS and PV

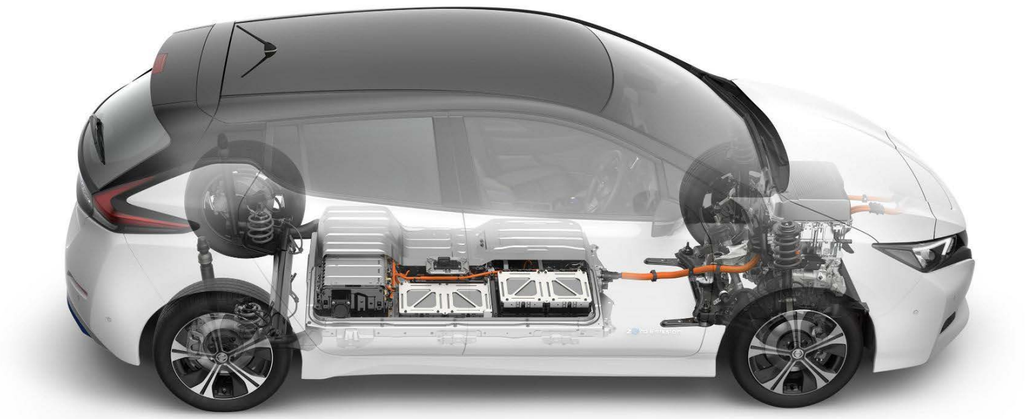
- Quaqtaq is a remote community, 1,746 km north of Montréal
- Genset: 1,085 kW
- Hydro-Québec's ESS: 600 kW/600 kWh
- PV: 20 kW
- Fuel savings: 1%
- Possibility of installing small wind turbines
- Technological challenges operating and integrating different energy sources
- Commissioning: December 2018

V2X R&D and Demo Projects

Hydro-Québec V2G and V2H vehicle and charging station prototype (2015)

- Watch V2G video on YouTube

V2X R&D and demo project in 2018 with the objective of developing a V2X charging station compatible with V2X-ready EVs on the market, such as the Nissan Leaf 2018



Solid-State Lithium Battery Technology

Next Generation Battery

"Solid-state batteries are much safer and have twice as much energy density as standard lithium-ion batteries."

– Karim Zaghib, General Director, Center of excellence in transportation electrification and energy storage at Hydro-Québec

Hydro-Québec (Montréal, Canada) and Dongshi Kingpower Science and Technology Ltd. (China) today announced the signing of a licensing agreement for the use of patents related to solid-state lithium batteries. This agreement will enable Kingpower to use technology developed by Hydro-Québec to manufacture batteries for the Chinese automotive market. (2018/01/22)

Conclusion

- Hydro-Québec is a world leader in safe battery material development
- Hydro-Québec is developing and testing ESS, microgrid and V2X technologies to face peak demand and other use cases
- Hydro-Québec’s solid-state (safe) battery will be a game changer in the near future, doubling the energy density of current Li-ion technology


Hydro
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