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Report ScopeThis report analyzes the flow battery market by battery type, battery material, deployment, application and end-use industries. Additionally, the report discusses the technological, regulatory, competitive and economic trends that impact the market. The analyst has included a patent analysis for the flow battery market, which depicts a strong investment prospect for investors.

It analyzes emerging technologies, the impact of COVID-19, and the competitive landscape, which enables the reader to understand the global market. The report concludes by looking at environmental, social and governance (ESG) developments and by providing detailed profiles of the major manufacturers of flow batteries.The report includes:

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As she drives her electric vehicle to her mother"s house, Monique"s battery gauge indicates that it"s time to reenergize. She stops at a charging station, taps her credit card at the pump, inserts a nozzle into the car, and in 5 minutes exchanges 400 liters of spent nanofluid for fresher stuff. As she waits, a tanker pulls up to refill the station itself by exchanging tens of thousands of liters of charged for spent fuel. Monique closes her EV"s fueling port and heads onto the highway with enough stored energy to drive 640 kilometers (400 miles).

The battery in her EV is a variation on the flow battery, a design in which spent electrolyte can be replaced, the fastest option, or the battery could be directly recharged, though that takes longer. Flow batteries are safe, stable, long-lasting, and easily refilled, qualities that suit them well for balancing the grid, providing uninterrupted power, and backing up sources of electricity.

Nanoelectrofuel batteries are a new take on the reduction-oxidation (redox) flow battery, which was first proposed nearly a century and a half ago. The design returned to life in the mid-20th century, was developed for possible use on a moon base, and was further improved for use in grid storage.

The cell of a flow battery uses two chemical solutions containing ions, one acting as the anolyte (adjacent to the anode), the other as the catholyte (near the cathode). An electrochemical reaction between the two solutions pushes electrons through a circuit. Typical redox flow batteries use ions based on iron chromium or vanadium chemistries; the latter takes advantage of vanadium"s four distinct ionic states.

On the chemical side of the reaction, each solution is continuously pumped into separate sides of a battery cell. Ions pass from one solution to the other by crossing a membrane, which keeps the solutions apart. On the electrical side, current moves from one electrode into an external circuit, circling around before returning to the opposite electrode. The battery can be recharged in two ways: The two solutions can be charged in place by a current moving in the opposite direction, the way conventional batteries are charged, or the spent solutions can be replaced with charged ones.

Besides beating lithium batteries in performance and safety, flow batteries also scale up more easily: If you want to store more energy, just increase the size of the solution storage tanks or the concentration of the solutions. If you want to provide more power, just stack more cells on top of one another or add new stacks.

This scalability makes flow batteries suitable for applications that require as much as 100 megawatts, says Kara Rodby, a technical principal at Volta Energy Technologies, in Naperville, Ill., and an expert in flow batteries. An example, she says, is the task of balancing energy flows in the power grid.

However, conventional flow batteries pack very little energy into a given volume and mass. Their energy density is as little as 10 percent that of lithium-ion batteries. It has to do with the amount of material an aqueous solution can hold, Rodby explains. There is only so much salt you can dissolve in a glass of water.

Therefore, flow batteries have so far been too bulky for most applications. To shrink them enough to fit in electric vehicles, you need to raise their energy density to that of lithium-ion batteries.