VANADIUM FLOW BATTERIES:

A sustainable, green energy storage solution

SDG 7

reliable, sustainable and modern energy for all

As the world continues to advance towards meeting sustainable energy targets by 2030, Vanadium Flow Batteries can substantially increase the share of renewable energy in the global energy mix and the integration of renewables into existing power systems.

These long-duration, utility-scale Vanadium Flow Batteries reliably store energy from wind and solar to overcome renewable energy intermittency challenges. This helps to unlock the full potential of renewables towards the global goal of achieving net-zero carbon emissions.

ENERGY STORAGE DRIVING VANADIUM DEMAND

2021
Energy storage 3rd largest consumer of vanadium behind steel, titanium.

2022
Vanadium Flow Batteries the 2nd largest consumer of vanadium for the first time in history.

2023
Vanadium demand in energy storage highest on record, increasing 60% year on year.

EXPONENTIAL GROWTH IN VANADIUM FLOW BATTERY DEPLOYMENTS

Guidehouse Insights forecasts global annual deployments of Vanadium Flow Batteries to reach
32,800 MWh by 2031
with Asia Pacific leading in deployments.

VANADIUM DEMAND GROWTH TO FOLLOW SUIT

Based on Guidehouse Insights' forecasts, energy storage alone is expected to consume about 140,000 mt/year of vanadium by 2031. Added to steel market demand, this will more than

DOUBLE

today's global vanadium demand of
127,000 mt/year.

Vanadium supply needs to grow by a
CAGR of 11.6% between 2023-2030
to meet the Guidehouse Insights' demand projections.

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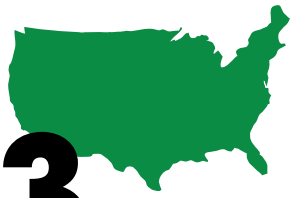
TOP 3 VANADIUM FLOW BATTERY DEPLOYMENT REGIONS BY 2031

01

ASIA-PACIFIC
14,500 MWh/year of Vanadium Flow Battery storage capacity

02

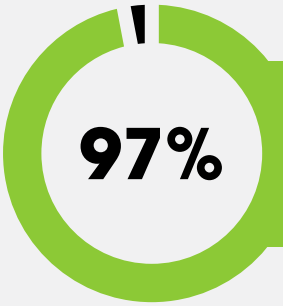
WESTERN EUROPE
9,300 MWh/year of Vanadium Flow Battery storage capacity



03

NORTH AMERICA
5,800 MWh/year of Vanadium Flow Battery storage capacity

IN 2022:

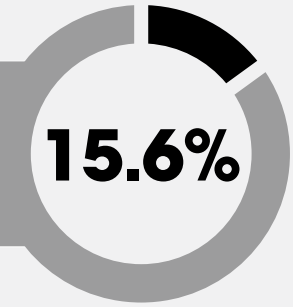


ASIA-PACIFIC

Installed 97% of Guidehouse Insight's projected Vanadium Flow Battery installation capacity for the region that year, due to rapid commercial adoption in China and Japan.

WESTERN EUROPE

Installed 15.6% of Guidehouse Insight's projected Vanadium Flow Battery installation capacity for the region that year.

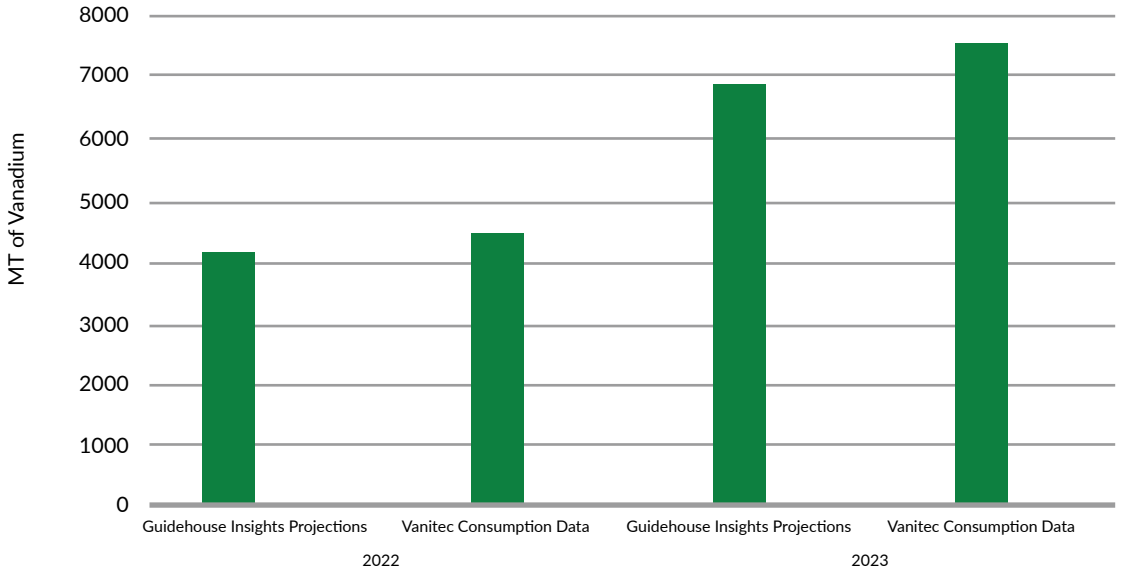


NORTH AMERICA

Installed 5.8% and of Guidehouse Insight's projected Vanadium Flow Battery installation capacity for the region that year.

IN 2022 & 2023, the consumption of vanadium in Vanadium Flow Batteries deployed in the Asia-Pacific region exceeded Guidehouse Insights' projected vanadium consumption by 287 and 619 mt of vanadium, respectively.

VANADIUM DEPLOYED IN VANADIUM FLOW BATTERIES IN ASIA PACIFIC REGION



CHINA LEADS IN VANADIUM CONSUMPTION

CHINA

accounted for **92%** of the total 2023 consumption of vanadium in Vanadium Flow Batteries.

WORLD

Vanadium consumption in Vanadium Flow Batteries accounted for **6.8%** of global vanadium consumption for the same period.

FOSSIL FUELS → CLEAN ENERGY

- **Demand for vanadium** in energy storage has increased rapidly since H2 2022 and is projected to dramatically increase over the next 7 years.
- **Over 300** Vanadium Flow Battery energy storage projects globally have been deployed, are under construction, contracted or have been announced.
- **Over a third** of the projects are in China.

GLOBAL VANADIUM FLOW BATTERY INSTALLATION MAP

"A fair, just, equitable, and urgent transition from dirty fossil fuels to clean energy is essential to avoid the worst of climate chaos and spur sustainable development."

– UN Secretary-General,
António Guterres, 26 January 2024

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