

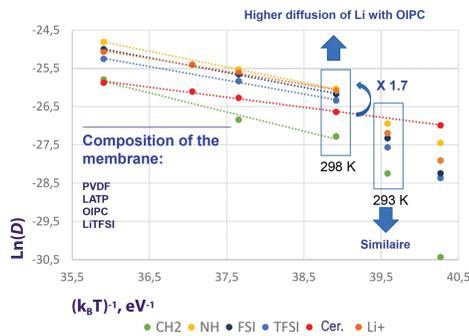
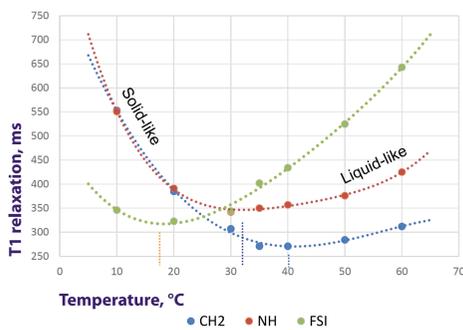
# HYDRO-QUÉBEC'S NEW GENERATION HIGH-ENERGY LITHIUM METAL POLYMER BATTERY

Hydro-Québec has been working on the solid-state batteries based on lithium metal anode and solid polymer electrolyte since 1979, which was successfully commercialized for electric vehicle applications. The combination of polymer electrolyte and ultra-thin lithium foil demonstrated excellent cycle life and outstanding safety performance. However, due to its limited performance at low temperature (< 50°C) and restricted stability at high voltage (> 4 V), the first-generation solid-state battery required specific thermal management and only useable at elevated temperature which led to compromised energy density at pack level.

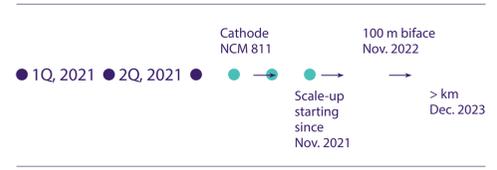
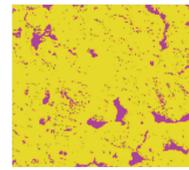
The development of a new hybrid polymer electrolyte having higher ionic conductivity at ambient temperature and wider electrochemical stability window (>4.3 V) now opens the opportunity for new generation solid-state batteries. Hydro-Québec developed a new family of Organic Ionic Plastic Crystal (OIPC) providing higher voltage stability, hence high-energy electrodes for solid-state batteries. By implementing the new hybrid polymer electrolyte and new cathode formulation, we introduce a New Generation High-Energy Lithium Metal Polymer Battery technology.

## OIPC AS CATHOLYTE FOR HIGH VOLTAGE CATHODE ELECTRODE

### LOCAL DIFFUSION OF OIPC BY NMR



### ADOPTION OF OIPC IN NMC811 ELECTRODE

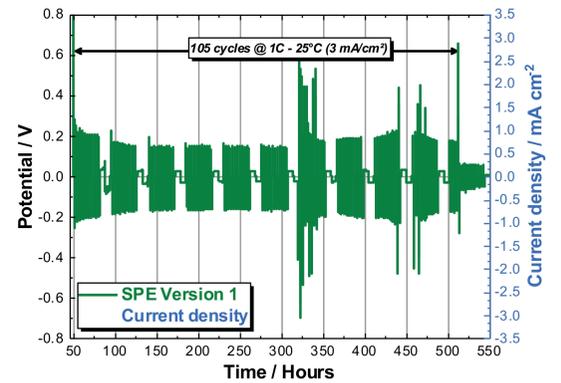
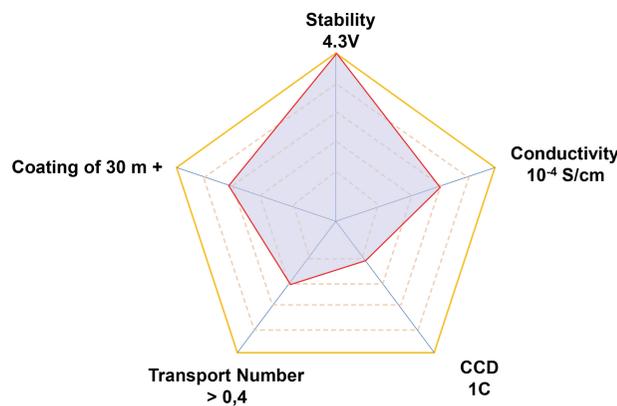


**GEN 2.5 : Cathode NCM811 based on OIPC**  
 NCM 811 as positive electrode  
 New OIPC families as catholyte (patent pending)  
 Li+ diffusion > 1.5 times higher compared to LATP  
 Stable up to 4.5 V  
 Scale-up completed with conventional LIB equipment

Ref: Daigle, J.-C., et al., WO2022165598 A1

## NEW HYBRID SOLID POLYMER ELECTROLYTE

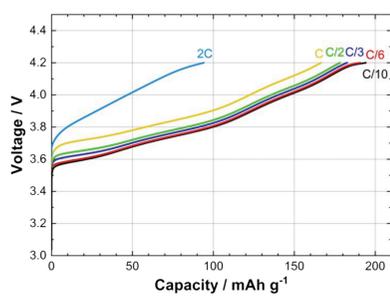
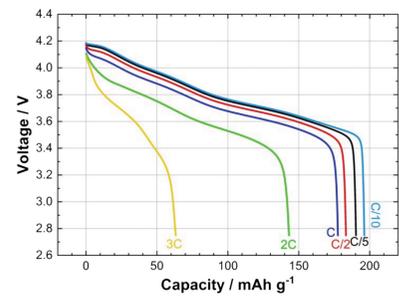
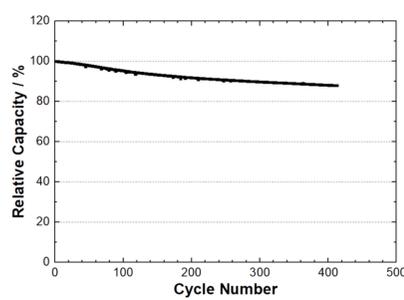
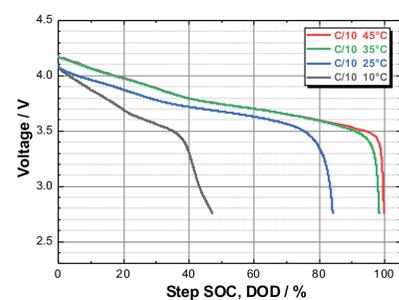
Good performances at 25°C  
 Modified PEO-based SPE  
 Improved stability and transport properties  
 No dendrite after more than 500 hours



Ref: Zhang, X. et al. CA2023/050037; Zaghbi, K. et al., CA2517248, 2007.

## HQ GEN 2.5: NEW GENERATION POLYMER-BASED SOLID-STATE BATTERY

**SPECIFIC ENERGY 270 - 320 WH/KG**  
**ENERGY DENSITY 500 - 700 WH/KG**



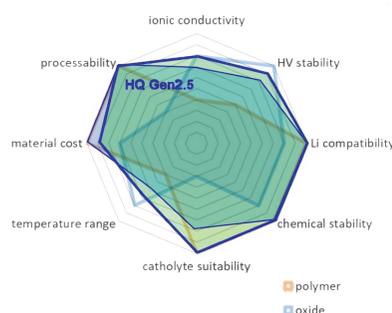
## LARGE FORMAT SSB PILOT LINE



## SUMMARY

### HQ GEN 2.5

Hybrid polymer electrolyte  
 Stabilized cathode interface with reduced porosity  
 Compatible to high Ni cathode  
 Higher C-rate performance at lower temperature  
 Excellent R2R processibility



**Pilot line with coating and stacking capabilities, enabling fast scale-up of new technologies to full cells in industry-relevant format**

Automated pilot production line for large format cells installed in dry rooms  
 Production capacity: 3 MWh/p.a.  
 Dry room 11,500 ft<sup>2</sup>  
 Lab 18,000 ft<sup>2</sup>

