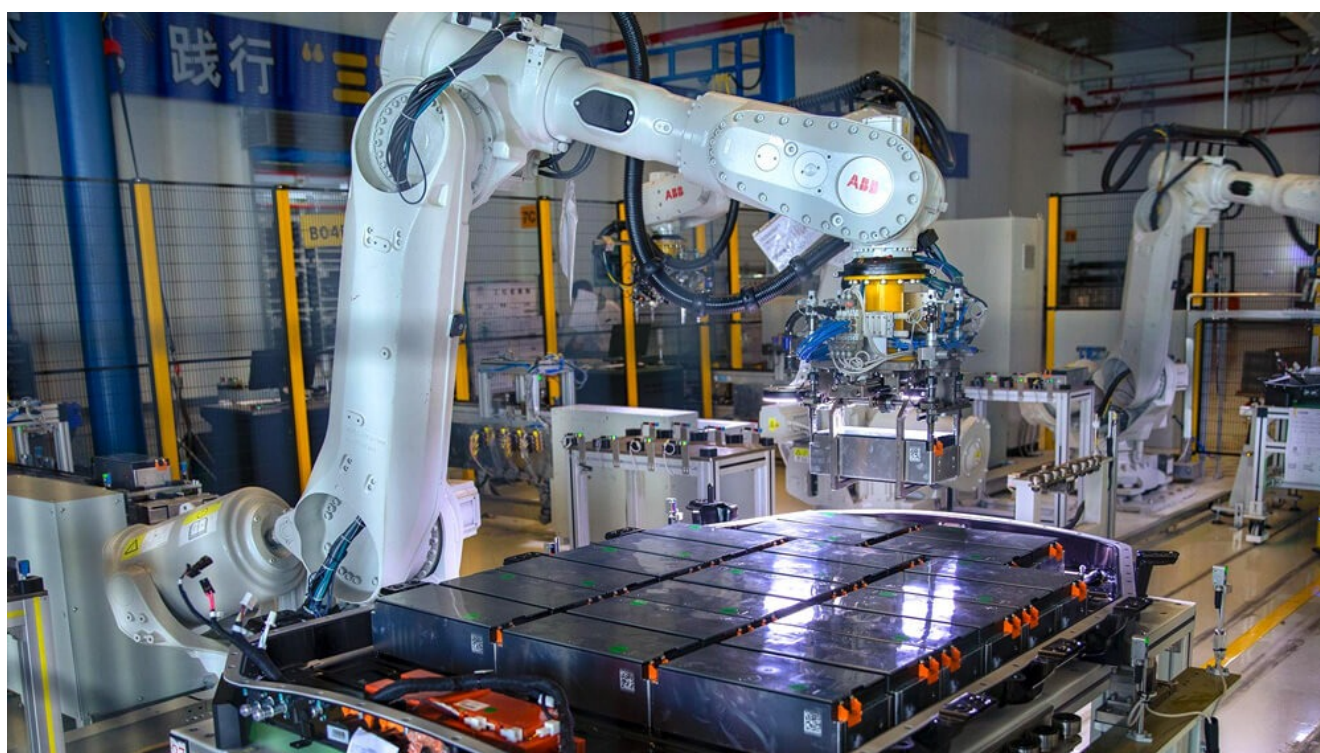


Revolutionising Energy Storage With Organic Flow Batteries

The growing shift to [clean energy](#) propels the global expansion of [renewable energy](#) installations. Meeting the ever-increasing energy demand and facilitating large-scale transition necessitates the crucial role of [energy storage](#). Likewise, addressing the [intermittent](#) nature of renewable energy sources demands incorporating low-cost and durable energy storage systems into [electric grids](#).

Thermal energy storage, organic flow batteries, [lithium-ion](#), sodium-sulphur, compressed air energy storage, and pumped hydro storage actively serve as [viable options](#) for large-scale storage, ranging from tens to hundreds of megawatt-hours.



Flow batteries, as opposed to traditional batteries, store energy in the electrolyte solutions.

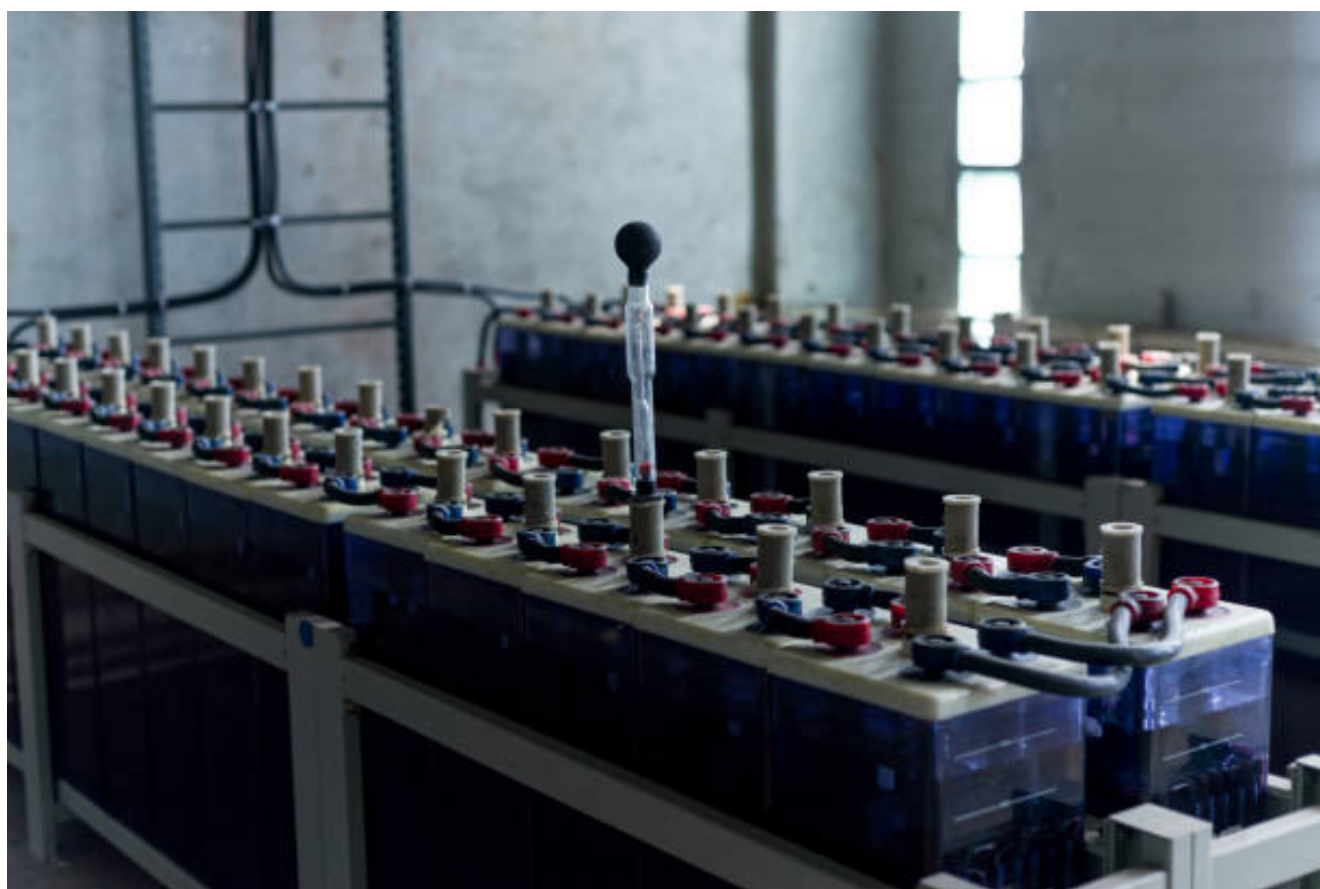
Source: [Tycorun Energy](#).

First, the [flow battery](#) is an [electrochemical energy storage](#) considered a promising technology for large-scale renewable energy conversion and storage, due to its inherent decoupling of power output and energy storage capacity. Among the diverse types of flow batteries, the organic flow battery, utilising naturally abundant organic molecules as its redox-active species, is actively

recognised as a [suitable choice](#) for achieving high performance, enhanced energy density, and reduced costs.

What Are Organic Flow Batteries?

Put simply, Organic Flow Batteries (OFBs) are [energy storage](#) technology that uses organic compounds (carbon-based molecules) to store and release electrical energy. These batteries [work](#) by flowing liquid organic molecules through a system, where they undergo chemical reactions to store or release energy.



A clean and sustainable energy future demands radical new concepts for energy storage. Source: [iStock](#)

Organic flow batteries [leverage](#) the abundance, excellent structural tunability, and low cost of organic molecules as [Redox-Active Materials](#) (RAMs), to achieve high designability for low-cost and high-energy-density flow batteries. Depending on the electrolyte media, OFBs are categorised into Aqueous Organic Flow Batteries ([AOFBs](#)) and Non-Aqueous Organic Flow batteries ([NAOFBs](#)). The latter offers a [wide range](#) of working temperatures, high cell voltage, and potential energy density.

Benefits of Organic Flow Batteries

Organic flow batteries present several [advantages](#) over conventional flow batteries which include:

Low toxicity and flammability

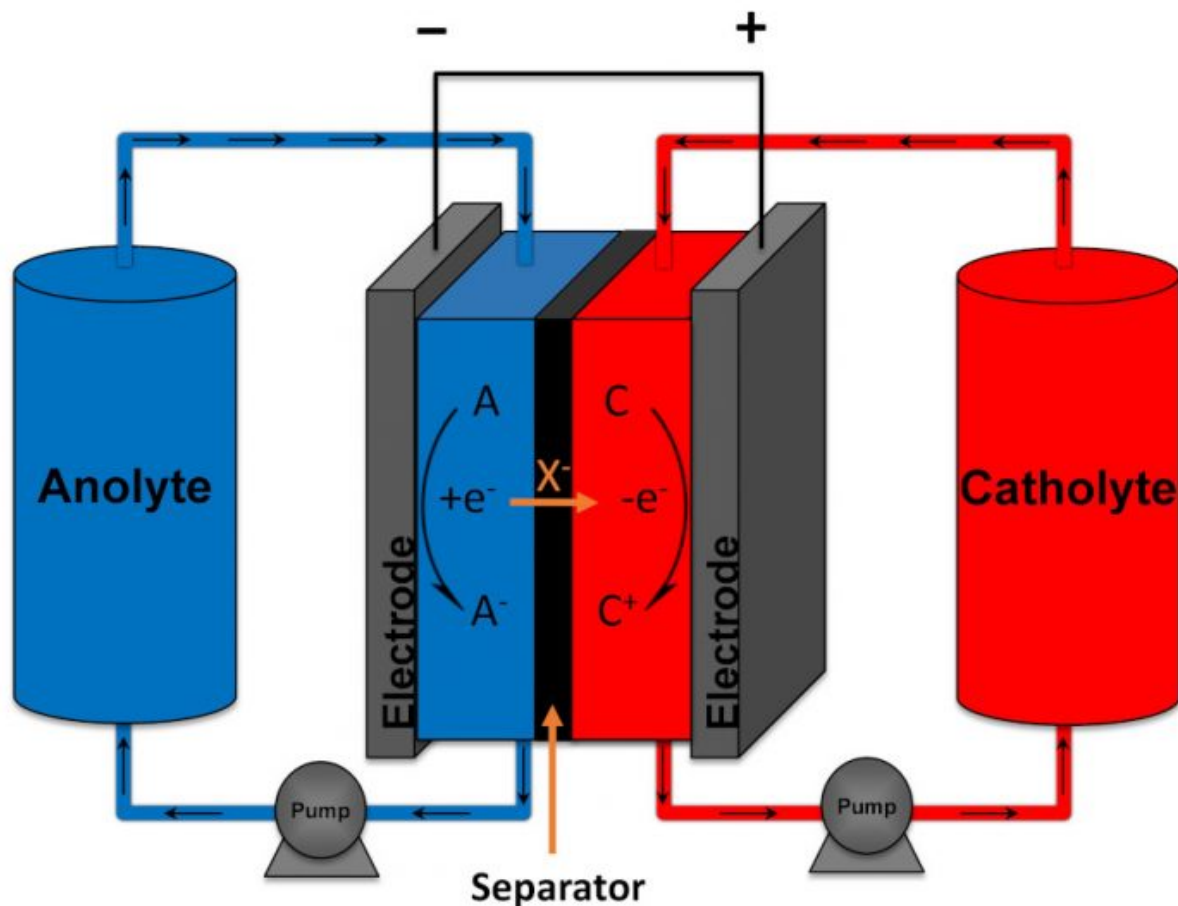
OFBs are unique due to electrolytes that are less hazardous and less prone to combustion. Conventional flow [batteries](#) often employ hazardous substances like vanadium, zinc, or bromine requiring special handling and disposal. Alternately, OFBs utilise organic molecules such as quinones, ferrocenes, or viologens. These organic compounds are obtained from natural sources or synthesised from abundant materials.

High energy density and scalability

Another benefit of OFBs is that they have higher energy density and scalability than conventional flow batteries. OFBs have higher energy density because organic molecules can store more electrons per molecule than metal ions. OFBs also have higher scalability because they can use different organic molecules for the positive and negative electrolytes, which allows for more flexibility and optimisation of the system performance.

Low cost and environmental impact

OFBs have lower costs because organic molecules are cheaper and more abundant than metal-based or inorganic compounds. OFBs also have a lower environmental impact because they use less energy and [water](#) for production and operation. Also, they generate less waste and [emissions](#).



The cell of a flow battery uses two chemical solutions containing ions, one acting as the anolyte (adjacent to the anode), and the other as the catholyte (near the cathode).

Source: [M2N Research Group](#).

moving forward

[Renewable energy](#) sources such as [solar](#) and [wind power](#) are increasingly replacing [fossil fuels](#). Organic flow batteries display significant potential for widespread integration of large-scale [energy storage](#).

Organic Flow Batteries are suitable for different application areas in the [power grid](#) such as the intermediate storage of power from [renewable energy](#) generation or in connection with the balancing of demand peaks in industrial companies. Additionally, OFBs can be utilized in the [charging infrastructure](#) required for electric mobility. The batteries enable a buffer storage to relieve power grids which do not have to be upgraded for additional loads. Although OFBs are in the

early stages of research and development, their potential as a viable and sustainable solution for future energy storage is considerable.

Why is it essential that we focus on Organic Flow Batteries?

Using 'organic' electrolytes makes redox flow batteries a more efficient, long-lasting, and sustainable electricity storage technology. Unlike lead-ion, [lithium-ion](#), and other traditional redox flow batteries based on vanadium- and zinc-based battery chemistries, OFBs are unique [alternatives](#) due to the easy replaceability of the liquid electrolyte.

While OFBs offer numerous benefits, [challenges](#) such as organic molecules' stability, solubility, and selectivity impact the system's efficiency, durability, and reliability. Opportunities for OFBs include the exploration of new organic molecules, the improvement of system design and integration, and the identification of new applications and markets.

achieving the United Nations Sustainable Development Goals (SDGs) and how they link to Organic Flow Batteries

The [renewable energy](#) transition needs powerful, scalable, and affordable energy storage systems that do not harm people and nature. Advancements in [battery technology](#) are essential to meet [climate goals](#) sooner, especially in contributing to achieving [SDG9](#) and [SDG7](#). SDG9 supports the development of [sustainable infrastructure](#), promoting innovation, facilitating [sustainable](#) industrialisation, and enabling the transition to cleaner and more efficient energy systems. Moreover, SDG7 aims to ensure access to affordable, reliable, sustainable, and modern energy for all. Achieving this goal is vital to protect our environment, foster [economic growth](#), reduce [poverty](#), and improve [quality of life](#).

A Thrivable Framework

At [THRIVE](#), we firmly embrace the infinite potential of humanity. Our mission is to ignite the awareness of implementing [sustainable solutions](#). By not only preventing catastrophe and nurturing societies to flourish, we unlock their true potential for [prosperity](#) and [growth](#). Our [THRIVE Framework](#) examines issues and evaluates potential solutions concerning this overarching goal of [thrivability](#). It is about making predictive analyses using modern technology that supports environmental and [social sustainability](#) transformations.

The transition to carbon neutrality and renewability is well underway—and [batteries](#) have a significant role. To learn more about how the [THRIVE Project](#) is researching, educating, and advocating for a future [beyond sustainability](#), visit our [website](#). [THRIVE](#) has its own set of [publications](#) as a guide for anyone wanting to run or support sustainable business practices. You can follow our informative, diverse [blog](#) and [podcast series](#), and learn more about our regular live [webinars](#). [Sign up for our newsletter](#) to receive regular updates.