Greener Generation, Greener Storage – Vanadium's Role in Lowering the Carbon Impact of Energy

Distributed on behalf Vanitec, the only global association promoting the use of vanadium and vanadium bearing materials

The energy sector has been saddled with challenges amidst the COVID-19 pandemic. As we begin to imagine life in a post-COVID world, reducing the carbon footprint within the energy value chain will continue to be of paramount importance for the energy sector.

Our collective experience of the COVID-19 pandemic has placed renewed emphasis on the world's ability to transition to green energy, and the timeframe within which this can be accomplished. According to the International Energy Agency (IEA), a decline of approximately 7% of global carbon emissions from electricity generated from fossil fuels will be recorded for the 2020 period. In contrast, global renewable energy installation hit a record level in 2020. According to The IEA, approximately 90% of newly installed electricity generation in 2020 was renewable.

The shift towards renewable energy sources offers immense scope for lowering the carbon emissions resulting from electricity generation – the U.S. Energy Information Administration (EIA) has estimated that renewables will collectively increase to account for 49% of global electricity generation by 2050. Wind and solar have enormous potential; however, they both present the challenge of intermittency and a potential mismatch between optimum generating times and times of peak demand. As a result, accelerating the transition to green energy within the global energy mix will require a concomitant increase in green energy storage provision.

Scalable, long-duration energy storage offers a solution by operating as an enabling technology for renewable energy generation by smoothing out disparities between supply and demand. However, this can also come with carbon costs. What is needed is a form of safe, grid-scale energy storage that reduces carbon emissions in its own right.

While many storage methods exist, Vanadium Redox Flow Batteries (VRFBs) are among the most promising of such technologies. VRFB technology offers potential advantages in terms of reduced CO_2 emissions over lithium-ion batteries (LIB) across the whole-life cycle, especially when storage is coupled to a renewable source. In general, the carbon efficiency of energy storage is directly linked to the carbon intensity of the source of the energy to be stored. Further savings can be unlocked by ensuring that the vanadium electrolyte in each VRFB is either reused or recycled at the end of its lifetime (90% of the vanadium in each VRFB can be recycled).

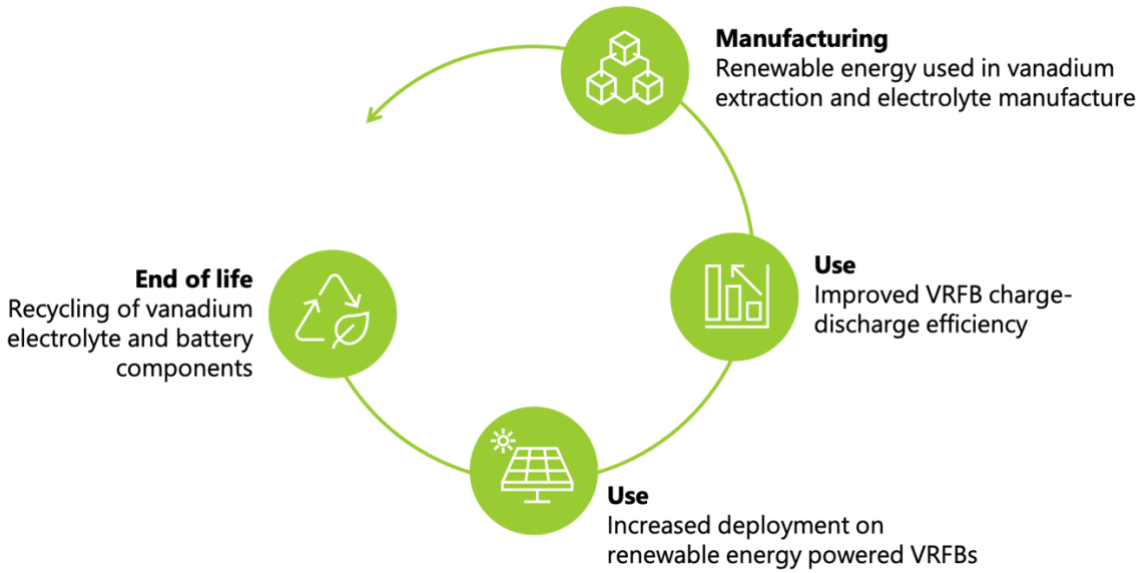
Even without recycling, VRFBs contribute approximately 17 kg CO_2 (30%) carbon emission savings over LiBs for every 1MWh of capacity. Where recycling is considered, the unmatched recyclability of the vanadium electrolyte drives these carbon emission savings to 78% - or almost triple.

Taken together, vanadium recycling and green energy generation make an unanswerable case for the adoption of VRFBs as the preferred long-duration energy storage solution in grid-scale applications.

The time for VRFBs is now!

VRFBs offer uncapped carbon reduction potential across all phases of its lifecycle. These phases are manufacturing (production of the VRFBs); use (the active lifespan of each VRFB, typically determined by its design life in charge-discharge cycles); and end of life (the decommissioning, dismantling and disposal or recycling of the components).

Pre-existing trends all point towards VRFB adoption:



As the energy sector strives to achieve reduced carbon emissions, Vanitec, the only global association promoting the use of vanadium and vanadium bearing materials, is increasing its support for the transition from fossil fuels to clean energy sources. The solution for reliable and low-carbon electrical energy must include sustainable, safe, reliable and large-scale energy storage. Only one technology ticks all these boxes: VRFB. Vanitec is therefore committed to continuous advocacy for the integration of VRFB and renewable energy generation.

Notes

1. *This thought leadership piece draws on a meta-analysis of detailed life cycle assessment studies on vanadium redox flow batteries from Texas A&M University: Life Cycle Assessment of Vanadium Products by Dixit et al.*
2. *This study in turn draws on the work of Weber et al., 2018 for calculations based on the configurations and charge/discharge efficiencies of VRFBS.*
3. *Carbon savings are calculated with respect to a typical lithium–titanate battery, a mainstay in lithium-ion battery applications.*

4. *The functional unit used to compare the overall environmental performance of different energy storage technologies is kg CO_2/1MWh over a 20-year lifetime.*