Struthers Report V23 # 6.0 Vanadium, New Battery tech - Vanadiumcorp VRB April, 4, 2017

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I know most of you are very familiar with the lithium ion batteries and alternate energy like Wind and Solar because of a number of stocks I have been following in past years. Besides that we all have experience with these technologies, the lithium batteries in our electronics, small solar panels and chargers as well as wind mills dotted across the landscape.

There is another technology that will now come to the forefront because of the way and speed the renewable energy market has progressed.

The lithium-ion battery although can be hazardous as those with Samsung phones surely are aware, they are entrenched in the energy storage market. They are and will continue to be the battery of choice for electronic devices and some larger applications like electric cars.

Now that renewables are becoming entrenched on our electrical grid, new challenges are emerging. I have commented many times that typical grids can go to 15% to 20% renewables and the intermittance of those renewables can be managed with the grid.

Many countries are approaching those limits and the other factor is smart technologies now being used on grids means more effective management of these grids. This has resulted in electric utilities starting to put demand on electrical storage.

There has been numerous announcements by utilities that plan on deploying large battery storage. Elon Musk and his Tesla giga factory have been catching their share of business and making headlines.

The most prominent deal is in California where basically battery grid storage is going to be used to replace a gas fired electrical plant (nick named 'the peaker') currently being used for peak demand periods. By 2021 it is destined to be the world's largest storage battery, capable of holding and delivering over 100 megawatts of power an hour for four hours.

The utility, Southern California Edison Co., picked the designer of the battery, AES Corp., an Arlington, Va., company, against 1,800 other offers to replace the peaker. **It was the first time an energy storage device had won a competition against a conventional power plant.**

The real problem here is that utilities need solutions now, not by 2021 so demand for grid storage is going to continue to soar in the years ahead.

The Long Beach facility, when it is completed, will have 18,000 battery modules, each the size of the power plant of the Nissan Leaf. An electric car like the Leaf will have thousands of lithium-ion batteries, these are about the size of an AA battery

So we are talking about 100 million little batteries, seems kind of silly when you look at it from that angle!

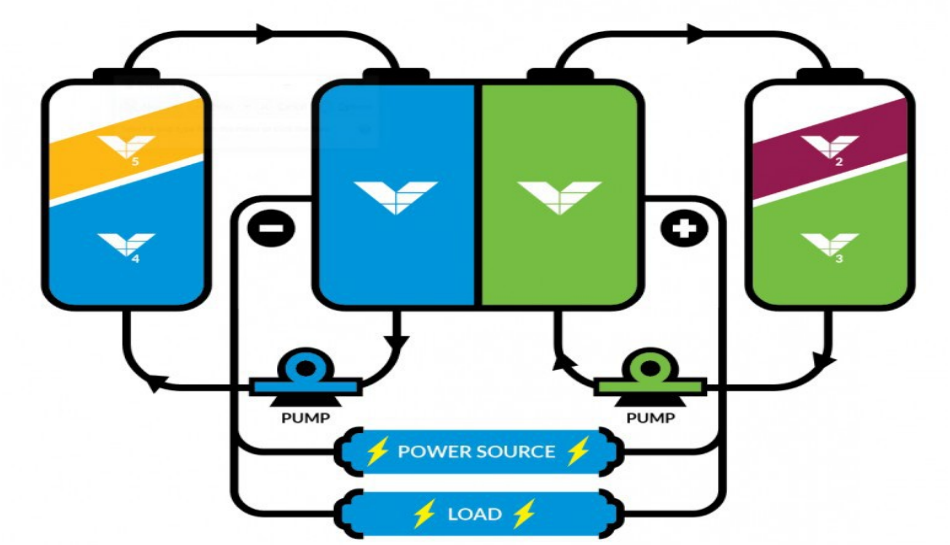
Not to worry, there is something much better when it comes to grid storage and Japan has been using it for decades. It is worth noting that Panasonic a Japanese company is a world wide leader in lithium ion batteries and makes them for Tesla, yet for their Grid, Japan has gone with the Vanadium Redox flow battery.

Market disruption in 2016: **Unknown to most people, a vanadium battery in construction in Dalian, China will be at least 100 times larger at 3000mWh capacity. That is the equivalent of three nuclear power plants of energy storage capacity.**

Some of you may remember in 2002 a major stock play called McKenzie Bay "MKBY" aiming to solve America"s energy crisis in an environmentally friendly manner. Their asset was 70% of a vanadium property in Quebec, that is now 100% owned by Vanadiumcorp. They were working with the Quebec government to mine Vanadium for the Vanadium Redox Flow Battery. Their Japanese partner, Sumitomo was starting to implement this technology in Japan and can still be called the leader today with at least 20 large Vanadium Redox Batteries on their grid. However, it was just to early, the market was not ready for grid scale energy storage yet.

For grid storage, I have no doubt this will be the battery of choice. There is just one hurdle for this battery to be deployed on a larger scale and most likely a small Canadian junior company is going to leap that hurdle.

First some detail on how these batteries work, Basically one cell can replace thousands of the lithium ion cells and the battery is safer, more efficient and has longer life among many other advantages. Vanadium electrolyte is pumped on each side of the cell for your positive and negative terminals. I would suggest you watch this youtube video as a very good way to understand how these work.



VRB Key Points

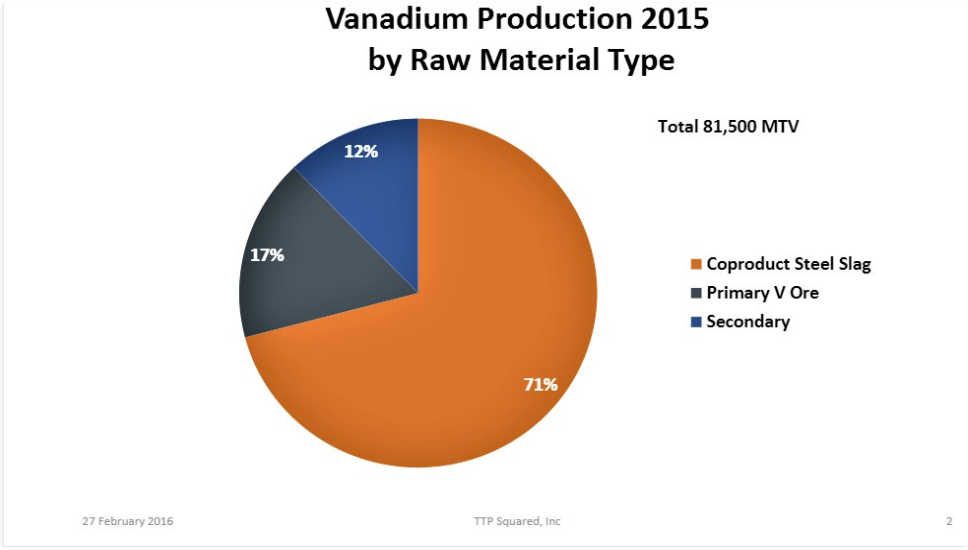
- 20-25 year lifetime (No cross contamination as vanadium is the cathode and anode)
- Contained vanadium electrolyte is 100% reusable and recyclable
- Holds energy indefinitely (No thermal runaway)
- No overheating, or possibility of fire or explosions (Highest safety rating)
- Scalable (Capable of multi-megawatt/gigawatt storage)
- High energy conversion efficiency (Best for storing renewable energy)
- Simple management and maintenance (no small battery cells!)
- Best temperature range suitable for most climates

There is no doubt the VRB is the best choice for grid storage. It has many advantages over lithium-ion technology.

You don't need to worry about multiple elements that inevitably cross contaminate over time such as Lithium-Cobalt, Nickle/Cobalt, Zinc-Bromine, Iron-Chromium, Bromine, Graphite. All you need is Vanadium. Vanadium is the cathode, anode and electrolyte. Generally speaking, good conductors of electricity are also good conductors of heat. That is not the case for metallic vanadium dioxide, a material already noted for its unusual ability to switch oxide states on demand and from an insulator to a metal.

It's simplicity is actually what provides the current challenge or hurdle. Without a single producer of vanadium in North America, expensive imported vanadium positions this amazing technology at a higher cost than it should be. Currently almost all vanadium mined is for the steel industry from China, South Africa and Brazil.

About 85% to 90% of Vanadium production is used for alloys in steel. The most common oxide of vanadium, (vanadium pentoxide V2O5), is used as a catalyst in manufacturing sulfuric acid by the contact process and as an oxidizer in maleic anhydride production. Vanadium pentoxide is also used in ceramics and the VRB.



Like most everything about 60% of production is from China with South Africa and Russia the next largest producers. There is no Vanadium mines in North America but some is produced as a by-product of other mines.

The current hurdle for the VRB is to find a quality, lower cost source of Vanadium pentoxide. Currently it is sourced as basically a by-product of the steel industry and often has impurities to deal with and costs and production flow sheets are not tailored to the VRB.

That is where Vanadiumcorp Resource TSXV:VRB comes in. Recent Price $0.06

52 week trading range $0.03 to $0.08 Shares outstanding 206.6 million

Their goal is to become the world's first dedicated vanadium electrolyte producer needed to commercialize vanadium batteries in North America. Currently they have two of the best vanadium deposits in the world (NI 43-101 Resources) and they have the expertise, processes and patents to become the leader in this market. With only a small fraction of global vanadium supply meeting the requirements of the high purity markets, Vanadiumcorp is in a highly strategic position.

Vanadiumcorp has the event-er of the VRB - Dr. Maria Skyllas-Kazacos on their advisory board and I encourage to watch this video interview with her about the VRB

Management

You would be hard pressed in a junior company to find more expertise and focus in a Technical team that management has behind them.

Adriaan Bakker President and CEO has 14 years experience in mining and battery materials in the public and private sectors includes project management, finance, marketing and M&A. He was instrumental in identifying and acquiring VRB's vanadium assets, securing strategic partnerships and assembling the industry's leading technical expertise. Through his leadership, two historical projects are now exclusive NI 43-101 vanadium resources and the Company is developing innovative process technologies to produce high purity vanadium electrolyte.

Stephen Pearce, CFO & Corporate Secretary has 27 years experience in mining He received his law degree from the University of British Columbia and an Honours Bachelors Degree in economics from York University with an emphasis on corporate finance.

Paul Sorbara, M.Sc., P.Geo & Director has 26 years experience in mining, management and project development. Currently a director of Golden Goliath Resources Ltd. He is a graduate of the University of Toronto where he received a Bachelor of Science Degree in 1976 and a Master of Science Degree in 1979.
John Hewlett, Director has been financially involved in the resource market for 30 years. His experience includes mine development in B.C. and the Yukon as well as real estate for the last 20 years in B. C., Canada.

Projects and Products.

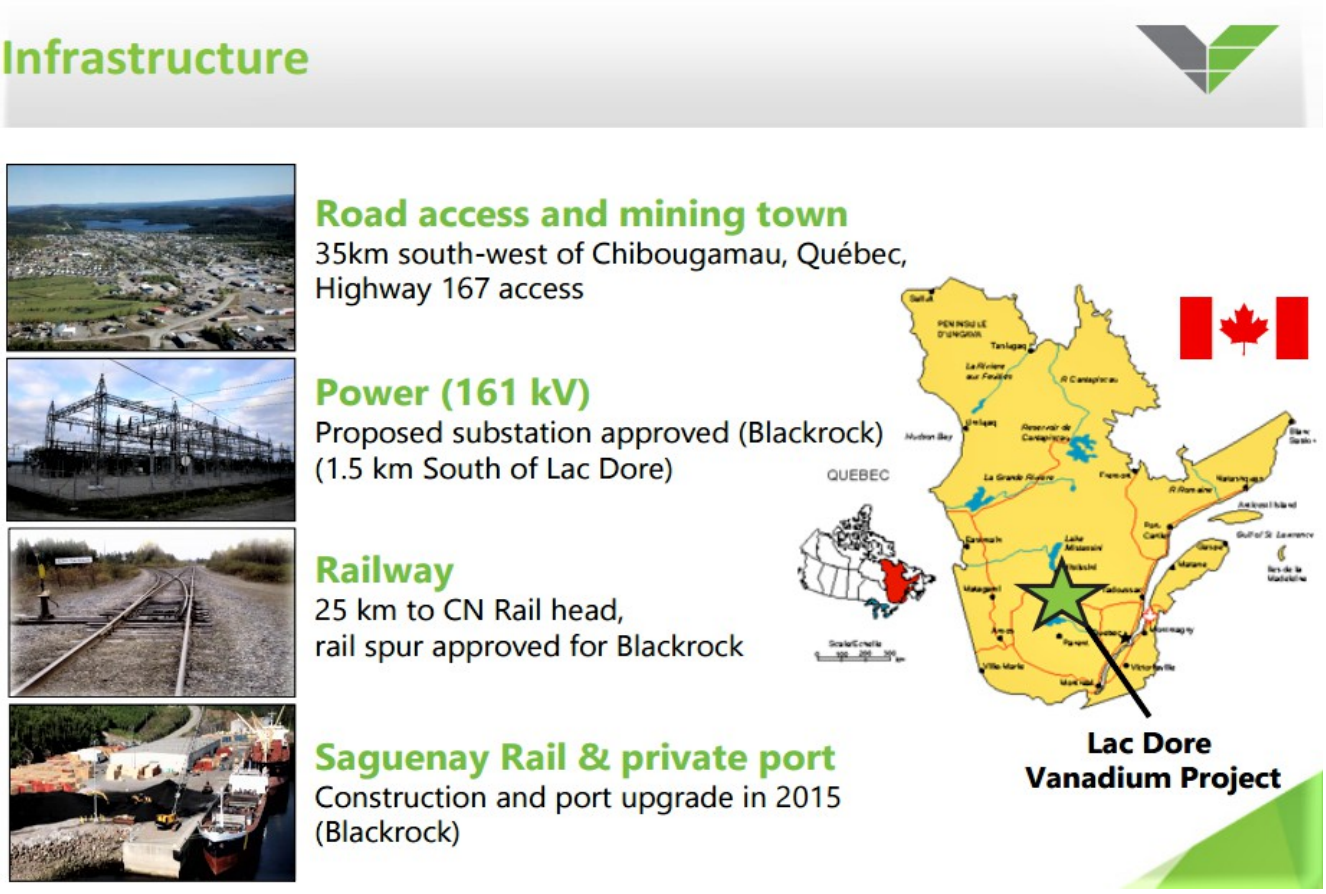
Vanadiumcorp is not just about a potential Vanadium mine but exclusive vanadium assets with the unique condition to meet the requirements of the high purity markets and exclusive production processes for the VRFB market.

Their project is advanced and is historically well known as an excellent Vanadium deposit in North America or perhaps anywhere. I know the project from many years ago when it was McKenzie Bay but it was just too early at the time for battery electrical grid level storage.

Lac Doré Vanadium Project, 100% owned

A high quality vanadium bearing titaniferous magnetite deposit with a concentrate grade of 1.08%. The Lac Dore Vanadium Project compares favourably to many vanadium deposits currently in production in other countries. Additionally, it has very low levels of contaminants, most importantly silica (SiO2).

The project is in miner friendly Quebec with good infrastructure and a historic resource of 621,214,000 million lbs at 1.08% V2O5. The P2 Zone – Up to 2% V2O5. Previous work indicates 95% recovery from concentrate



There has been, 8 different historic resource calculations from the following firms: Quebec Department of Natural Resources (3 studies), SOQUEM, LMBDS-Sidam, IOS Services Géoscientifiques Inc, Cambior Inc. and SNC-Lavalin. All of these resource calculations are considered non-current and obsolete. Over 200 reports dealing with exploration, drilling, metallurgy and economical aspects.

As noted this is a well known and defined project. The previous owners from 10 to 15 years ago were trying to advance the project for Vanadium batteries but it was like trying to grow the chicken before hatching the egg.

The egg that needed to hatch was a market for Vanadium batteries, meaning grid storage and that is now here.

The current problem in the VRB market is one of supply at a competitive cost as concluded by a Canadian government report in late 2016. The VRB market needs a Vanadium mine or resource dedicated to batteries instead of trying to deal with the scarp and left overs from steel mining and production.

On this point, in late 2016 the Canadian Government officially launched a mandate on Vanadium through the Nation Research Council (NRC). Some highlights or key points. (bold is my doing)

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Energy storage technologies are expected to increase at an exponential rate in Canada and abroad over the next decade -- all positive news for proponents of a greener, more efficient grid. With growth comes new opportunities.

What is the outlook for demand

***VRFBs have emerged as a promising solution for grid services** because of their long-lifecycle potential and high energy capacity, which can provide extended discharge times. Additionally, given the ability to scale power and energy of a system independently, VRFB technology may be a long-term solution for off-grid power systems and micro grids. In particular, these systems could be used to support residential, community, military and commercial end-users, and to fulfill remote energy access needs of rural areas in developing countries.*

Approximately 90 per cent of today's vanadium consumption occurs in the steel industry. About 10 per cent is used for non-ferrous alloys (titanium alloys, super alloys, magnetic alloys) and chemical applications (catalysts, dyes, phosphors). VRFB energy storage applications, in which V2O5 quality requirements are usually more rigorous, accounted for about one kiloton of vanadium demand in 2014, compared with global production of 94.3 kilotons of vanadium that year.

Estimates on vanadium requirements for VRFB vary among producers, with an average of approximately eight kilograms of high-purity V2O5 per kilowatt-hour. ***Currently, there are few vanadium producers able to produce high-purity V2O5, and products show significant differences in purity and trace element levels.***

High performance VRFBs require high-quality V2O5; vanadium electrolyte must be at least 99.5 per cent pure. High-purity V2O5 production can ***be costly if the mined ore or secondary sources used require extra processing to achieve this level of quality.*** *In fact, the cost of vanadium contained in the electrolyte amounts to 42 per cent of the overall VRFB cost. Reducing electrolyte costs by 55 per cent is needed to reduce the cost of VRFBs to make this technology competitive in grid-level energy storage applications.*

Given cost and quality considerations, vanadium used in VRFBs is about 1 per cent of total current demand; however, demand could ***increase significantly over the next several years if supply chain and cost challenges are addressed.*** *Considering the potential size of the grid energy storage market, even a slight increase in VRFB demand would mean significant growth in V2O5 consumption for this end-user product. For example, it is estimated that the vanadium consumption in the battery energy storage industry* ***could rise 3,100%*** *by 2025 to 31 kilotons of vanadium.*

What's the opportunity for Canada

Canada is not currently a primary producer of V2O5, and only 1.3 kilotons of vanadium were produced in Canada in 2014 from secondary sources. However, primary production options are in development, and untapped secondary sources may produce relatively low-cost, high-quality V2O5 for electrolytes in VRFBs and VRB technologies.

Given the opportunity for growth, NRC is working on a vanadium market assessment report exploring Canada's role as a potential producer and supplier of high-purity V2O5 for North America.

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Those are government numbers that speak of 3,100% growth, **being among the first to this market is a huge opportunity** and Vanadiumcorp has many of the best people in this sector, one of the best projects in a great jurisdiction and at this point are leading the charge.

Vanadiumcorp has the Vanadium, they are first developing the recovery technology, pilot plant to prove the process and cost with a prefeasibility study. Things have been progressing quite well.

In 2016, Vanadiumcorp started the Vanadium Electrolyte Process Partnership - an independent alliance of vanadium developers collaborating to establish low-cost vanadium electrolyte solutions.

Mid 2016 Vanadiumcorp executed a partnership agreement with EnSciTech Inc. through the Vanadium Electrolyte Process Partnership (VEPP) - an independent alliance of vanadium developers collaborating to establish low-cost vanadium electrolyte solutions.

EnSciTech, located in Alberta, Canada, is working on clean initiatives within the oil sands industry. The primary purpose is to convert waste from the oil sands into battery materials for leading storage technologies. EnSciTEch is currently planning development of its vanadium electrolyte pilot plant, which would facilitate Alberta's climate change commitment by reducing wastes from the oil sands industry and transforming them into battery materials.

In January Vanadiumcorp signed a memorandum of understanding with leading United Kingdom technology company C-Tech Innovation Ltd. to collaborate on the development of a vanadium electrolyte (VE) plant in Canada. Direct VE capacity is the main consideration in the company's preliminary economic assessment. C-Tech will assist in recovery optimization and beneficiation of Vanadiumcorp electrolyte directly from magnetite concentrate.

C-Tech is an innovative research and technology company focused on preparation of VE for use in vanadium redox flow batteries (VRFB). Under the MOU, a test plant capable of producing battery-ready electrolyte will be established in Quebec, Canada. C-Tech will also collaborate with Vanadiumcorp (along with other consultants) on a commercial-scale VE plant.

The most important news was in February

In early February Vanadiumcorp announced they were working with Quebec-based industrial company, Electrochem Technologies & Materials Inc., to collaborate on metallurgical and electrochemical technologies to produce vanadium electrolyte (VE) directly from VTM (vanadiferous titaniferous magnetite) concentrate.

Adriaan Bakker, chief executive officer of Vanadiumcorp, stated: "*Our partnership with Electrochem will focus on the most critical cost-reducing component of vanadium batteries. Integrating exclusive vanadium supply with new technology is the ultimate strategy to reduce cost/kwh and accelerate commercialization of vanadium-based energy storage."*

Dr. Francois Cardarelli, president of Electrochem, commented: "*Novel metallurgical and electrochemical technologies can offer significant advantages in reducing emissions of greenhouse gases, in cost savings and increasing efficiency. In the vanadium industry, this bottleneck has inhibited vanadium redox flow battery economics for decades.* ***Developing a vertically integrated supply chain for VE manufacture in Canada would be a disruptive approach for energy storage."***

The bold above is my doing and even better news was at the end of February on their progress with a U.S. Patent filed. These next four paragraphs are the most important so in red!

Vanadiumcorp applied, jointly with Electrochem Technologies & Materials Inc., for a U.S. provisional patent application (U.S. 62/463,411) for a combined metallurgical and chemical process. Successful test work commenced by Dr. Francois Cardarelli at Electrochem's facilities in Boucherville, Que., yielded high recoveries of both iron and vanadium values from a vanadiferous titanomagnetite concentrate that was extracted, prepared and beneficiated by IOS Services Geoscientifiques Inc., directly from the company's 100-per-cent-owned Lac Dore vanadium project in Chibougamau, Que.

Conventional pyrometallurgical processes utilize either direct soda ash roasting of the magnetite, followed by water leaching, or the arc smelting and slagging of the magnetite, followed by soda ash roasting of the vanadium-rich slag. Smelting or roasting is capital intensive with high operating costs, technical risks and significant emissions of greenhouse gases that pose serious environmental issues.

Hydrometallurgical processes for the extraction of vanadium have been proposed in the last decade as a lower-cost alternative in replacement of the conventional processes, but they fail to produce a high-quality iron co-product.

The Vanadiumcorp-Electrochem technology addresses these key issues and allows the full recovery of vanadium for the production of either a vanadium electrolyte (VE) or vanadium chemicals used for preparing vanadium battery electrolyte as well as the concurrent production of a high-quality and competitive iron co-product.

Summary

The key factor with this exclusive 100% green process is it **focuses on recovering Vanadium pentoxide at a purity level for batteries (VanadiumCorp Electrolyte™) and concurrent production of iron co-product.** The process is electricity based and uses no heat which is very beneficial in Quebec where hydroelectricity is cheap and abundant. The iron product, may cover part or all of production cost allowing Vanadiumcorp to target a lower vanadium cost than China before 2015 when steel (over) production allowed for large supply base of low cost vanadium co-product.

With low cost vanadium sources depleted in China, vanadium prices are set to rise placing VanadiumCorp in a highly strategic position. The lower the cost of vanadium, the lower the cost of energy. (vanadium is 42% of a VRFB).

Vanadiumcorp has 100% ownership of North America's most significant vanadium resources. Only a small fraction of global vanadium supply can meet the requirements of the high purity markets. With a patent process (still needs to be issued), Vanadiumcorp can not only just sell the V2O5 electrolyte but could also license it for an ongoing revenue stream. Remember once produced the electrolyte basically lasts forever.

I also wanted to point out that besides the obvious grid applications there is a huge market right in front of us in Canada and Vanadiumcorp having the Cree First Nations advisor, Jim MacLeod on their team will be a big plus.

There is a significant opportunity for energy storage in Canada with remote first nation communities in Northern Canada that require diesel-generated power.

In Canada, 292 remote off-grid communities are electrified by diesel generators, which require fuel that must be delivered by air, water and winter roads. By installing renewable power in combination with VRFB storage, quality of life would increase, capital costs would decrease, and it would result in complete elimination of GHG (greenhouse gas) emissions, localized air and noise pollution, as well as the soil and groundwater, plus transportation-related emissions associated with delivering the fuel.

The government of Ontario noted, "*A large, diesel-powered community produces more than 10,000 tonnes of carbon dioxide a year.*" In diesel-based communities, the estimated consumption to generate electricity alone is 215 million litres per year (excluding transportation and heating) and, per capita, has almost double the environmental footprint of the Canadian emission average. In Ontario, the cost of producing off-grid electricity using diesel can be up to 10 times higher (up to 94 cents per kilowatt-hour) than electricity within the primary electricity grid.

Globally, there are similar large rural areas where there are no reliable electrical grid and electricity.

VRB just announced a $660,000 private placement that will be used to further advance their exclusive Vanadiumcorp-Electochem process.

Positive news to look forward to will be the NRC report on Vanadium, VRB's pre-feasibility and possible collaboration or JVs to move Lac Dore forward to production for battery grade V2O5.

A real wild card would be a significant VRFB installation with Vanadiumcorp Electrolyte TM. This would validate the the technology and Vanadiumcorp demonstrate the value of exclusive stable supply.

Stock Chart

The stock has not moved much yet, but over the past 6 months volume has picked up. Since management started advancing the project in earnest in 2016 with collaboration agreements and technical people additions - the stock has been under steady accumulation seen in rising OBV.

It has been stepping higher and the last move was to 8 cents. It has since settled back and consolidated around 6 cents and this provides a very nice entry point.

The 200 day MA has been moving higher and acting as support. It is pretty much a perfect looking chart of stepping higher, consolidating and going higher again. I expect the next up move could come at anytime as there is a lot happening with the company and the VRFB market.

I currently own 188,000 shares mostly from the recent 6 cent financing.

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