

# Identifying market opportunities for flow batteries

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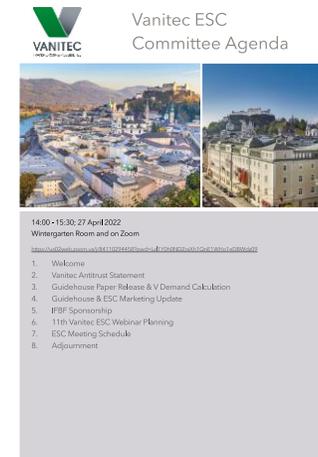
International Flow Battery Forum

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# Vanitec and the Energy Storage Committee

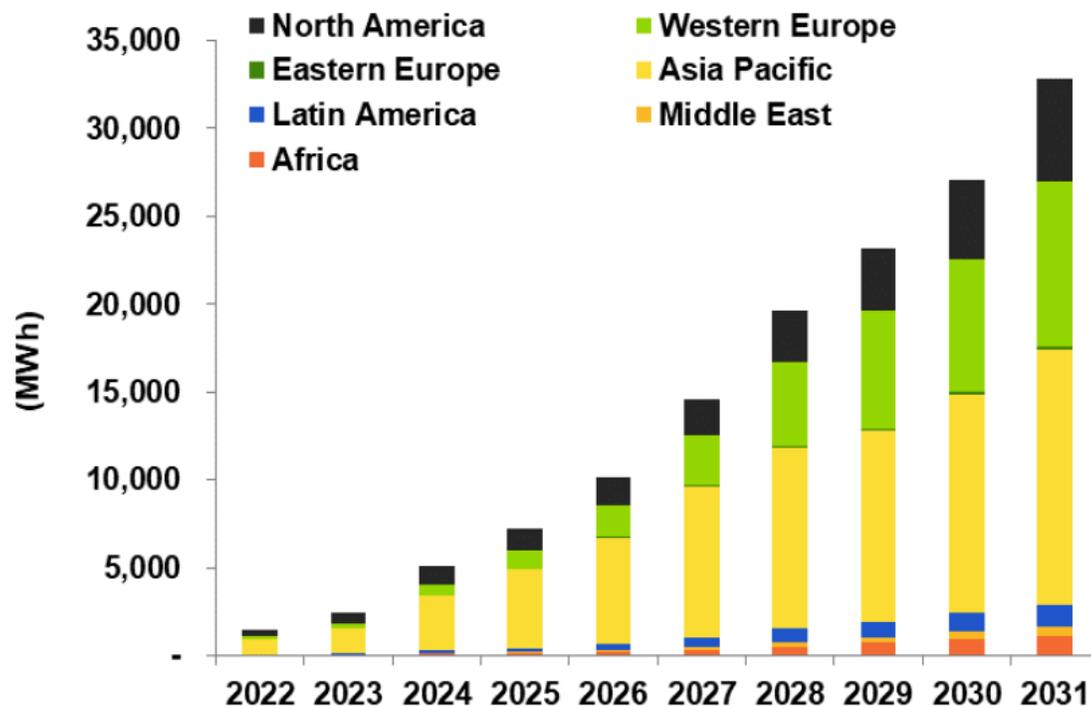
- Vanitec is the only not-for-profit international global member organisation whose objective is to promote the use of vanadium bearing materials. Our members include all the world's major vanadium producers as well as vanadium users and those involved in vanadium energy storage.
- Vanitec members benefit by the organisation representing the interests of its members in technical, market development and HSE issues. It offers a forum for collaboration to understand and promote the uses of vanadium at a global level.
- The Energy Storage Committee focuses on supporting the use of vanadium in energy storage applications
- The Committee meets monthly internally and holds 1-2 external meetings that are free and open to everyone
- It has a long-standing collaboration with the IFBF (such as in-person meetings)
- Our next webinar will be in September



# The market for vanadium redox flow batteries (VRFBs) is large

Guidehouse Insights forecasts over 30 GWh of VRFB demand by 2031

*Annual Installed VRFB Utility-Scale and Commercial and Industrial Battery Deployment Energy Capacity by Region, All Application Segments, World Markets: 2022-2031*



- Guidehouse forecasts that VRFB's will account for 32,800 MWh by 2031, a market share of ~20% of the stationary storage market.
- Over the next 5 years, the vast majority of that is forecast to be in China, with faster growth in other regions in the second half of this decade.
- The annual growth rate of over 40% has massive implications for VRFB OEMs and companies in the battery supply chain.
- The implication for vanadium producers is also significant, as based on Vanitec calculations, this VRFB market would require between 127,500 and 173,8000 tons of additional vanadium per year. That is over twice current production.



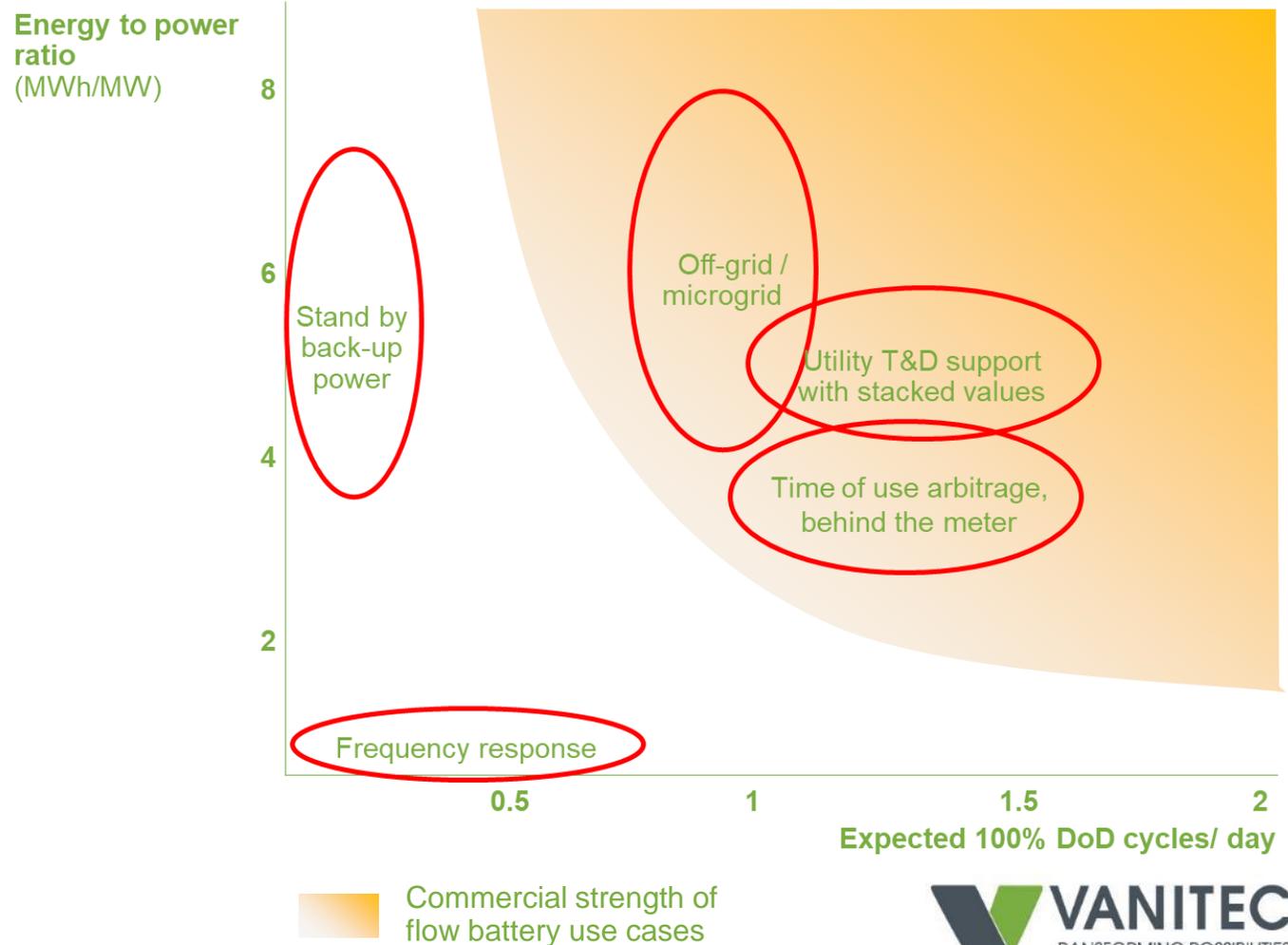
# The technical advantages of flow batteries determine where they will be commercially competitive

Today, three key technical differentiators determine a commercial opportunity for a flow battery:

1. Separation of power and energy modules, increases competitiveness for longer durations;
2. Non-degradation from cycling, increases competitiveness for frequent, deep charge – discharge cycles;
3. Non-flammability of the chemistry, which makes it viable in high fire risk locations.

There are other benefits, such as a lower manufacturing carbon footprint and the reusability of vanadium; however, customers are not yet fully valuing these benefits.

Selected storage applications based on daily usage and storage requirements



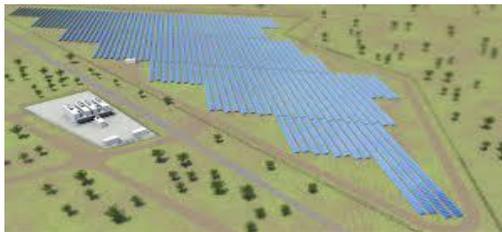
# Three VRFB sites exemplify the breadth of flow battery opportunities



- 15 MW/60 MWh VRFB at the Minami-Hayakita substation on Hokkaido, Japan
- Used for peak shifting, frequency regulation and balancing power output from the wind and solar sources to load requirements in the area
- Part of regional grid-expansion programme



- 2 MW/5 MWh VRFB at the Oxford Superhub in Oxford, UK
- Co-located with a 50 MW Li-ion battery to combine ESS with EV charging, low carbon heating and smart energy management systems to reduce carbon emissions
- The VRFB is the first resource activated when the system is called upon to reduce wear and tear on the Li-ion battery



- 1 MW/4 MWh VRFB at the Vametco mine, in Brits, South Africa
- Co-located with a 3.5 MW solar PV array and connected to the mine's internal grid
- Provides time-of-use tariff arbitrage, increases the amount of renewable energy and reduces the impact of system operator mandated load reductions



Thank you

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