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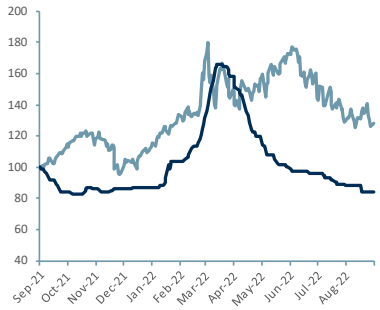
Value Range

N/A – N/A



Price Relative vanadium (darker) vs. WTI (lighter)

Monday, 05 September 2022

CellCube (Enerox Gmbh).

Core Investment Case

CellCube (Enerox GmbH) is a pioneer and technology leader in the development and deployment of off-grid Vanadium Redox Flow Batteries (VRFB). CellCube's product addresses volatile supply in renewable generation. The company has recently signed a set of cross sector construction and distribution agreements in the US, Australia and Africa. VRFB is a promising scalable energy storage technology. Redox flow batteries lend themselves to microgrids, utility-scale storage projects, renewable energy integration and blackout prevention. Moreover, VRFBs are better placed than Li-ion or other solid-state batteries to serve grid needs (scale, longevity, durability, charging cycles, responsiveness, non-flammable). CellCube is a bankable European VRFB leader.

- Leader in Vanadium Redox Flow Batteries (VRFBs);
- VRFBs known for their long-duration energy storage capacity;
- Critical in utility-scale grid management, e.g., for renewable power;
- VRFB market forecast CAGR of 41% from 2022-2031.

The trading multiples peer group table below is normalized to USD. LMT is excluding from the peer averages and medians to reduce distortion. FX translation rates are as at date of note.

TTM Metrics / Company Name	Market	Tkr	MCAP US$(m)	EV $(m)	EV / REVS	EV / EBITDA
Lockheed Martin	**XNYS**	**LMT**	**110,985**	**117,675**	**1.83x**	**16.46x**
The Chemours Co.	XNYS	CC	5,157	13,197	1.90x	10.00x
Redflow	XASX	RFX	48	48	23.84x	N/M
Rectifier Technologies	XASX	RFT	38	38	3.46x	28.33x
Invinity	XLON	IES	63	63	17.28x	N/M
Average					**11.62x**	**19.16x**
Median					**10.37x**	**19.16x**

Investment Case

CellCube is a pioneer in developing and deploying Vanadium Redox Flow Battery (VRFB) technology. CellCube offers a bankable product in the fast-growing long duration energy storage solutions market.

Leader in Vanadium Redox Flow Batteries – CellCube is the leading provider of industrial-grade and bankable VRFB systems in the global market. Given the intermittency in renewable power, more flexibility is needed in the power grid to maintain grid supply-and-demand capacity over multiple hours. This is where long-duration energy storage is key. VRFB batteries can also function as a backup electricity source

BTM or behind the meter refers to energy storage systems (e.g., batteries) that are on the customers side of the grid with respect to the utility's service meter, in other words it is power that the utility is unable to bill for.

Better alternative to Li-io batteries: Vanadium Redox Flow Batteries are emerging as a better alternative to Li-ion batteries especially for stationary storage applications behind the meter (BTM) or for large utility scale. VRFBs offer higher energy capacity and full discharge, allowing for long-duration storage that can boost the resilience of a grid powered by renewable energy. Furthermore, the Vanadium electrolyte is non-flammable, non-explosive and does not degrade over 20 or 30 years of operation. Vanadium and Lithium commercially exploitable deposits are comparable in terms of metal volumes. The Vanadium based technology is fast emerging as a solution of choice to accelerate energy transition and meet climate targets.

Strong demand potential over the next decade: The VRFB market is poised for rapid growth in the coming years, especially as demand for long-duration storage capabilities increases. According to market intelligence and advisory firm Guidehouse Insights, global annual deployments of Vanadium Redox Flow Batteries (VRFBs) are expected to reach 32.8 GWh per annum by 2031. This represents a CAGR of 41% during 2022-2031.

Long-term agreement de-risks Vanadium supply: CellCube has established long-term supply agreements with the electrolyte providers US Vanadium (USV-private) and Bushveld Minerals (AiM:BMN.L). This allows the company access to high quality vanadium electrolyte of multiple millions of liters p.a. at a price cap, shielding the company from vanadium price volatility.

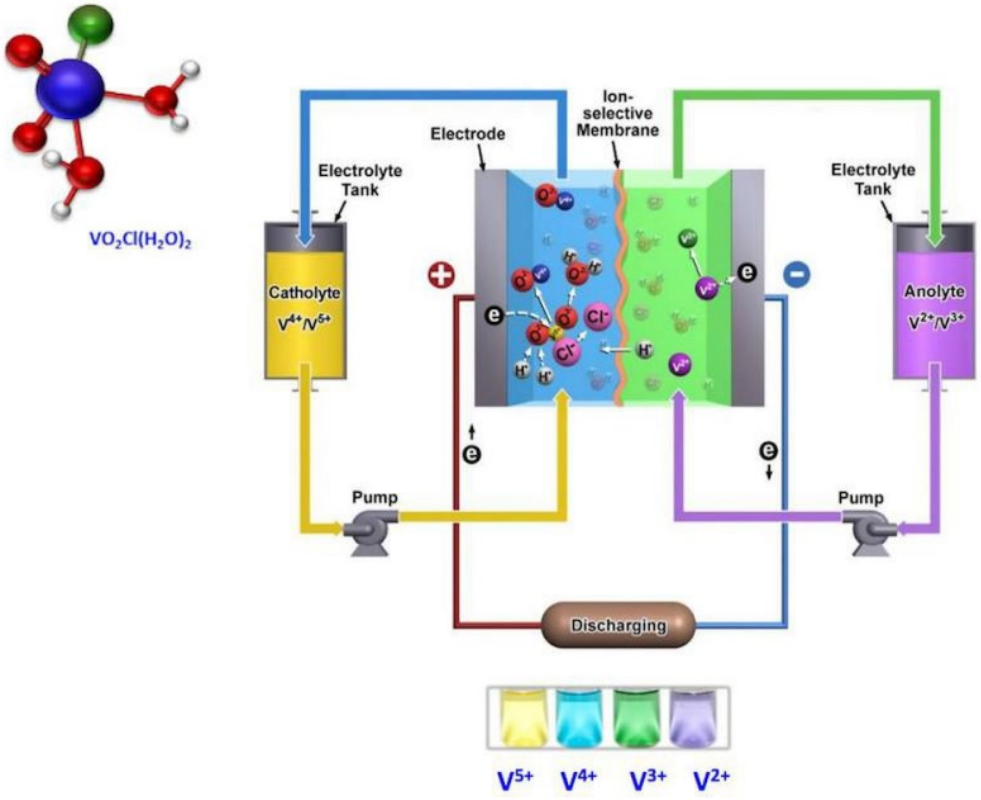
Catalysts

Expansion in North America and Australia; Further distribution and cross sector agreements; Decrease in cost of VRFBs; Increase in grid and microgrid renewable energy mix.

Operational Strategy

CellCube's strategy is to become a leader in long-duration energy storage solutions. CellCube has been developing VRFBs for two decades and has installations in over 130 sites worldwide. The majority of the company's VRFB energy storage systems are installed outdoors. The sales **emphasis is on microgrids, industrial, commercial, private and remote applications.**

Exhibit 1: **Vanadium flow redox battery (VFRB) schematic**



Sources: Sumitomo Electric Industries (copyright 2001); Forbes.
*Positive half-cell (discharge) $VO_2^+ + 2H^+ + e^- \blacktriangleright VO^{2+} + H_2O$

Vanadium redox flow batteries (VRFBs) leverage the multiple valence states of vanadium to store (and release) electrical charge.

In the electron discharge cycle, V2+ is oxidized to V3+ in the negative half-cell, releasing an electron (e^-) to do work in the external circuit (either DC or via an AC/DC converter for AC). In the positive half-cell, $VO^{2+} + H_2O$ accepts an electron from the external circuit, reducing it to $VO_2^+ + 2H^+$ + electron (e^-). In addition, H^+ ions pass through the cell membrane between the positive and negative half-cells maintaining charge neutrality.

There is no capacity loss via precipitation in a vanadium only system, meaning the total amount of vanadium in the system is unchanged, so the capacity of the battery does not reduce over time.

High margin electricity - CellCube positions itself as a high-tech renewable energy storage company delivering high margin electricity. CellCube has invested in the development of recycling and reclamation of vanadium and claims that its entire battery system product is >50% reusable and up to 98% recyclable, according to management.

VRFBs, unlike lithium-ion batteries, can function well without degrading or raising safety concerns (non-inflammable) in a wide variety of settings, which makes VRFBs suitable for residential, commercial, and industrial use.

Long term vanadium supply agreement - CellCube entered into a long-term agreement to secure access to vanadium supply, which is a critical raw material in its long-duration energy storage solutions. The company signed a 5-year deal with vanadium electrolyte supplier U.S. Vanadium, in February 2022.

The U.S. Vanadium agreement also ties in well with CellCube's recent move to establish its presence in North America. The access to made-in-America ultra-high quality processed vanadium will help it offer its solutions at a competitive price.

European manufacture and regional assembly - CellCube develops, manufactures and tests its VRF batteries in Austria in Europe. In regions such as North America and Australia, CellCube production will be supported by regional assembly lines and local production of electrolyte. CellCube's batteries are designed to last 20+ years.

Distribution - CellCube has added several value-added resellers in order to execute its Long Duration Energy Storage (LDES) technology distribution strategy. Reseller partnerships of particular strategic value exist in the US, Germany, the UK, Romania, the Netherlands, Australia, South Africa, Taiwan and Singapore. CellCube recently announced a US distribution deal with G&W Electric (solar microgrid plus VRFB) and a conditional exclusive rights South African partnership with Kibo Energy (KIBO.L) for the sale, configuration and delivery of CellCube VRFBs.

CellCube and G&W electric together intend to take advantage of the PJM capacity market (Reliability Pricing Model), a long-term market that secures power supply on a 3-year future demand horizon.

CellCube also signed, in November 2021, agreements for VRFBs in the maritime sector for an electrified inland ship and charging pontoon with Portliner, and in the food processing and agriculture sector with an off grid Austrian fish farm. We see both these agreements as cross sector proofs of concept. Both sectors have well documented significant CO_2 footprints.

Product key operational characteristics - CellCube's VRFB can supply 4 to 24 hours electricity per day, its maximum power draw is 200% of nominal power, response times are in milliseconds, it has unlimited charge cycles and is non-flammable (setting VFRB batteries apart from Li-ion batteries).

Long term storage and outage protection - CellCube's VRFB system is able to support electrical microgrids (grids that are isolated from a national or regional grid system).

Transmission distance and load balancing - There are two factors constraining the use of non-nuclear renewable energy as a replacement for fossil fuel power stations.

Transmission distance limitations - mean that areas of the world suitable for mass renewable power generation (such as deserts for solar) are a long way from consumption markets. Recent developments in transmission suggest this is changing.

The distance electricity can be transmitted from its generation source to its end consumption market, before heat energy losses make it uneconomic to supply, was established in 1980.

- The **direct current** (DC) transmission economic distance limit was established at 7,000 Km (4,300 miles).

- The **alternating current** (AC) economic distance limit this was established at 4,000 Km (2,500 miles) with current technologies (significant recent advances commercialized).

Load balancing – Renewable energy, largely, is produced asymmetrically (not when it is necessarily needed), meaning historically it is only usable whilst it is produced and cannot be stored. Fossil fuels overcome the load balancing challenge by consistently providing a fuel power source 24/7. Therefore, a significant drawback of any renewable energy generation strategy is that it is not always on, it is not always dependable, and it often cannot be stored.

Long duration energy storage (LDES) provides renewable energy generation the same load balancing capability as fossil fuel electricity generation. VRFBs turn renewables into a credible substitute for fossil fuel electricity generation.

Market Opportunity Summary

Energy shifting is the change in the energy consumption profile in any local geography in response to changes in overall capacity within the electricity grid.

Energy shifting is considered a disruptive change to power suppliers by some parties.

VRFBs are currently best suited for the long-duration energy storage market. They are capable of delivering around 8+ hours of power for stationary applications such as energy shifting. The general consensus is that VRFBs can last 20 years and perhaps more.

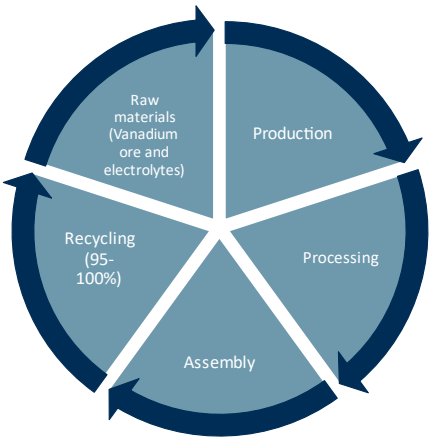
A vanadium redox-flow battery was first demonstrated at the University of New South Wales (NSW) in 1986 (patent file date) by the Skyllas-Kazacos group, according to Sangwon Kim (Vandium Redox Flow Batteries: Electrochemical Engineering).

Mitsubishi Electric Industries and Kshima-Kita Electric Power Corporation are credited with the first significant scale VRFB of 200kW/800KWh in 1995. Commercial versions have been operating at scale for over 11 years (a CellCube system in Austria, according to management), according to the Energy Storage Association. The largest VFRB energy system to date, 100MW/400MWh, was put into commission on the grid in Dalian, China, according to China Energy Storage Alliance (CNESA), an industry grouping.

The Dalian system took 6 years from planning and construction to commissioning. Phase II will double its capacity. The VRFB system will reportedly help to lower peak grid load in Dalian City (population 2022, 5.9m).

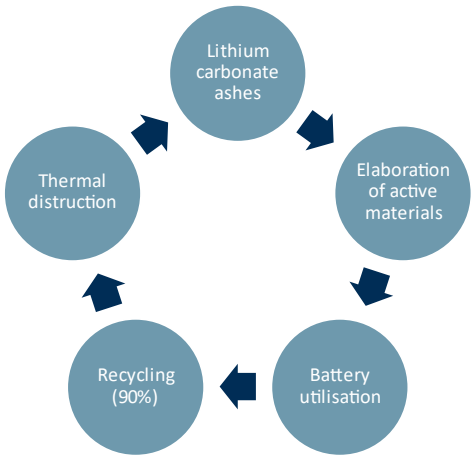
Recycling comparison - Lithium-ion (Li-ion) batteries are costly or uneconomic to recycle for most applications. The recycling efficiency of VRFB components is assumed to be between 95-100% vs that of the lithium batteries at 80-90%. Information from CellCube suggests that its VRFB systems are 85% practically and economically reusable.

Exhibit 2: **VRFB life cycle**



Source: ACF Equity Research Graphics; ScienceDirect.

Exhibit 3: **Li-ion life cycle**



Sources: ACF Equity Research Graphics; ScienceDirect.

"VRFB is intrinsically safe with no fire risk from thermal runaway (cf. solid-state Li-ion). Additionally, the contained vanadium electrolyte can be recycled for reuse in other VRFB instalments at the end of the battery life." according to Largo Resources CEO Paulo Misk (Vanadiumprice, 2020).

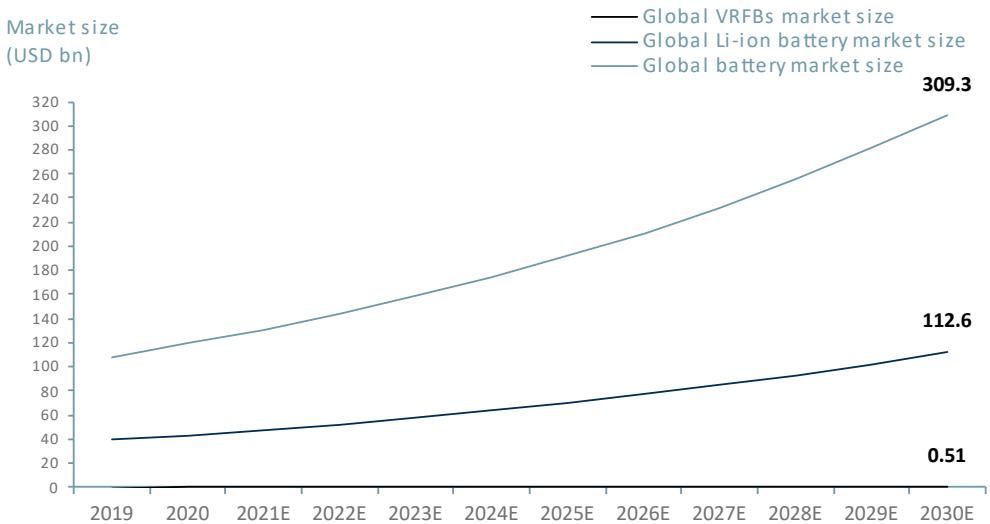
Although recyclability is positive for the 'E' in ESG, it should be recalled by investors that vanadium (V) in the VRFB electrolyte is dissolved in sulphuric acid, which comes with its own environmental risks.

Charge/discharge cycles comparison - According to Largo Resources (Nasdaq:LGO, OTC:LGORF, LGO.TO), a vertically integrated high grade vanadium miner, "vanadium flow battery systems show wear and tear after 10k cycles, which is the equivalent of over 26 years, if cycled daily" (Vanadiumprice, 2020). Other sources suggest VRFBs can achieve 20-25k cycles.

Levelized cost of storage (LCOS) comparison - VRFBs are competitive with solid-state batteries, which have 4-5k charge/discharge cycles. The levelized cost of storage (LCOS) also compares favourably to solid-state batteries. VRFB LCOS is in the order of 10s of cents, much lower than solid-state batteries. We infer from our analysis that an industry and regulator target VRFB LCOS of 5 cents is achievable. We assess that VFRBs can bridge the grid stability challenge for renewable electricity.

Market forecasts summary – We forecast that the vanadium flow battery (VRFB) market will surpass US$ 500m by 2030 up from US$ 200m in 2020. The global batteries market is forecasted to reach US$310bn by 2030 up from ~US$ 125bn in 2020. Both forecasts have a CAGR of 10%. Based upon our analysis VRFBs will also have a market in homes, where they can deliver energy efficient systems.

Exhibit 4: **VRFB battery market vs. Li-Ion battery market US$ (bn)**



Sources: ACF Equity Research Estimates; Adroit Market Research; PR Newswire; Allied Market Research.
Notes: VRFBs = vanadium redox flow battery; Li-ion = Lithium-Ion battery

Management Team

- **CEO, Alexander Schoenfeldt.**

Alexander is a creative leader with broad experience in technology-based growth situations in the energy industry. Alexander has innovated and developed smart and/or disruptive business solutions, taking them from concept to customer success stories. He began his career in the IT and Energy division of Siemens and has held various management positions at regional and global level. He has also led start-up companies into successful growth and expansion, organically and via M&A.

- **CFO, Daniel Pindur.**

Daniel brings over 14 years of experience in corporate finance and business strategy. He has extensive experience in corporate finance/M&A and project & infrastructure finance advisory, including over 6 years at mid-market corporate finance house, Oaklins. Prior to CellCube, he was the CFO of a London listed high-growth energy group, Contour Global (GLO.L) where he was responsible for GLO's pan-European Wind and Solar businesses and holdings. He qualified in accountancy with KPMG

- **Head of R&D & Technology, Martin Harrer.**

Martin has over 21 years of experience in VRFBs. He joined CellCube at its inception. Martin has led CellCube's interdisciplinary R&D team for the last 12 years. He is responsible for the development of the physical product -CellCube. Martin is an inventor and co-inventor of key CellCube features with more than 20 patent applications. He earned a degree in chemical engineering from Georg-Simon-Ohm University of Applied Science in Nuremberg, Germany.

Risks

High cost – Vanadium batteries have, for short duration (<4 hours), a typically higher capital cost compared to Li-ion batteries. This is a potential barrier to adoption of VRFBs across all applications for stationary storage. If the cost can be reduced and made comparable to Li-ion batteries, it would drive a significant increase in the interest in VRFBs. Notwithstanding this risk, VRFBs can be used in scenarios where Li-ion battery characteristics are inappropriate or less effective.

Vanadium price risk – CellCube's operations are dependent on the market price of Vanadium. Vanadium prices are extremely volatile and a potential increase in prices could lead to its solutions becoming economically unviable. To counter this, CellCube has entered into a long-term supply agreement which gives it access to Vanadium at a capped price. In addition, CellCube has joined a consortium of VRFB OEMs to consider own electrolyte conversion plants.

Technology obsolescence: Rapid and significant technological changes continue to confront the battery industry, in which CellCube operates. New services and technologies may be superior to, impair, or render obsolete the products and services offered by CellCube. If CellCube is unable to develop new products and services to keep pace with rapid technological developments and evolving industry standards, then the business would be adversely affected.

Personnel - Small and mid-sized companies are more dependent on their C-suite/executive management teams than large and mega-cap global companies. The loss of key personnel can have a disproportionate impact on valuation and investor perception compared to similar events at larger more mature (often ex-growth) companies.

Notes [Intentionally Blank]

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