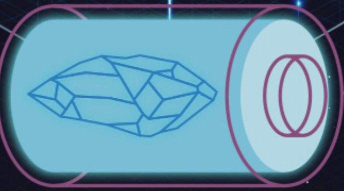


VANADIUM

THE ENERGY STORAGE METAL

The first wide-scale use of vanadium in industry was in 1905, when Henry Ford realised that the Model T could be stronger and lighter if he used vanadium-enriched steel.

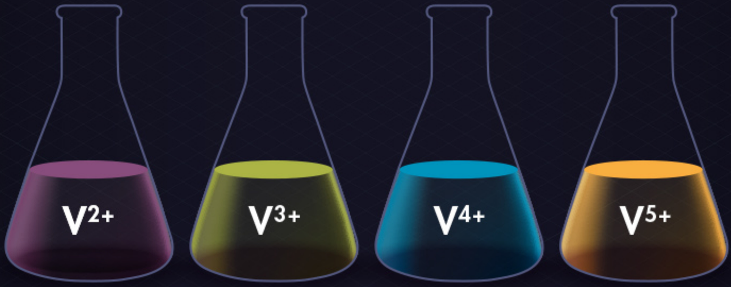
Today, vanadium promises to be a major player in the green energy storage revolution.

CHARGED WITH POTENTIAL

Aside from vanadium's incredible strengthening abilities, the metal also acts as a battery material that is 100% reusable.

HOW?

Vanadium has four different oxidation states. This allows it to be infinitely reused as both the anode (+) and the cathode (-) of Vanadium Redox Flow Batteries (VRFBs)

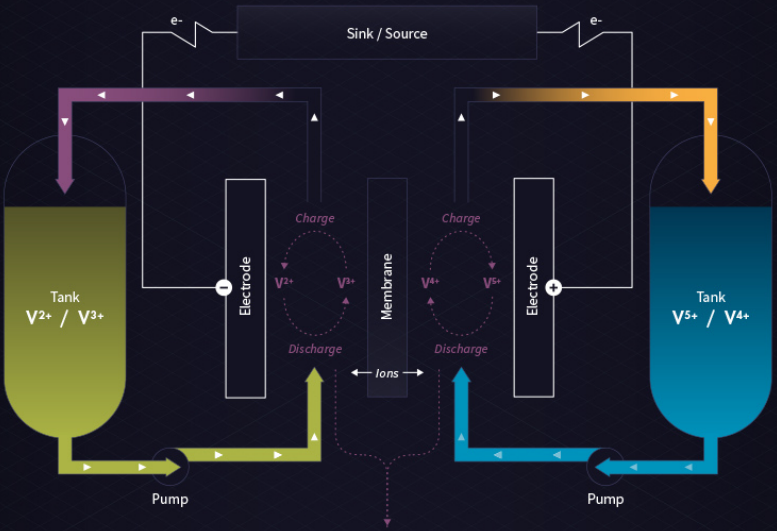


THE RESULT

A breakthrough VRFB battery that offers to change the green energy landscape.

HOW DOES A VANADIUM REDOX FLOW BATTERY WORK?

The battery only uses vanadium electrolyte, and it takes advantage of the metal's multiple oxidation states.



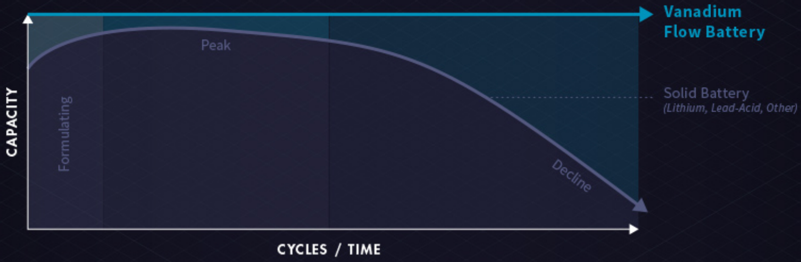
The electron differential between the

two cells generates electric power.

ADVANTAGES

- By using the same metal, there is no cross-contamination of battery materials
- Extremely scalable
- Cycle life is theoretically unlimited
- Can rapidly release large amounts of electricity
- Can maintain ready state for long periods
- Vanadium electrolyte is reusable, recyclable, and has a battery lifespan of 25+ years.
- Can be charged and discharged at same time
- Non-flammable / Extremely safe

CYCLE LIFE



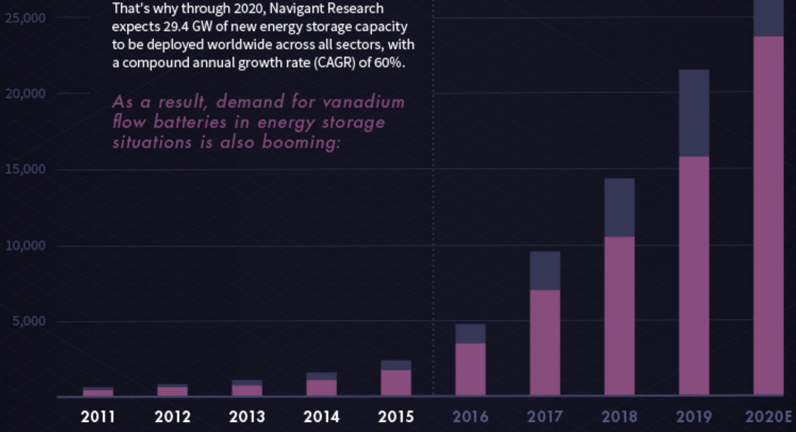
GO WITH THE FLOW

With demand for renewable energy growing at a record pace, the need for utility-scale energy storage has never been more crucial.

Source: TTP Squared, Inc.

That's why through 2020, Navigant Research expects 29.4 GW of new energy storage capacity to be deployed worldwide across all sectors, with a compound annual growth rate (CAGR) of 60%.

As a result, demand for vanadium flow batteries in energy storage situations is also booming:



***Metric tonnes of Vanadium contained**

Source: TTP Squared, Inc.

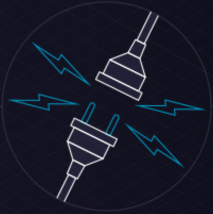
This is fitting, because vanadium flow batteries are particularly appropriate for storing energy from intermittent sources such as solar or wind:

VANADIUM FLOW BATTERIES CAN:

Be scaled up to handle big loads

Be cycled repeatedly over a long period of time

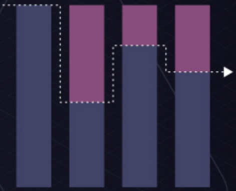
Release large amounts of power on demand



AS A RESULT, THEY CAN BE USED IN A VARIETY OF ENERGY STORAGE APPLICATIONS:

MICROGRIDS

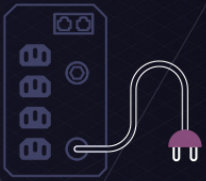
PEAK SHAVING



LOAD LEVELING

WIND AND SOLAR

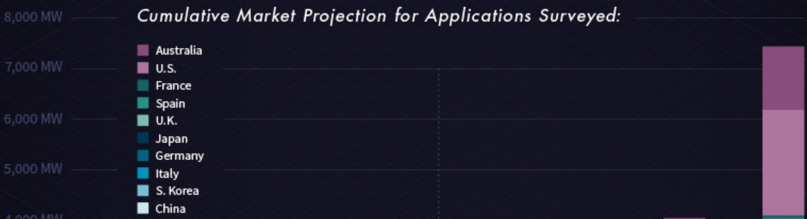
UNINTERRUPTIBLE POWER SUPPLY (UPS)



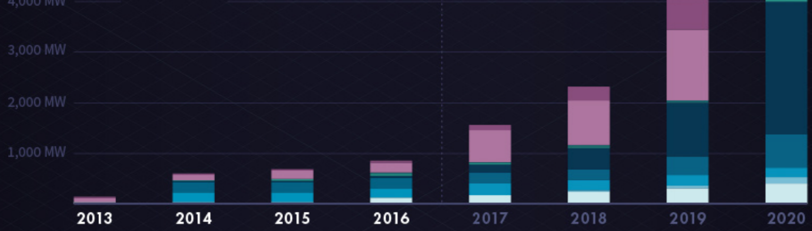
OFF-GRID POWER SUPPLY

THE ENERGY STORAGE DEMAND

Vanadium energy storage technology is well placed to meet a growing global demand. For these ten countries alone, the energy storage market is expected to increase by 80% CAGR between 2013 and 2020.



Cumulative Market Projection for Applications Surveyed:



Source: Azure International

VANADIUM FLOW INSTALLATIONS

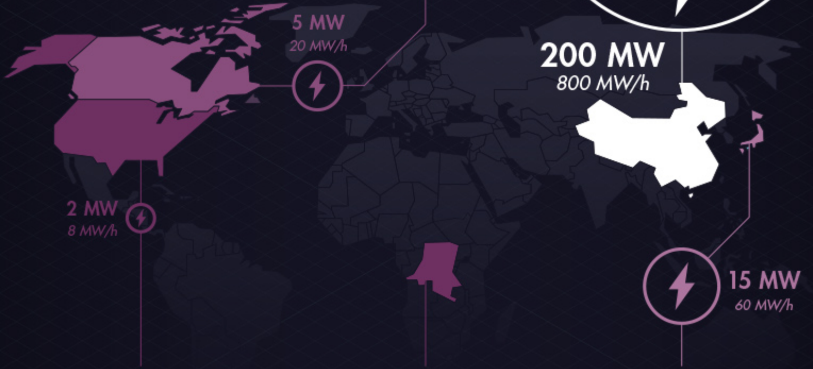
As the energy storage market blooms, vanadium flow batteries are being installed around the world. Here are some of the most noteworthy projects:

CANADA

By the end of 2017, Canada will have the most powerful vanadium flow battery in North America and Europe.

CHINA

The largest grid-scale battery system in the world is being built on the Dalian peninsula in China, and it will serve about 7 million residents. The battery will be able to peak-shave approximately 8% of Dalian's expected load in 2020.



USA

The largest vanadium flow battery in the U.S. can keep the lights on in 1,000 homes for eight hours.

DRC

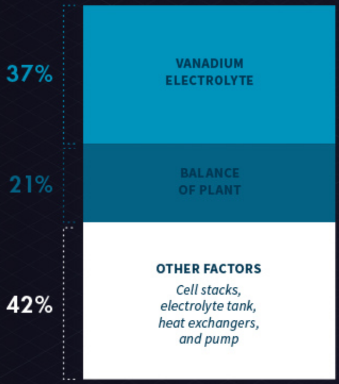
Ivanhoe Mines and Zijin Mining are evaluating the installation of up to 100 MW of solar power, as well as vanadium flow batteries, to make their mine in the DRC the greenest in the world.

JAPAN

Next to one of the country's largest solar power plants is a 15 MW vanadium flow battery from Sumitomo.

THE ECONOMICS OF VANADIUM ENERGY STORAGE

Despite a clear fit for storing green energy, the biggest obstacle for vanadium flow batteries moving forward are the economics.



Source: Department of Chemical Engineering, University of Tennessee

The biggest drag on cost?

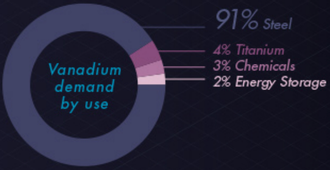
Vanadium electrolyte. It can make up 30-50% of total battery costs.

By finding better and cheaper sources of vanadium electrolyte, material costs could be significantly reduced.

THE CHALLENGE?

Vanadium energy storage requires high purity compounds, which makes up only 2% of all vanadium output. A direct consequence of this limited supply is the cost.

Source: TTP Squared, Inc.



> "...there's a revolution coming in Vanadium Redox Flow Batteries..."

- Robert Friedland
Founder and Executive Chairman Ivanhoe Mines

Demand for vanadium batteries is growing rapidly with the urgent need for grid-scale renewable energy storage.

Primary supply of vanadium electrolyte is crucial to positioning vanadium batteries to the forefront of the green energy storage market.

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