



# Enlarging solutions for flow batteries (FB) with hydrocarbon-based ionomers

26th June 2025



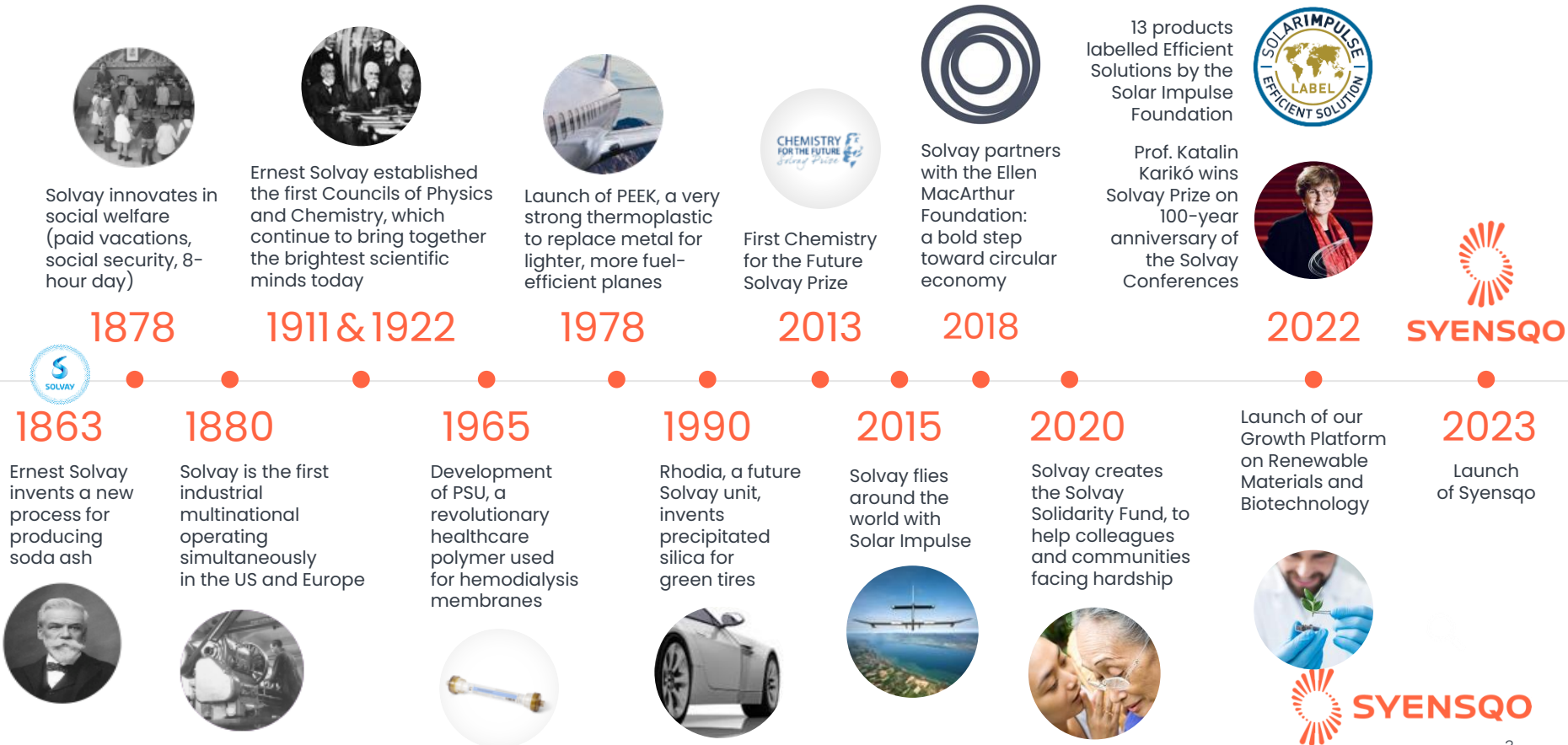


 WELCOME

WE CREATE  
**TODAY**

- 1) Introduction & Background
- 2) Aquivion® G+: Characteristics & Innovations
- 3) Technical Performance & Cost Efficiency
- 4) Q&A

# A strong legacy and a passion for science



# Overview of the **Transition**



€4.1 B

2021 Net Sales

1

## Soda Ash & Derivatives

- Soda Ash
- Bicarbonate

2

## Peroxides

- Hydrogen Peroxide

3

## Silica

- Silica for tires

4

## Others

- Coatis
- Rare earths for automotive catalysts



€6 B

2021 Net Sales

## Materials

1

## Specialty Polymers

(High-performance polymers, leading position in thermoplastic composites)

- Thermoplastic
- Batteries
- Hydrogen

2

## Composite Materials

- Composites for civil aerospace
- Composites for defense

3

## Novecare

- Specialty surfactants & polymers

4

## Technology Solutions

- Mining reagents

5

## Other Solutions

- Aroma
- Oil & Gas

## Performance & Care

## Other Solutions



# Top-tier specialty player



# Addressing Market and Technology Demands in BESS

1

## Price Challenges

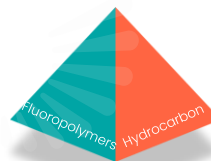
Increased price challenges from competing BESS technologies, especially Li+ batteries

2

## Environmental Safety & Sustainability

Focusing on organic FB and electrolytes using scalable, cost-effective metals with hydrocarbon based, yet long-lasting components

# Aquivion® G+ Syensqo's first **fluorine-free** hydrocarbon-based ionomer



## RESIN TYPE

**Cation-conductive ionomer resin**

## MATERIAL EXPANSION

**Expand material options for FB separator membranes**

## VERSATILITY

**Potential value in non-battery applications**

## SUSTAINABLE COMPLEMENT

**Complements existing PFSA options**

## DIVERSIFY

**Enlarge the available ionomer solutions**

# Aquivion® N+ as cutting-edge ionomer for VRB membranes



**25+ years**  
of Aquivion® legacy

## SCALABILITY

**Large-Scale Membrane Production** ready on industrial coating lines



## PERFORMANCE

- **Low V-electrolyte crossover** despite a low thickness
- **High Mechanical Strength** despite a low thickness
- **High electrical efficiency (EE)** up to **87~88 %**



## VFB TEST IN PROGRESS

- **Accelerated testing** ongoing
- ...so far forecasting **calendar life** of at least **6 years**

## FLUORO- IONOMER BASE RESIN

Membrane made exclusively with **Syensqo's fluorosurfactant-free PFSA resin**

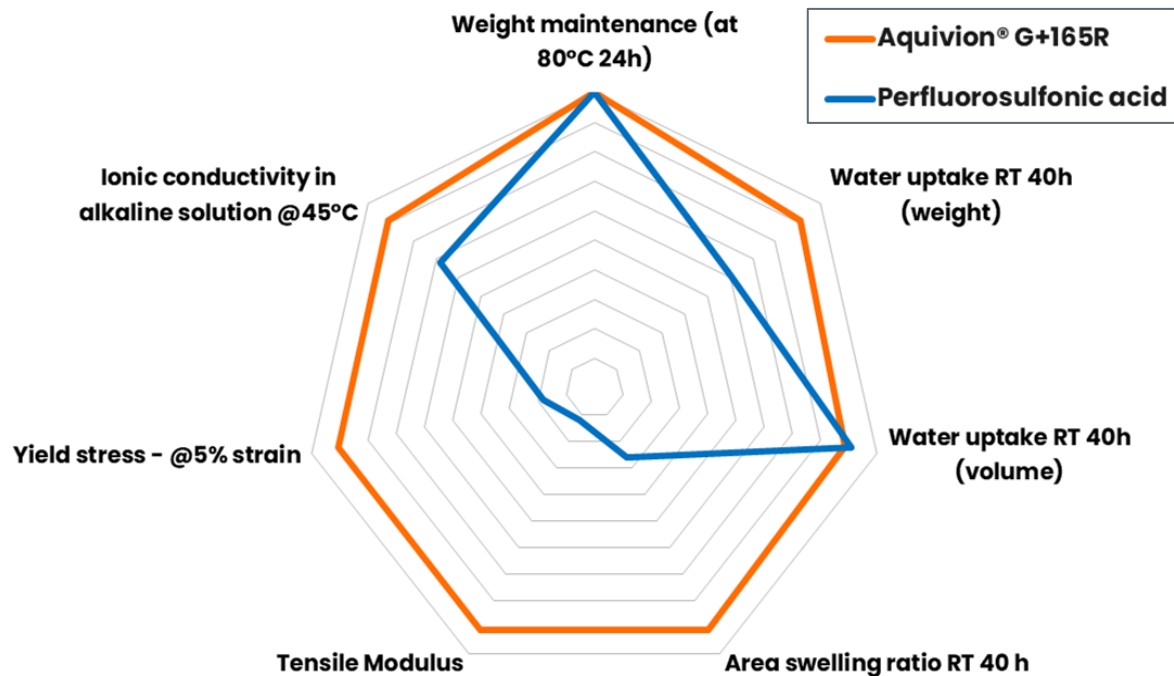
## CHEMICAL RESISTANCE

Proven **chemical resistance** of perfluoro-SAs at near-zero / sub-zero pH incl. V(5+)

## FINANCIAL PAYBACK

Membrane **pricing effective** to support VFB's LCOS competitive with Li-Batteries

# Advancing Membrane Technology with Aquivion® G+ for Next-Gen Flow Batteries



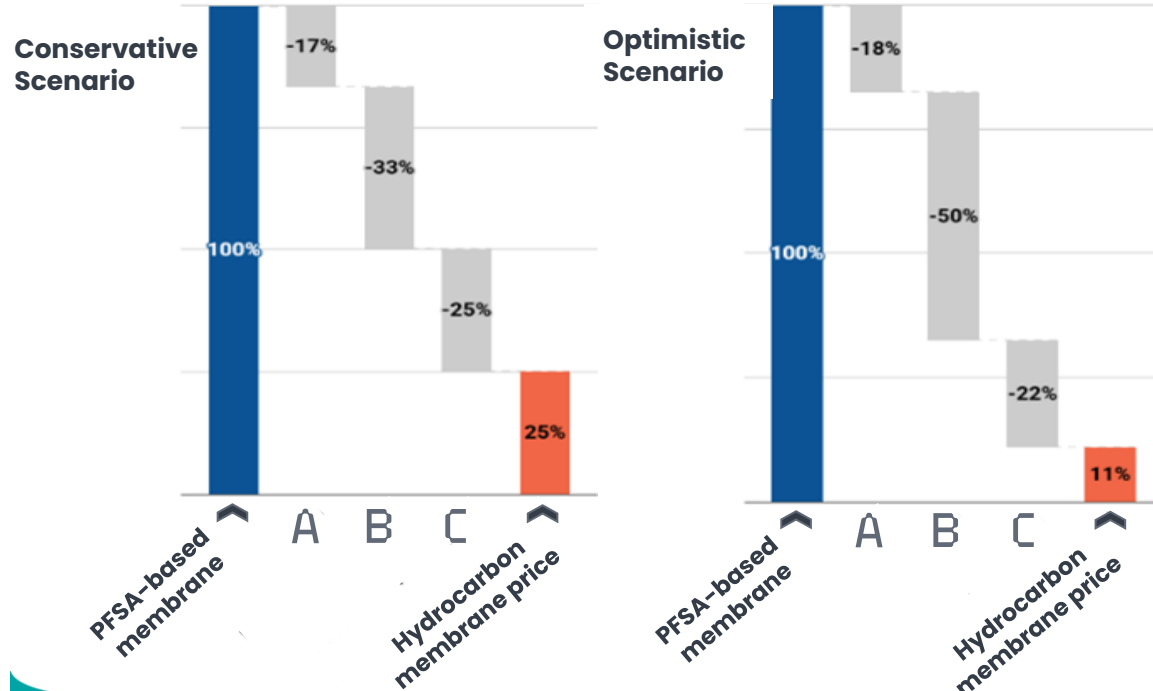
Lab tests show exceptional hydrolytic stability, low area swelling, and superior mechanical properties as the tensile modulus and yield stress are higher compared to PFSA membranes

## Meeting Flow Battery membrane needs with:

- **Strong chemical resistance** at various pH
- **Strong oxidative resistance** observed around neutral/ high pH
- **High Na<sup>+</sup>/K<sup>+</sup> conductivity**
- **Low area-specific resistance (ASR)** when in membrane form
- **High selectivity**, with the frequently used ferricyanide - ferrocyanide redox couple

# Unlocking Cost Efficiency

## The potential Impact of Membrane Cost Savings on FB LCOS Reduction



Switching from PFSA to Aquivion® G+ membranes can reduce costs by 75–90% for FB OEMs and suppliers

Reducing the resin costs of flow battery separators driven by:

- A** Better mechanics thinner selective layers
- B** Difference of polymer density (~1.4 vs. 2.0)
- C** More favourable polymer pricing of hydrocarbons compared to PFSA
- ▶ Separator Validation (to assess if cost reductions are offset by technical constraints)

# Driving Sustainable Innovation in Flow Battery Manufacturing



- **Aquivion® G+** is **available** for **FB Manufacturers** as a hydrocarbon-based, fluorine-free ionomer resin.
- Key component in the advanced flow battery value chain, with **Membrane Manufacturers playing a crucial role in its advancement.**



## Manufacturing

- **Available for FB manufacturers** as a **hydrocarbon-based, fluorine-free ionomer resin.**



## Sustainability

- Syensqo's **LCA** of Aquivion® G+ shows a **lower PCF** than other ionomers in FB membranes.



## Scalability

- **Rapid industrial-level access**
- Resin quantities for **MW-scale deployment..**

At Syensqo we are at the forefront of ionomer innovation, in order to transform the energy storage landscape, our collaboration is key.



Thank YOU<sup>!</sup>



**Aquivion® G+** helps **broadening ionomer separator choices**, building a stronger basis for **sustainability** and **performance** in Flow Batteries.

**Collaboration** along the entire flow battery **value chain** remains crucial to develop the next generation of membranes and FB systems!



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**SYENSQO**