## Redox Flow Batteries: Current Market and Technology Status

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- | REDOX FLOW BATTERY vs X 01
- Power and Energy capacity are decoupled offering increased modularity. >Very Long Lifetime, Minimal Capacity Degradation, Augmentation not required. >Non-flammable, Non-explosive, Zero thermal runaway risk, Safe in transportation. >Up to 97% recyclable materials and 100%





- -Lithium-Ion
- -Nickel-Hydrogen
- -Sodium-Ion
- -Sodium Nickel Chloride
- -Ultra Capacitors
- -Zinc Hybrid

- recyclable electrolytes.
- $\triangleright$ Operation at high temperatures without significant cooling requirements.  $\geq$  Room for further improvement of RTE, energy and power density, and cost.

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## 02 | THE REDOX FLOW BATTERY FAMILY

- Most commercial products are using vanadium based electrolytes.
- > Titanium, Iron, Vanadium, Hydrogen, Zinc and Bromine



- based electrolytes are the most matured technologies (TRL4 - TRL9).
- R&D efforts to decrease electrolyte and power stack cost, increase energy density, power density and efficiency.

## 03 | THE REDOX FLOW BATTERY WORLD MAP

- > 35+ Manufacturers in USA, Canada, Europe, Australia and Asia.
- $\succ$  Most suppliers offer vanadium based products.
- $\succ$  A few are exploring iron, zinc, bromine, hydrogen based and organic electrolytes.
- > 1.3+ GWh installed or under construction worldwide including pilot projects.