VSEP Vibes Newsletter

Welcome to the New Logic Research Newsletter.

Cobalt, The Conflict Metal

Lithium Ion batteries are used in most of the devices we use every day such as cell phones and laptop computers. They are also the heart of the electric vehicle (EV) technology. No matter the size, a Lithium Ion battery consists of an anode, a Lithium electrolyte, and a cathode. During charging, electrons are collected in the cathode. During use, the electrons are transferred to the anode by the electrolyte in between.

Cobalt mine production (2017) and reserves in tonnes according to USGS[64]

Country	Production	Reserves
DR Congo	64,000	3,500,000
Russia	5,600	250,000
Australia	5,000	1,200,000
Canada	4,300	250,000
Cuba	4,200	500,000
Philippines	4,000	280,000
Madagascar	3,800	150,000
Papua New Guinea	3,200	51,000
Zambia	2,900	270,000
New Caledonia	2,800	-
South Africa	2,500	29,000
Morocco	1,500	
United States	650	23,000
Other countries	5,900	560,000
World total	**110,000**	**7,100,000**

The most common cathode design uses an alloy consisting of 60% Nickel, 20% Manganese, and 20% Cobalt. The Manganese adds thermal stability; the Nickel is the conductor of electrons; and the Cobalt prevents degradation of the cathode. If you increase the Nickel concentration you can increase the life or the range of the battery. However, when you do this, you decrease the Cobalt content and therefore you decrease the stability and increase the risk of fire due to higher voltage. This is the tradeoff that EV companies consider when dealing with customers' "range anxiety". You can drive farther, but your car might catch on fire.

30% of the cost of an EV is the battery. 31 lbs (14 kgs) of Cobalt are used for each EV produced at a cost of about $800 per vehicle. The cost of one metric ton of Cobalt is about $45,000 which is more that the total cost of all the other metals used in an EV combined on a per metric ton basis. In 2021, there were 600,000 EVs on the road in the United States which is double the amount in 2020.

By far, most Cobalt is mined in the Democratic Republic of Congo (DRC), which has been plagued by conflict for years. Cobalt mining in the DRC is produced with child labor and other conflict mining methods. China has invested heavily in the Cobalt mines in the DRC and now controls 80% of the Cobalt produced worldwide.

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With the explosion of Lithium battery devices and vehicles, the demand for metals has increased. California has passed a law that will ban the sale of gas or diesel powered vehicles. This would mean only electric vehicles can be sold in the State. There are relatively few mines in the United States to produce these metals. Currently, we import 90% of platinum, 50% of palladium, and 35% of the copper we use. There is currently only one active Nickel mine in the United States located in Michigan. Cuba, Madagascar, and New Caledonia each produce more Cobalt than the United States does.

As with almost everything, there has been a trend of outsourcing manufacturing and production of all the things we consume and use every day. The economy in the United states has become a service economy and the percentage of GDP made up by manufacturing and mining has shrunk consistently. This makes us dependent on other countries some of which are authoritarian and not our best friends. Rather than encouraging clean responsible mining of the metals needed for the expansion of Lithium ion batteries, our leaders have promoted and outsourced mining to countries like the DRC where 70% of the world's supply of Cobalt is produced.

The US government opened the door to financing mining projects in the Democratic Republic of the Congo through the IMF, despite the DRC's documented issues with child labor used in such mines as well as appalling working conditions for all workers. Recently, Secretary of State Antony Blinken signed a memorandum of understanding (MOU) with the DRC lauding their work improving the electric vehicle battery supply chain. During a signing ceremony, Blinken said "I really want to commend the DRC and their government for their leadership and vision in developing an electric vehicle battery council."

Cobalt is often found in Nickel and Copper deposits. In 2012, New Logic conducted pilot trials for a company called Polymet which is developing a Copper and Nickel mine in northeastern Minnesota. It is estimated that this mine could also produce 6.2 million pounds of Cobalt. That would be enough for 200,000 electric vehicles. This is one-third of the total number that are currently on the road. The mine would also produce Copper, Nickel, and Palladium which are all used in electric vehicles.

In 2005, Polymet purchased the former LTV Steel mining Company site which had closed in 2001 after that company laid off 1,400 workers when it closed. At this time, Polymet began preparing environmental impact studies (EIS). In 2014, the EPA gave the draft EIS the highest rating the agency has ever given to a mining project of this type. In 2018, the State of Minnesota issued all of the needed mining permits. In 2019, the US Army Corps of Engineers issued a wetlands permit, the last permit needed to begin operations.

Then, in March of 2021, the EPA stepped in and stopped the project stating that it was obligated to notify a local tribal land nation and the State of Wisconsin that the water discharge may affect their waterways and may be subject to discharge requirements from those jurisdictions. The State of Wisconsin reviewed the EIS and did not object, however, the local tribal community has instituted a

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discharge requirement far stricter than the State of Minnesota and so the project has been halted pending litigation once again.

Inactive Polymet Mine Site

After 17 years of environmental studies and about $100 million in development costs, the project is on hold. The mine operation would include a tailings basin. Seepage from this basin is required to be treated before being discharged at two permitted outfalls. Based on a 2009 wild rice survey conducted by Polymet, the regulators determined that Embarrass Lake is a water used for the production of wild rice and that it could be subject to the 10 mg/L Class 4 water quality standard for Sulfate. Through microbial reactions, Sulfate can be converted to Hydrogen Sulfide (H2S) which is the rotten egg smell and could affect aquatic life.

During pilot testing, New Logic conducted 36 batch concentration studies over several months on the tailings basin water. During these studies, The VSEP system was not only able to meet the limits for Sulfates but was able to produce filtrate with less than 1 part per billion (PPB) of heavy metals such as Cobalt, Copper, Iron, Lead, Nickel, and Zinc. The average VSEP flux rate was measured at 52 GFD (88 LMH) at 15°C and 85% recovery. The only pretreatment that would be required is a wire mesh screen and pH adjusting to 6.0

Record Setting Year for VSEP

The last few years have been very strange. Out of the blue, Covid took hold and set the entire world into panic and chaos. Plant shutdowns, fear of the unknown, and ever changing outlooks dominated in 2020. Things slowly became more clear in 2021, but the economy was nearly stopped and our business was also slow as companies held back on big decisions. Emanating from all this was an epic supply chain shortage problem that is still with us today. Adding to this, workers fled the cities and sought shelter in suburban and rural areas. Many retired and left the workforce. All of this created a huge labor shortage problem when the economy wanted to ramp up again at the end of 2021.

We were not immune to these problems. Beginning in the fall of 2021, our orders for new systems began to cascade in at an unreal rate. We were getting large system orders every month. We spent all of 2022 trying to hire and catch up on orders as they came in.

Even with these huge impediments, New Logic has recorded its best year in 35 years in regards to revenue and system orders. At its peak, we had 17 system orders in backlog during last year. We have managed to catch up and clear the decks for the new orders that continue to come. We are very proud of the work we did last year where we overcame the obstacles to production and were able to increase our revenue by 266% comparing 2022 to the year before.

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Why "Research" is still in our name

At the beginning of New Logic, there was a lot of research being done. Not only on the design of the vibrating membrane device, but on all of the possible applications where it could be used. One of the most interesting early design features of the VSEP was what would be used for the "torsion spring" which is now the large vertical shaft that moves in torsion as the bottom mass and the filter move in opposite directions. In the early days, we tried the coil spring from a Mazda car as our torsion spring. When started, the machine hoped across the floor like a helicopter out of control. During the first five years of development, there were many changes to the design. But now after 35 years, the technology is very mature and we have not made any significant changes in two decades. The beauty of the design is how simple it looks. While some have tried to copy us, the design is not simple as it might appear.

The picture here shows Dr. Bill McKean of the University of Washington at Seattle explaining how the VSEP works to industry members attending a workshop at the research lab where VSEP is installed.

The research we do now is to explore using our enabling technology to develop new processes and methods of separation that were previously not possible. Many of our customers are able to make or purify their product in ways that could not be done before. We had one of our fertilizer customers build a $80M manufacturing plant to make a product that only VSEP can produce.

This is what makes our job interesting at New Logic. We love to solve problems and do something that some say can't be done. Much of this research work is done in collaboration with more than a dozen Universities around the world. New Logic has provided LP VSEP pilot machines to these institutions so they can be used to investigate new applications and uses for industry. These pilot units are also used by post-graduate students for their thesis. Over the years, there have been dozens of technical papers and peer-reviewed articles written about the VSEP.

Here is a list of the Universities who have our LP VSEP pilot equipment and are currently conducting research:

Institution	Country
Northeastern Agricultural University	China
Technological University Compiegne	France
Bangor University	England
Tomsk Polytechnic University	Russia
University of Southern Denmark	Denmark
University of Washington	Seattle
Rowan University	New Jersey
Aristotle University	Greece
Abu Dhabi Men's College	UAE
Lappeenranta University	Finland
Lund University	Sweden
Qatar University	Qatar
Szeged University	Hungary
University of California	Davis

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Get to Know New Logic – Tom Henry

Each month we will feature one of our excellent VSEP engineers. New Logic has a wide range of engineering disciplines. Tom Henry is one of our most valued engineers. Tom celebrated his 6th year with New Logic last summer. Tom is originally from the San Francisco Bay Area and started working for us at our Emeryville facility. Soon after, he joined our team at the new facility in Minden Nevada. Tom is currently working as a project manager assisting several customers who have installed VSEP systems. He also manages parts of the production process for new systems in fabrication. To complete his VSEP education, Tom started as a lab tech running bench tests and then field pilot trials at customer facilities. After becoming a veteran VSEP engineer, Tom has completed several full-scale installation and commissioning projects.

Tom received his B.S. degree in Environmental Studies at Sacramento State University in 2015. Tom studied the interaction between Man's footprint on the world and the eco-system. Tom knows what Mugwort is in great detail. It is an important spiritual, ceremonial, and medicinal plant for local indigenous California tribes .His Thesis project was an in depth analysis of a wetland restoration project located near the American River in central Sacramento. In addition to studying the native plant species, Tom observed and documented the abundant animal life including turtles, beavers, river otters, possums, gray foxes, and even one episode of bear scat.

Tom has demonstrated his ability to anticipate and solve problems. He is flexible, capable, and dependable. This is what makes him such a great addition to the New Logic team. Really what we do for a living is problem solving. It just so happens that we have unique equipment as a remedy, but problem solving is what we get paid for.

Word of the Day - Donnan Equilibrium

Donnan Equilibrium is a condition where charge neutrality is maintained across a membrane. Cations and Anions will migrate through a semi-permeable membrane in both directions randomly. Disassociated, (ionized or charged), mono-valent ions are able to pass more easily than disassociated multivalent ions due to their lower electrical potential. However, they can only do so in quantities so that charge neutrality is kept equal. Un-ionized molecules, if small enough in size, will pass freely since there is no electrical impedance or balance that must be maintained. Donnan Equilibrium is the state at which positive and negative electrical potential is equal.

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Another Pig Manure Digester Effluent Project

Tium Eco&Energy owns and operates a biogas facility in Korea. Tium, in Korean translates to a seedling that has sprouted. They have recently purchased a VSEP system to treat the effluent from the anaerobic digester. 70 tons/day of pig manure and 30 tons/day of food waste are used to feed the digester.

In 2018, Tium was awarded a Livestock Development Contribution Award from the Gyeonggi Provincial Government for greenhouse gas reduction. In 2019, they were awarded a Low Carbon Contribution Award from the Ministry of Agriculture of the Korean Government.

The VSEP system will treat approximately half the flow of effluent to generate clean water for reuse and a concentrated nutrient stream. The system consists of a single module 84" VSEP RO system as well as two RO spiral systems to polish the VSEP filtrate. This equipment has arrived at the project location in the middle of winter where it is very cold right now. Tium is preparing for the installation which is planned for early in 2023.

Shipping in winter can be a challenge. The VSEP filters are prepared with a preservative solution consisting of Glycerin as an anti-freeze and Propionic Acid as a biocide. The temperature at the Korea location was last reported to be unusually cold at -18°C making installation work difficult. The system will be installed in a temperature controlled building with heat tracing and other features to protect the system during the winter months.

Currently, the system is planned to treat half the volume of effluent since Tium can have the other half hauled as a liquid fertilizer product. Later, the VSEP system may be expanded to treat all of the flow so that the liquid nutrient stream is a small volume making hauling easier.

The Chief Technology Officer, SangSeop Ahn and the Chief Executive Mr. Soong Heo. Are planning to become a VSEP distributor for similar projects in Korea and will be coming to Minden Nevada in March to execute an agreement for this purpose.

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20 Year Drought in the Southwest US

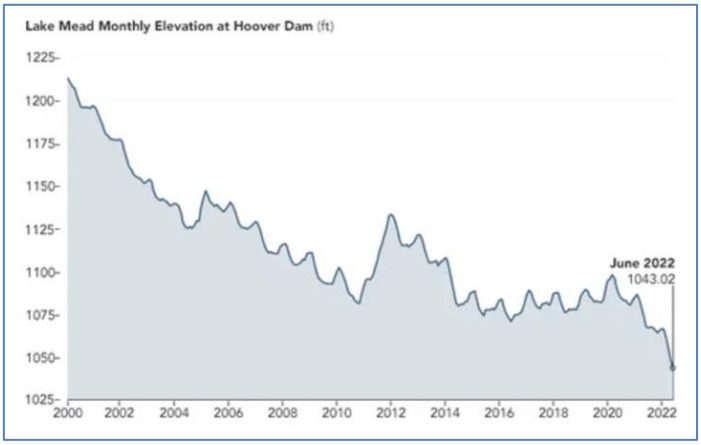
The mighty Colorado River starts in the mountains of Wyoming and traverses the landscape south through Utah, Nevada, California, and Arizona. Then is crosses the border and exits to the sea in Mexico. This Great Basin provides water for 40 million people by a system of dams that have created man-made lakes or reservoirs including Lake Mead and Lake Powell. Lake levels and stored water have fallen consistently for the last 25 years.

Year	Elevation	Capacity	Volume
1985	1213 Feet	87%	24.8 MAF
2010	1101 Feet	37%	10.5 MAF
2022	1040 Feet	27%	9.9 MAF
2023 est.	1016 Feet	21%	8.4 MAF
Dead Pool	895 Feet	0%	~

*MAF = Million Acre Feet (1 acre-foot = 364,000 gallons)

Last August, the Federal Government announced a tier 2 water shortage condition. This would require Nevada, Arizona, and Mexico to implement mandatory water cuts. For some reason, California is not yet included in the mandatory cuts. Arizona is required to cut 21% of its allocation from the Colorado River for a total of 0.5 MAF in reductions. For now, it is up to the individual States to make action plans for these reductions. However, the Federal Government has the authority to step in and take action if the goals are not met.. The current required cuts are to take effect in January 2023. However, the Bureau of Reclamation stated that future cuts of 2-4 MAF in total will be required to stabilize the lake levels.

An Arizona State task force has been evaluating water supply augmentation plans. One of these includes building a pipeline to deliver water from the Missouri River at a cost of more than $8 Billion. This plan is begin considered but has not been approved. Another plan that has been recommended by the task force is to build a seawater desalination plant in Mexico's Sea of Cortez. The plant would be built in the resort town of Puerto Peñasco in Sonora and would need the consent of the Mexican government. Under the plan, some water would be shared with Mexico and the balance would be pumped through a pipeline extending north where it will discharged to the current Central Arizona Project's (CAP) canal that currently distributes water from the Colorado River.



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The initial plant would generate 0.3 MAF and would cost about $5.5 Billion. The cost of this new water would be $2,500/acre-foot ($7.66/1000 gallons) compared to the current cost of a few hundred dollars for CAP deliveries. Residents served by the new water would end up paying for this cost. An Israeli company, IDE Technologies, would finance the project, but would require a commitment from Arizona to purchase the water for 100 years, even in times when Arizona does not need the water.

The proposed plant would consist of a Reverse Osmosis filtration system to desalinate the seawater and remove organics and organisms to make potable water for use. Because seawater can have about 3.5% dissolved solids, high pressure is needed to get water to pass through the membrane. Recovery rates are low at about 35% and the remaining reject water is returned to the ocean. The economics can be improved if the desalination can be co-located near a power plant where waste heat can be used to increase throughput capacity.

While desalination remains a viable option, industrial water recycling can make a very significant contribution to water conservation. Instead of taking pristine Wyoming snowmelt and then using it once and then discharging it to the sea, the water can be reused by recycling industrial plant effluent. There can be great reluctance to direct reuse of treated sewage for drinking water, but reusing water for non-potable uses from industrial effluent is done all the time with no problem. The cost of recycling industrial effluent is far less than the cost of desalinating seawater.

1 MGD VSEP Water Recycling in So. California

New Logic has been contacted by several companies in the Southwest who are facing water allocation cutbacks as a result of the new government order. This has included a Coca Cola facility in Tijuana Mexico. They currently use a RO spiral system to treat the water that is used for bottling. But, they throw away a significant amount of the water that the spiral system rejects. A VSEP system can help them to get a higher yield from the water they receive. So they can cut their water intake by 20%, but still produce the same amount of treated water for use in the bottling process.

During the drought period, the water cuts have been mostly voluntary and New Logic has installed several systems in the Southwest for companies who recycle their effluent. This includes a truck wash in the central valley, a wafer fabrication plant, a power plant, a winery, a casino, a refinery, and a large bottled water facility in Rialto.

Now with 8 Billion people on the planet, water recycling will become more and more important whether or not there is a drought. The world population has doubled since 1975.

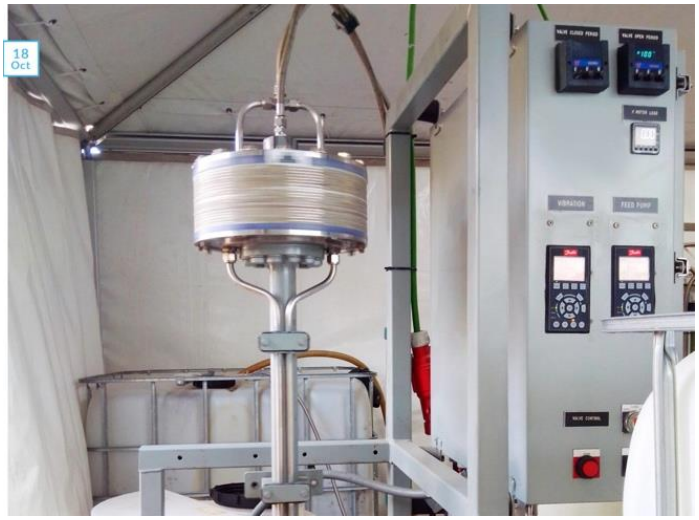
Rep Spotlight – Sitra Agua Industrial

Sitra is part of Grupo Gimeno which includes one of the oldest and most respected water management companies called Facsa which was founded in 1873 in Spain. Sitra is a full-service water treatment and management company. They can provide water and energy audits as well as turn-key project to provide solutions for industrial companies with discharge problems. Sitra also focuses on sustainability and the wise reuse of water and the saving of energy. In addition to supplying complete treatment plants, Sitra also operates 150 treatment plants as a service for their clients.

Sitra focuses on the food and beverage industry in Spain. Other areas covered include industrial wastewater and the renewable biogas industry. They

have a wide range of treatment technologies available to them. With vast experience using Spiral RO membranes, they realized the limitations of these systems and saw the benefits of the VSEP and the vibration of the membrane.

Two years ago Mr. Rodrigo Duque Hebrero, the head of the engineering department for Sitra, contacted New Logic to discuss a collaboration. During the initial meeting we discussed the best applications for the use of VSEP and how it could compliment the treatment technologies that Sitra currently deploys. Soon after that, Sitra acquired one of our LP VSEP pilot machines and began pilot testing for several projects.



Rodrigo's VSEP team includes Ms. Patricia Negro, Ms. Alba Sifre, and Antonio Rodriguez. They have been pilot testing continuously for the last two years. The Sitra team has quickly identified several good VSEP applications and is proposing VSEP systems for Landfill Leachate, Digester Effluent, RO Spiral Reject, and other industrial effluent customers.

Sitra has five locations throughout Spain. They can be contacted at info@sitra.es or by calling +34-964-571-855

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February 2023 Newsletter Edition