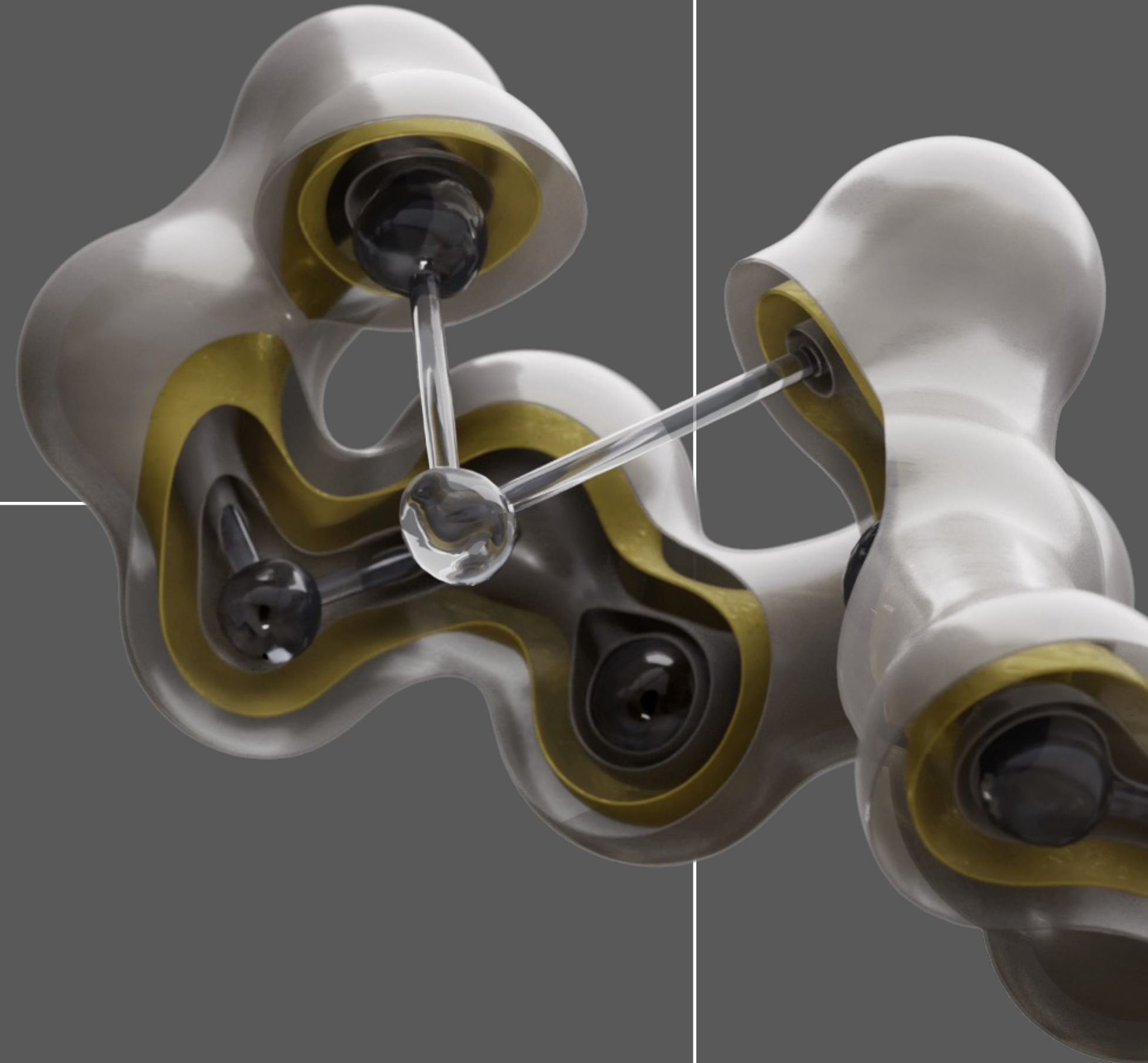
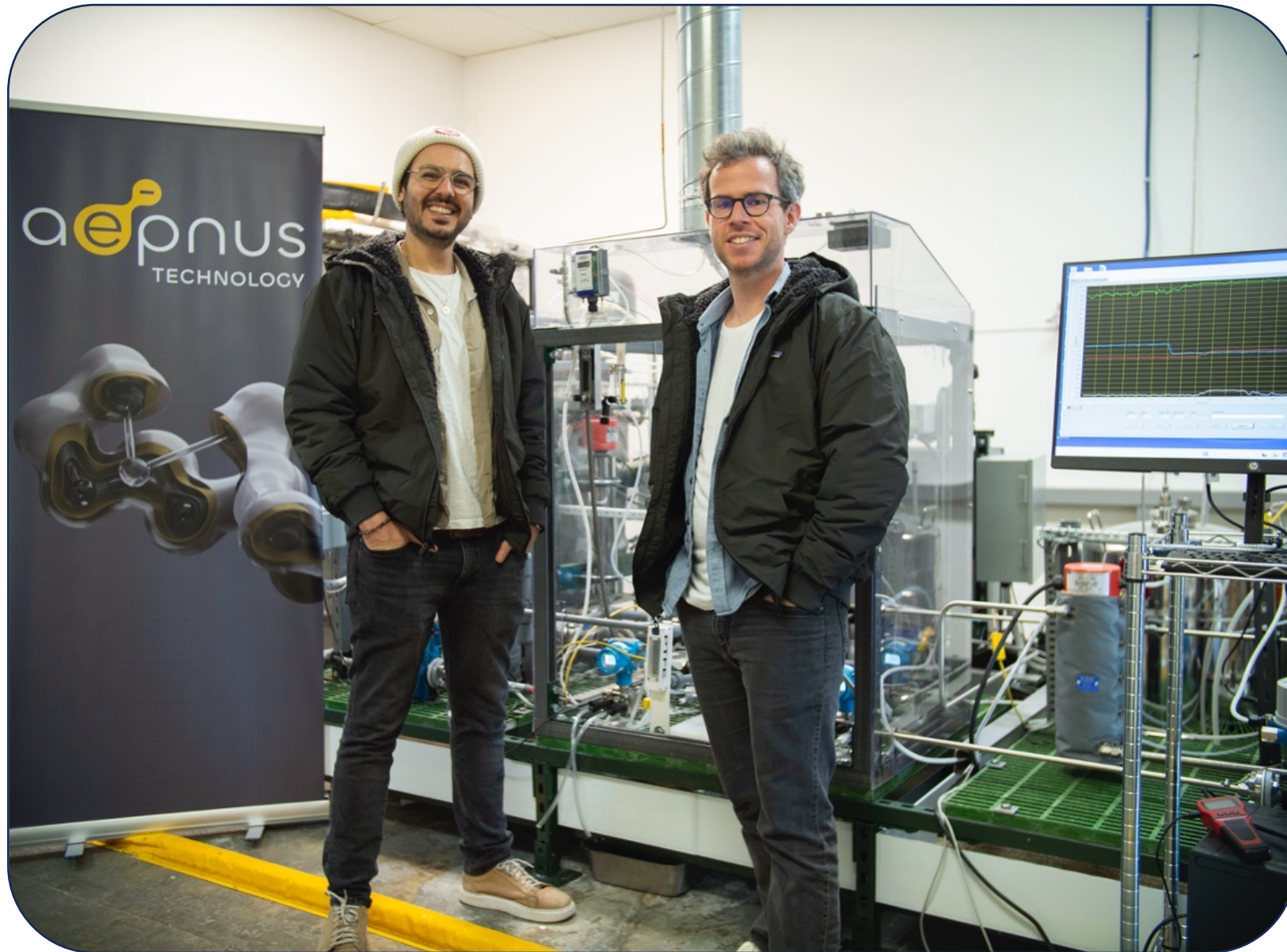


aeponus
TECHNOLOGY



Next Generation Electrolyzers
for Valorization of Sulfate Waste

Aepnus - California-based climate tech start-up



- Founded in 2019 after conceiving technology at Lawrence Berkeley National Lab / UC Berkeley, California
- 12-person engineering and ops team
- R&D center in Oakland, CA with subsidiaries in Germany and Canada
- +\$12M in venture funding
- +\$2.5M in grant funding from US National Science Foundation (NSF), US Department of Energy (DoE), California Energy Commission (CEC), and Canadian/Quebec Government CRITM Program

Government Support by:



Customer Discovery



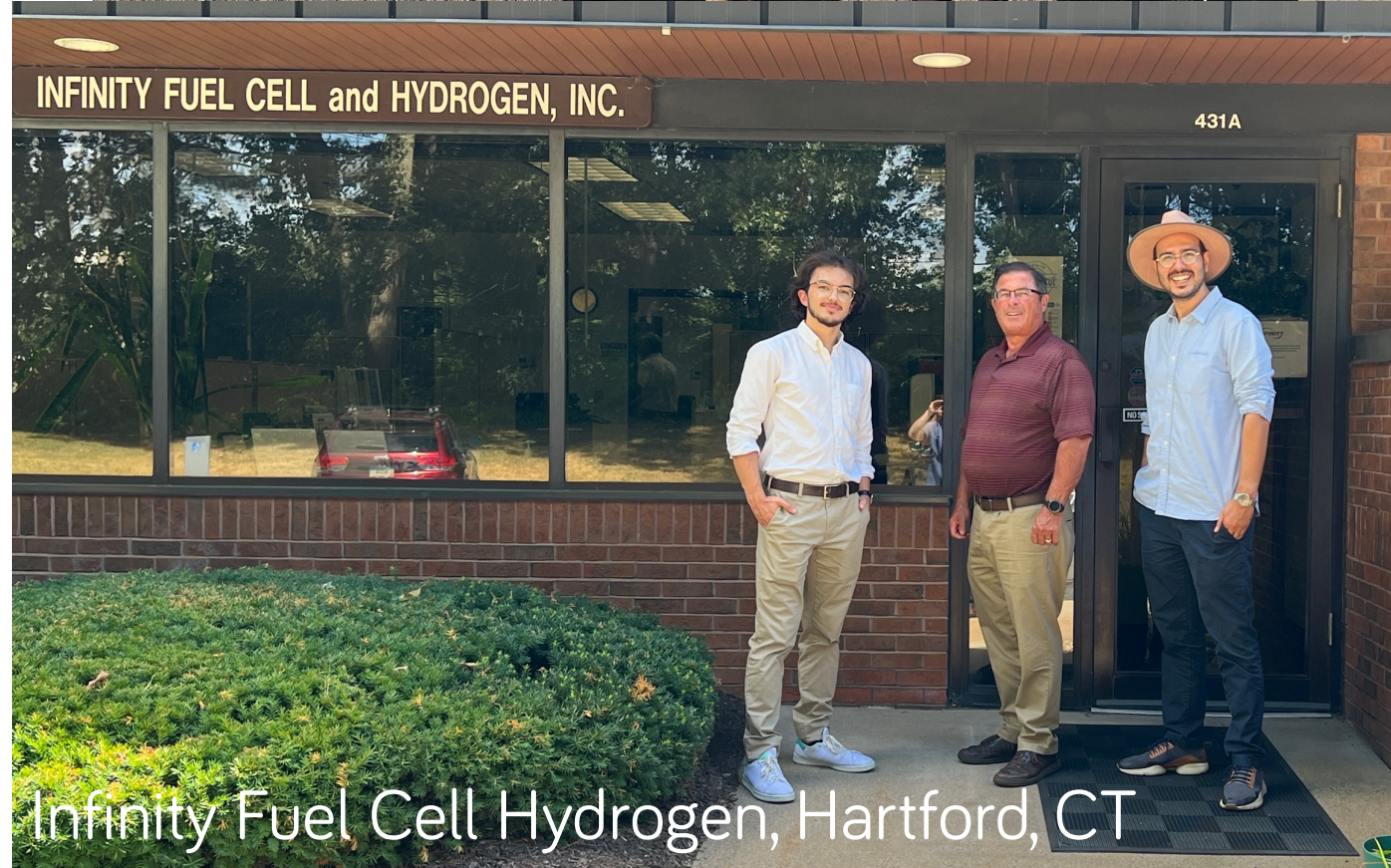
Rio Tinto, Boron, CA



Nemaska Lithium, Quebec



Redwood Materials, Reno, NV



Infinity Fuel Cell Hydrogen, Hartford, CT



ES Minerals, Salton Sea, CA



Ascend Elements, Boston, MA

Elephant In the Room: Reagent Chemicals

Significant amounts of chemical reagents are necessary to refine and process the materials needed for the energy transition.

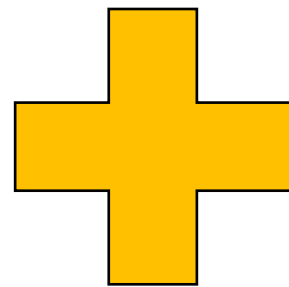
REAGENTS



Sulfuric Acid (H_2SO_4)

4,200 tonnes

For 1 GWh NMC battery production



Caustic Soda (NaOH)

3,400 tonnes

For 1 GWh NMC battery production



WASTE



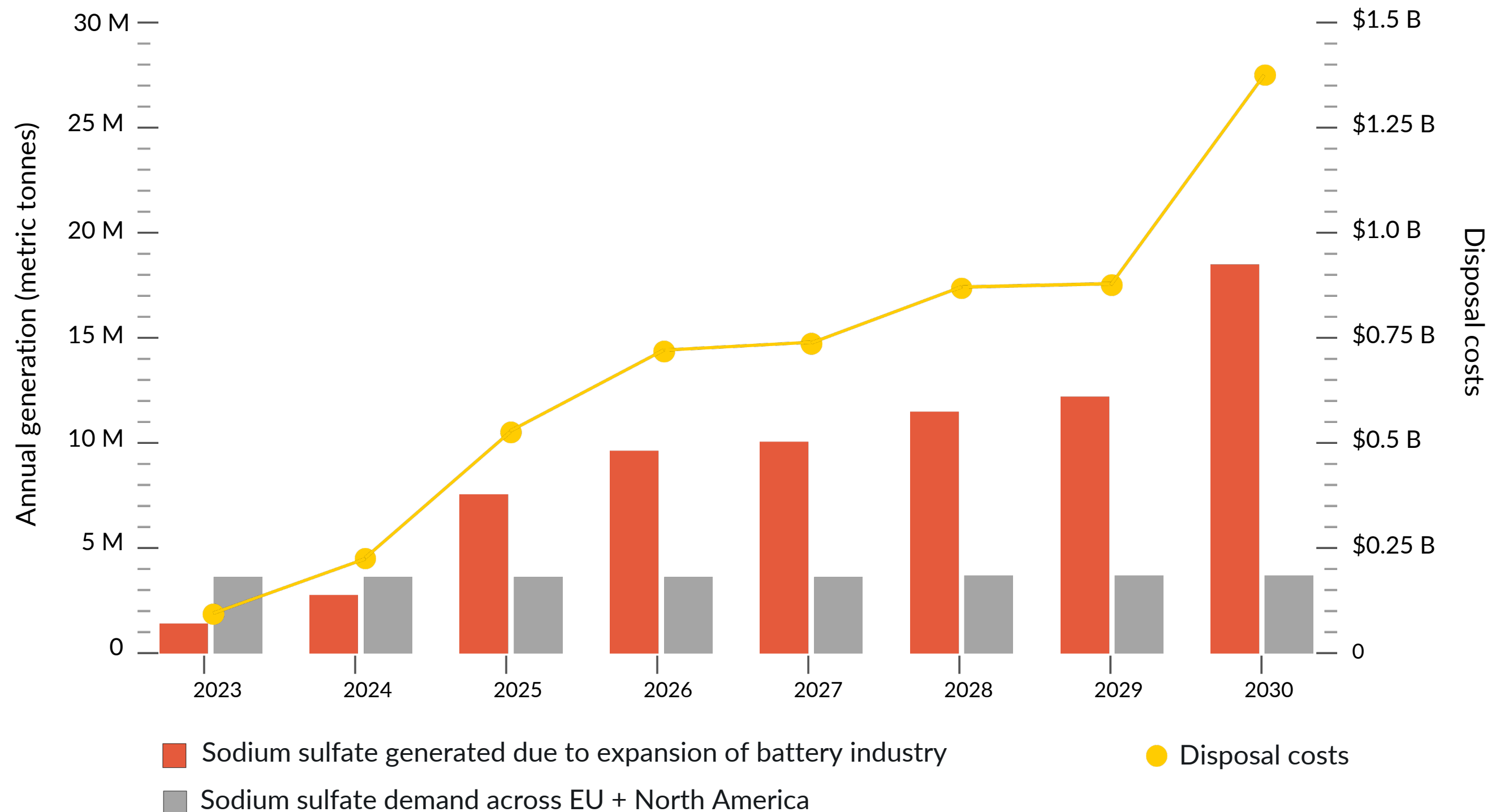
Sodium Sulfate (Na_2SO_4)

5,000 tonnes

For 1 GWh NMC battery production

Problem #1

The battery industry will flood the market with millions of tons of sodium sulfate waste making offtake and disposal very difficult.



Problem #1

The battery industry will flood the market with millions of tons of sodium sulfate waste making offtake and disposal very difficult.

What to do with the battery industry's sodium sulfate waste?



<https://cen.acs.org/energy/battery-industrys-sodium-sulfate-waste/102/i21>

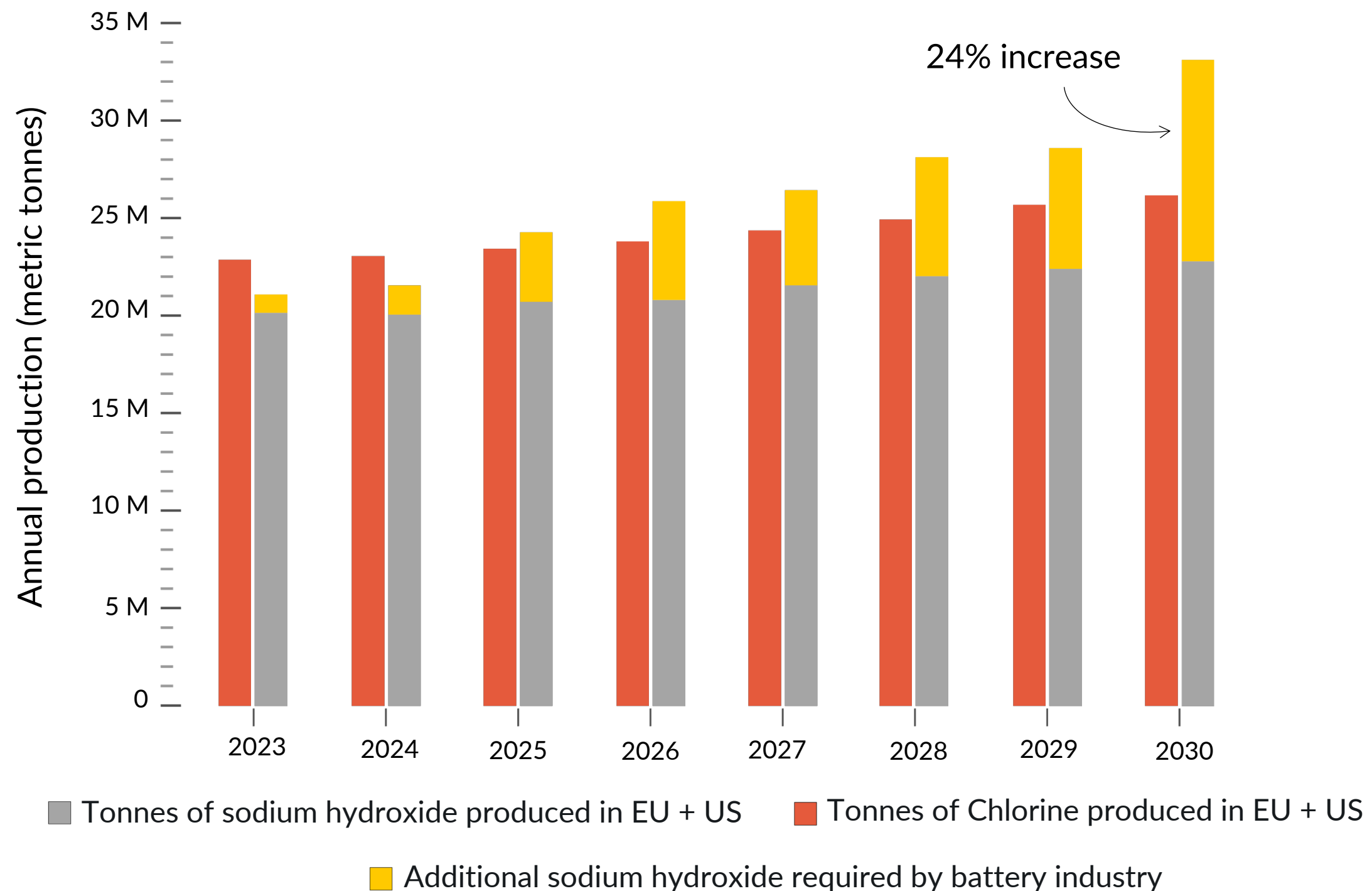
BASF battery project delayed because of environmental concerns



<https://cen.acs.org/environment/pollution/BASF-battery-project-delayed-environmental/102/i7>

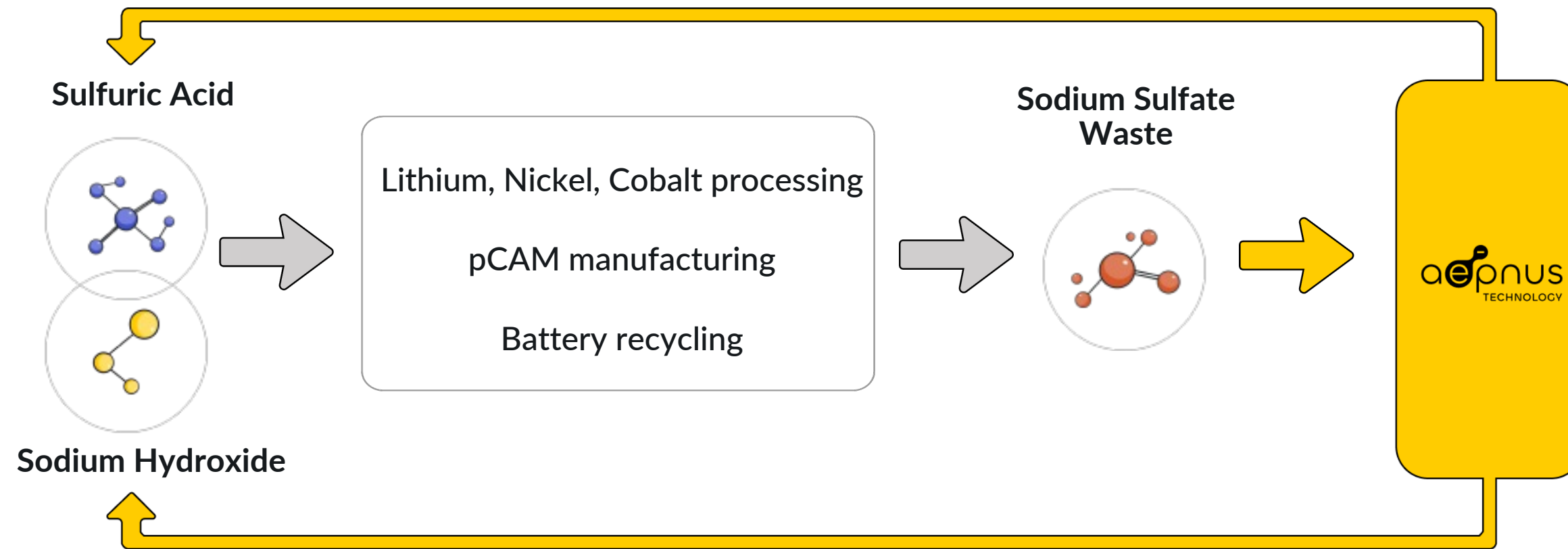
Problem #2

Additional demand for sodium hydroxide will destabilize chlor-alkali industry and drive up prices of sodium hydroxide in the future.



Our Solution

Aepnus converts sodium sulfate into sodium hydroxide and sulfuric acid for reuse, while mitigating permitting concerns and saving \$M in reagent costs.



Customer Benefits



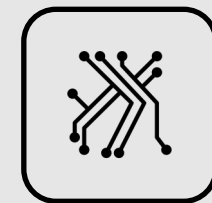
Drastically reduced customer Capex and Opex due to reuse of sulfuric acid and caustic



Shorter permitting times and time to market due minimal waste generation



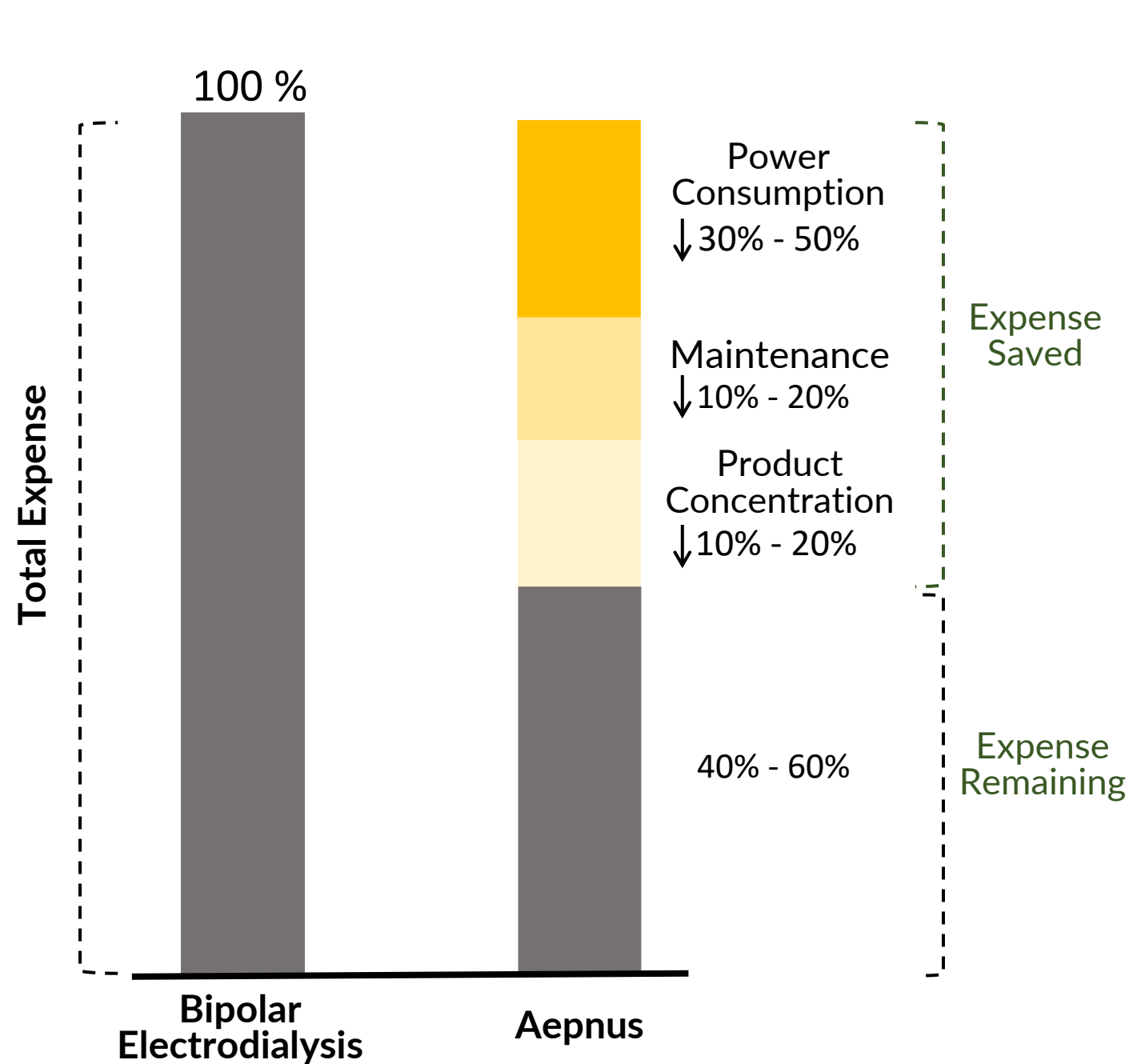
>2 t of CO₂ mitigated per t of sodium sulfate, if powered renewably



Lower supply chain risk with onsite chemical generation

Superior performance vs. bipolar electro dialysis

Aepnus' electrolyzers are 40% cheaper to operate than electro dialysis due to advanced electrode and membrane innovation.

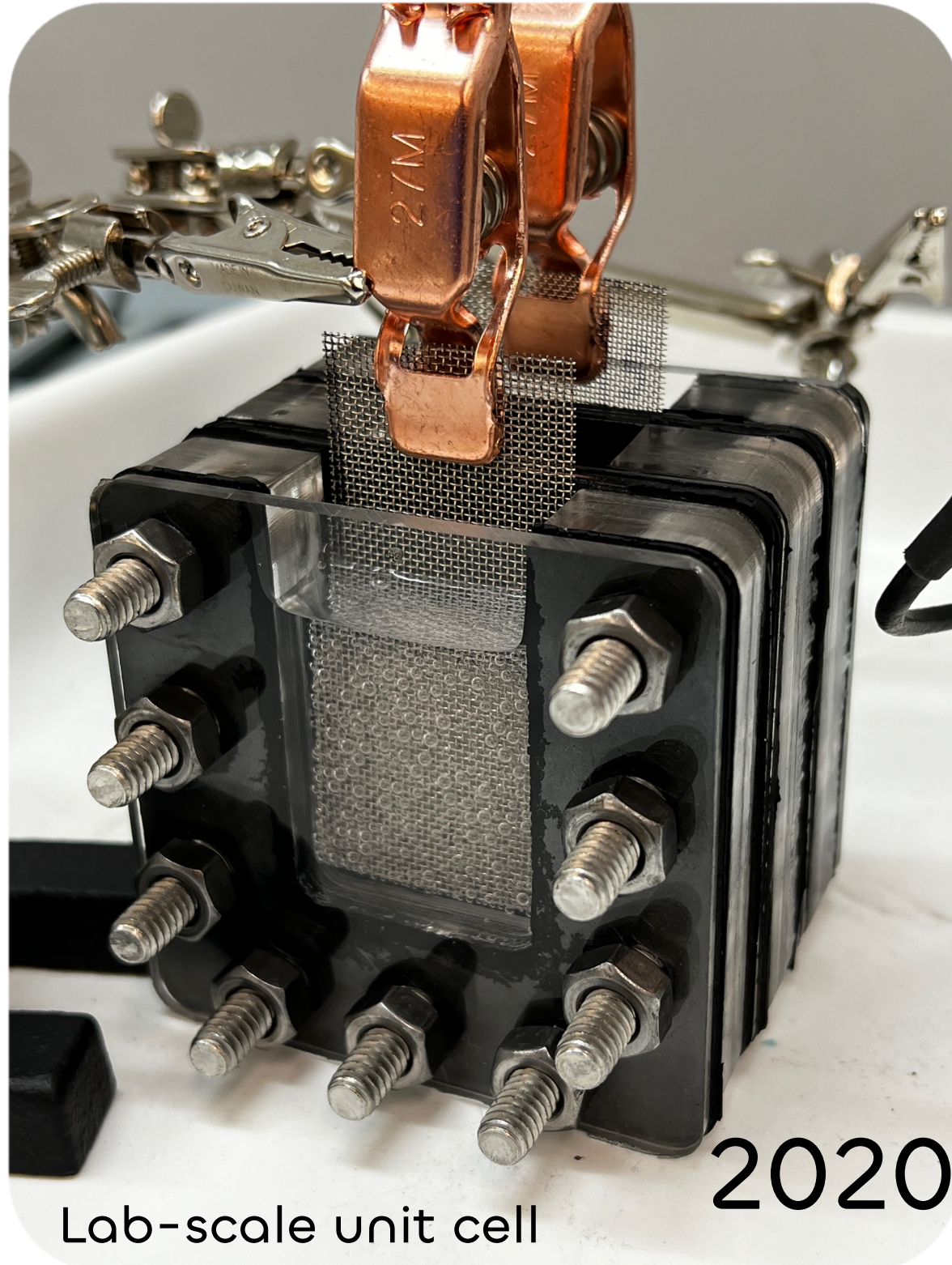


Maintenance cycle	Bipolar Electro dialysis: 6 - 12 Months Aepnus: 36 - 48 Months
Current Density	Bipolar Electro dialysis: 1000 - 2000 A/m ² Aepnus: 4000 - 6000 A/m ²
Energy Cost	Bipolar Electro dialysis: 1700 - 2000 kWh/t of Na ₂ SO ₄ Aepnus: 1400 - 1700 kWh/t of Na ₂ SO ₄
Operating Temperature	Bipolar Electro dialysis: < 50 °C Aepnus: > 70 (faster kinetics) °C
Product concentration	Bipolar Electro dialysis: 5 - 7 wt% Sulfuric acid Aepnus: 10 - 15 wt% Sulfuric acid
	Bipolar Electro dialysis: 4 - 10 wt% Caustic Soda Aepnus: 20 - 25 wt% Caustic Soda
Product purity	Bipolar Electro dialysis: > 2000 Sulfate in caustic (ppm) Aepnus: < 100 Sulfate in caustic (ppm)



Current Status

2 tpa pilot system commissioned, ready for on-site demonstrations.

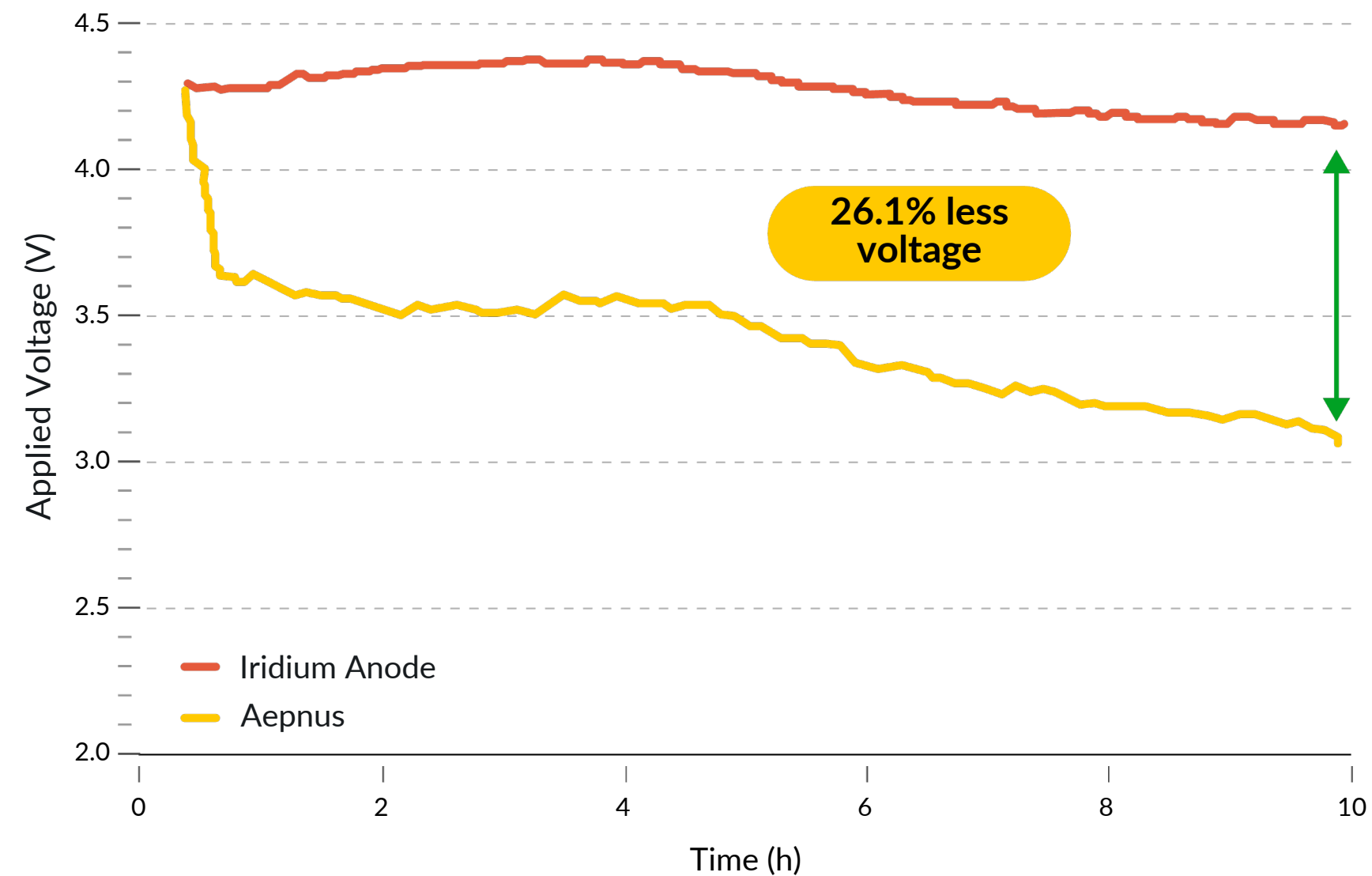


Performance Data

Aepnus uses hydrogen anodes to lower cell voltage and avoid costly MMO electrodes

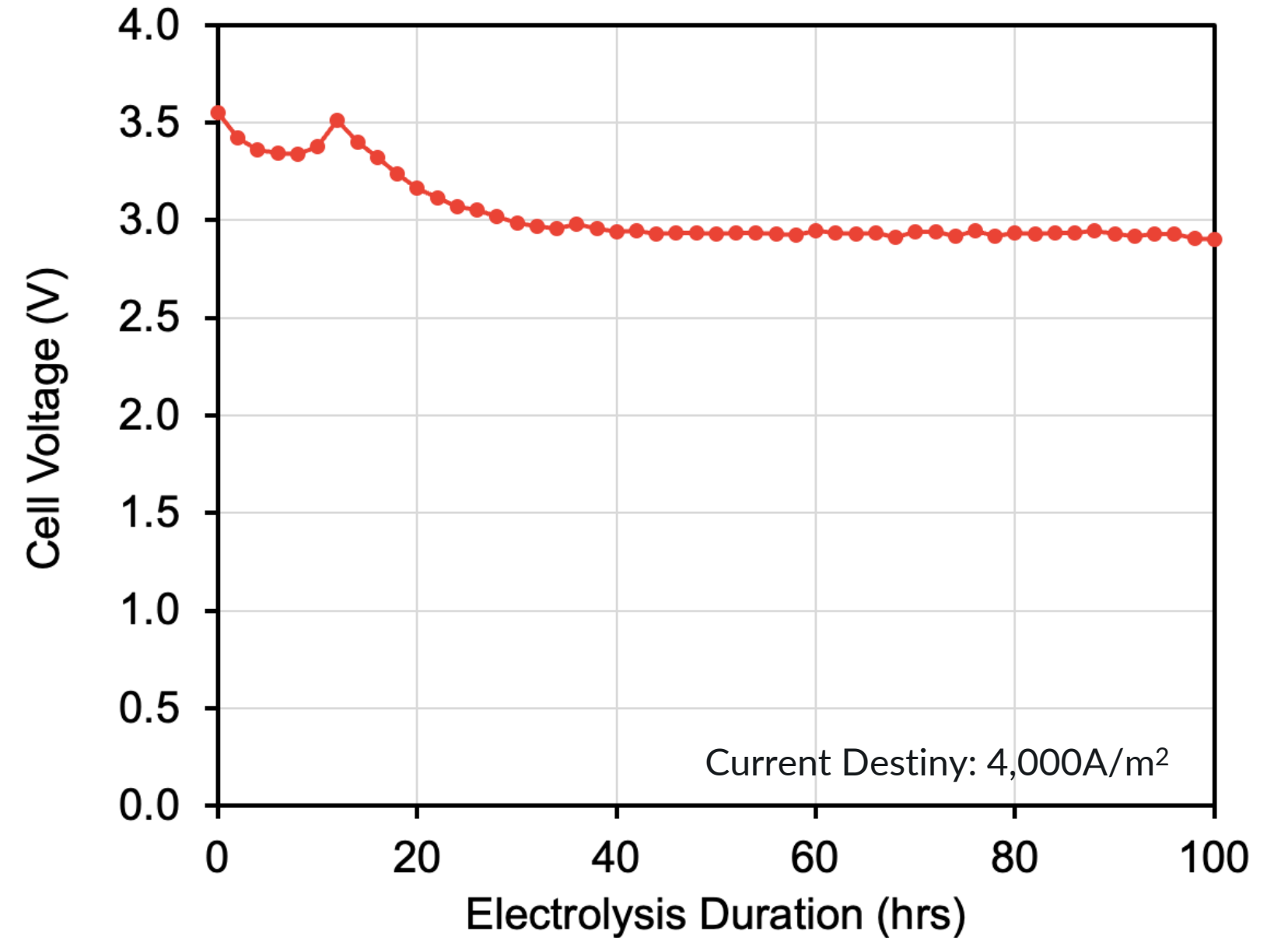
Comparison with MMO anodes:

Voltage vs. Time: Sodium Sulfate (Na_2SO_4)



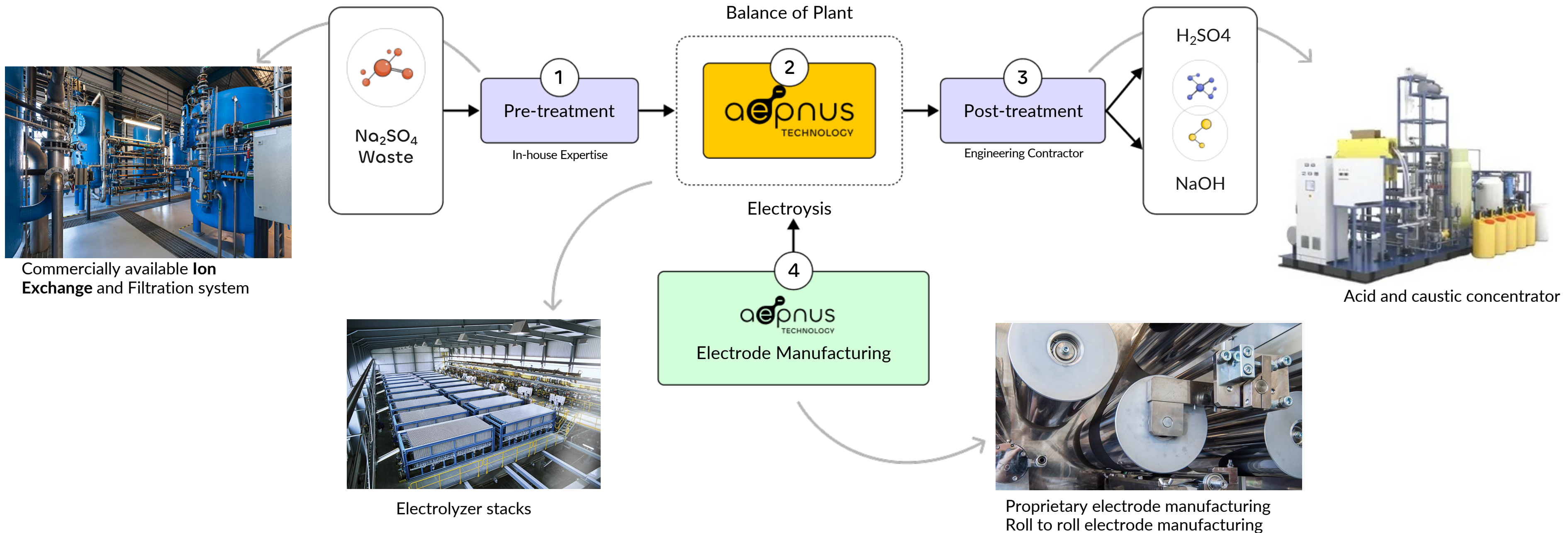
+100 hr Continuous Operation:

Voltage vs. Time; Sodium Sulfate (Na_2SO_4)



We aim to provide an end-to-end sodium sulfate electrolysis solution

Our complete technology stack consist of 4 components. Their development is partly outsourced and partly kept in-house.



Our Beachhead Market

The Energy Transition Valley Project in Becancour, Quebec will produce 250 kt of sodium sulfate byproduct once fully operational.

- **\$200M Opportunity**

Expected 250,000 t of sodium sulfate waste at least 4 major battery customers within a 1-mile radius.

- **500,000 tons of CO₂ mitigation potential**

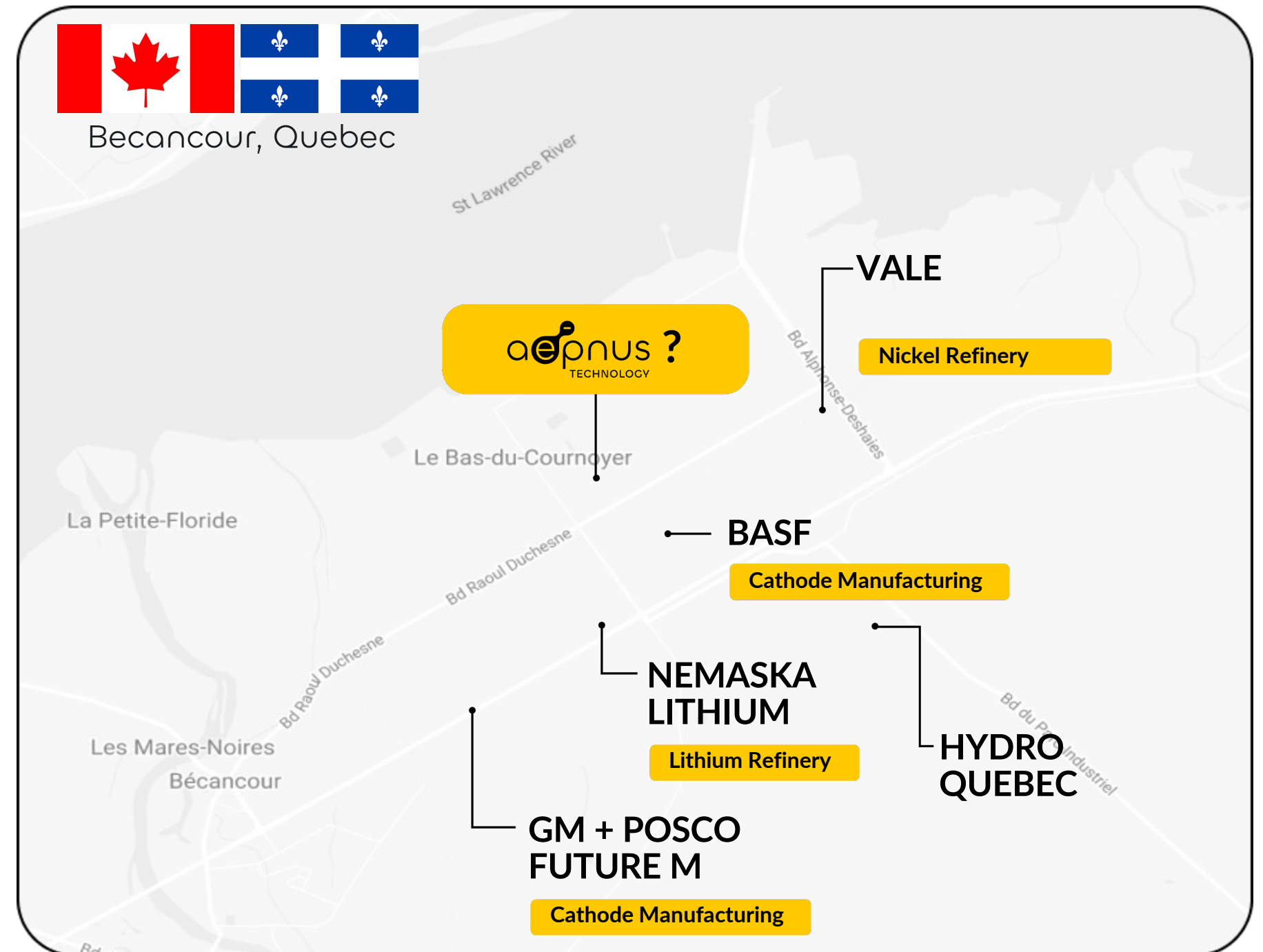
At 2.2 tons of CO₂ eq. emissions per tonne NaOH, roughly half a million tonnes of CO₂ emissions to be avoided .

- **\$1M Pilot Project currently underway**

Received \$1M from Canadian / Quebec government's CRITM program for the pilot-scale validation of our process technology.

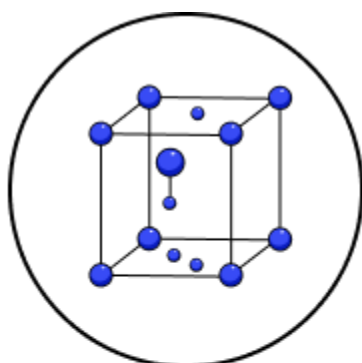


Partenaire financier du CRITM :



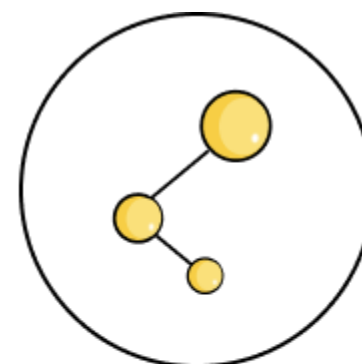
Our Vision

Expand **Aepnus'** electrolysis platform to electrolyze and decarbonize the production of a portfolio of commodity chemicals.



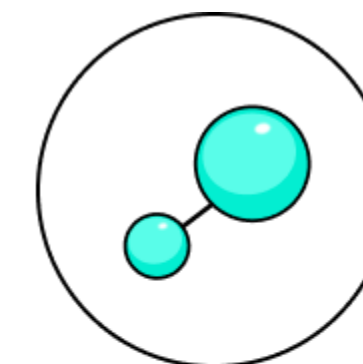
Lithium Hydroxide

\$1.4B global market, 7.2% CAGR



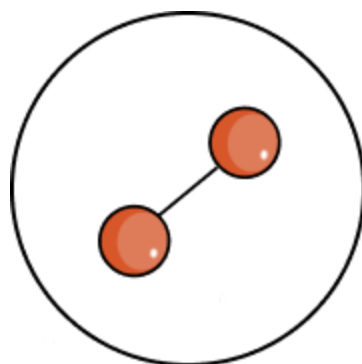
Sodium Hydroxide

\$49B global market, 4.4% CAGR



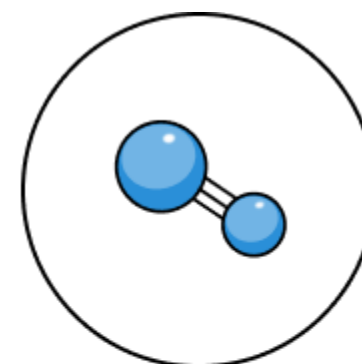
Zinc

\$26.6B global market, 11% CAGR



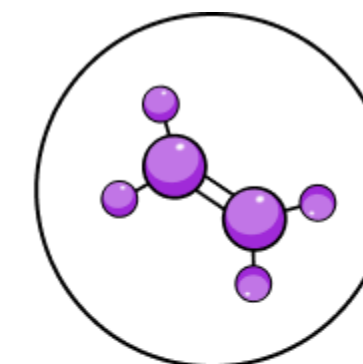
Copper

\$291B global market, 6% CAGR



Carbon Monoxide

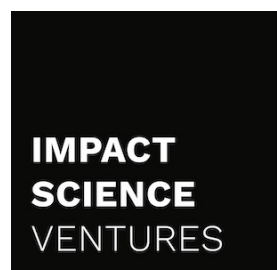
\$3.1B global market, 3.1% CAGR



Ethylene

\$176B global market, 5.6% CAGR

Team and Sponsors



Activate

cyclotronroad

chemstars.nrw



CalSEED



Partenaire financier du CRITM : Québec



Lab-Embedded Entrepreneurship Program





Lukas Hackl,
CEO, Co-founder

lukas@aepnus.com