WRI INDIA

EVCONNECT

Issue - 15 | October 2019 | *For private circulation only*

NEWSLETTER

INSIDE THE ISSUE

Dear Friends,

I am delighted to present to you the 15th issue of EVConnect.

This year's Nobel Prize in Chemistry was awarded to three scientists for developing the lithium-ion battery technology which is at the heart of fossil fuel free societies. Besides storing energy for electric vehicles, these batteries can also store weather-dependent solar and wind energy which can expand the share of clean sources in India's energy mix. There are many challenges around EV batteries, as there are opportunities - such as the lack of primary reserves in India, the absence of a manufacturing ecosystem for battery cells and limited access to mineral reserves located in foreign shores. But all of this can be dealt with if India strategises and uses statesmanship to build public policy support and a conducive business environment.

New developments are taking place at a very rapid pace, and it is often difficult to keep up with them. These are reported through multiple media channels and are hard to track. This newsletter seeks to bring together several of these developments into one accessible document. We hope this curated and compiled content will come in handy to those who are seeking the latest information on electric mobility.

This edition of the newsletter includes news from local and global sources on a closed-loop battery supply chain and how the global landscape of raw materials for batteries is changing swiftly. Our Powertalk section features a conversation with Ms. Rashmi Urdhwareshe, Director of ARAI, on the standards and testing for electric vehicles. We have also included a feature on the role of EV battery recycling in meeting the growing demand for electric vehicles.

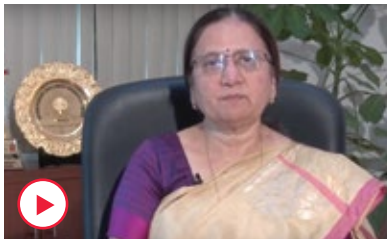
We hope you find this edition of the newsletter beneficial and share your thoughts so that we can improve further.

Sincerely,

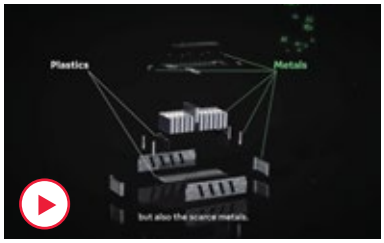
Dr. OP Agarwal
CEO, WRI India

WATCH

Presenting the monthly EV Connect Powertalk interviews featuring EV experts discussing exclusive insights. Also presenting a handpicked video section that showcases EV innovations from around the world.



Power Talk with Ms. Rashmi Urdhwareshe, Director, Automotive Research Association Of India (ARAI), Pune, Maharashtra, India.



Lithium-ion Battery Recycling Solution *(The views and positions expressed here are those of the company and do not necessarily reflect the views and positions of WRI India)*

WATCH the full interview **here**

POWERTALK

IN CONVERSATION WITH MS. RASHMI URDHWARESHE,

DIRECTOR, AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA (ARAI), PUNE, MAHARASHTRA, INDIA.

Interview by WRI India

"Standards offer a common approach to evaluation and development along with minimum technical and performance requirements that every product has to comply with. These are drawn keeping in mind usage patterns, duty cycles and the actual utilisation of the new technology that is brought into the market."

Question: **ARAI is involved in the setting of automotive standards, along with offering testing and certification services to manufacturers. Given its expertise, what is ARAI's vision of the electric mobility ecosystem in India?**

Ms. Urdhwareshe: At ARAI we work in four areas to develop the e-mobility ecosystem. First and foremost is preparing the industry and manufacturers to expand their research and development capabilities. We are doing it on a large scale in India and accordingly it requires a very special development process. The second pillar is enabling testing development and validation capabilities that can scale-up at the vehicle, component and charging infrastructure level. The third pillar is certifying all those vehicles, on a continuous basis, as well as certifying the charging infrastructure to meet local regulatory requirements. And the fourth pillar is developing the right skill sets for the country - varying from power electronics to power train design and safety.

Question: **In your opinion, what are the benefits of setting standards for electric vehicles, batteries and charging infrastructure? Especially given the nascency of this market which needs security and economies of scale to grow, coupled with the need for rapid innovation, to arrive at locally beneficial vehicle technologies.**

Ms. Urdhwareshe: We look at it from two standpoints - one is standard making and the other is standardisation. Standards offer a common approach to evaluation and development along with minimum technical and performance requirements that every product has to comply with. These are drawn keeping in mind usage patterns, duty cycles and the actual utilisation of the new technology that is brought into the market. These standards are usually notified under what is called the Central Motor Vehicles Rules (CMVR) and it is mandatory for all manufacturers to comply with the same. Standardisation, on the other hand, is usually done at the component level - such as batteries – and the effort is to standardise in a manner that achieves a scale of manufacturing. It is possible to work on standardisation of critical components such as battery design and controllers and motors. The first activity that is related to standards is usually governed by regulatory bodies.

Standardisation is more or less governed by the component developers themselves and usually, in such cases, a consortium approach always helps. Standardisation also helps in reducing the time to market and, once the project is in the market, it helps in better maintainability because the designs are standardised.

Question: **Consumers have several doubts about the safety of EVs. For example, can the batteries withstand the high temperatures of Indian cities, supply of excess of electric charge while charging vehicles, safety of retrofitted EVs, etc. In your opinion, how should these consumer concerns be alleviated?**
Ms. Urdhwareshe: I think it's a very valid point especially when we are talking about penetration of EVs at a large scale. We are not limited to personal vehicles but must consider three-wheelers, buses, two-wheelers and the taxi segments. Safety is a consideration not just in operating an EV but also in charging. Essentially, we are looking at high power coming and going into the battery power trains. Therefore, the standards that get developed look into the duty cycle. Obviously, the duty cycle is dependent on how the vehicle runs, how many times the charging happens, what are the ambient temperatures and other conditions such as poor roads and monsoon flooding. At ARAI we look at these requirements as well as the duty cycle requirements keeping in mind global regulations. We work with the local requirements while looking at how the rest of world has defined their standards. It's a long-drawn-out process; it took us 5-6 years to arrive at sound technical standards. These standards are put to very rigorous validation in the laboratories before they are made mandatory. After making them mandatory, we also look at the test data. We sit with the vehicle manufacturer to compile their use cases and then it's a continual process through which the standards are upgraded. We are also mindful that users see the product as their own with hands-on knowledge of the technology at their disposal. For any new technology, it is always desirable that the user refrains from tampering with the controls and this is especially valid for electric vehicles. It is imperative that the user refrains from entering into the control systems or tampering with the batteries and power train.

On the topic of retrofitment, if at all India is wanting to move ahead with this solution, we have to be extremely careful that the retrofitment kits are designed as per quality standards. They must be approved as per the notified standards and the implementation and the conversion should happen as per the stated norms.

Question: **Can you briefly discuss the process of designing and implementing standards, and testing an electric vehicle for adherence? Which all institutions are involved in this process? How do you ensure that India's testing methods and certification are at par with global practices?**
Ms. Urdhwareshe: Designing of new standard lags behind the introduction of new technology. For example, when CNG was to be introduced, the vehicles were readied first and then came the standards. Similarly, for electric vehicles there was already one product which was in the market many years ago. So, the process was started about 15 years ago through a committee called the Automotive Industry Standards Committee. The committee was appointed by the Government of India under the Ministry of Road Transport and Highways (MoRTH). The task of this committee is to look into the technology that is to be introduced and also to have stakeholder consultations with Tier 1 suppliers, OEMs, test agencies, transport authorities, the Government of India and research institutes like us. We also counsel user groups to listen to, and cater to, the consumers' needs while formulating standards. So, the procedure followed is the technical requirements are put out in the form of a draft and are run through various committees with experts from different stakeholder groups. Once the drafts are ready, they are circulated widely. Another review is then conducted and simultaneously we begin testing the standards in a laboratory setting. That test data is used for shaping the final standards. Once the standard is ready, post approvals from the committee, it is given to the Government of India to make it mandatory and send out a notification. While MoRTH is the main ministry a few other institutes are also involved. Upon notification, manufacturers and testing agencies are given sufficient lead time so that they can get their vehicles and equipment certified. And then comes the mandatory certification after which the vehicle goes for registration.

Question: **How are the standards and development of test facilities for electric vehicles different from those of Internal Combustion Engine (ICE) vehicles?**

Ms. Urdhwareshe: With the advent of electric mobility the test facilities that were necessary were primarily covering the component level development, transmission and complete control systems development. Our test facilities to this effect were established five years ago. Under the FAME scheme, ARAI was identified as the centre of excellence for electric mobility. Several facilities specific to motors, chargers and controllers have been put in place. The goal is not just testing but also helping the manufacturers in product development. The main difference arises because of the distinction between electric and ICE vehicle powertrains. The vehicle controls are different. Additionally, one has be mindful about the operational safety of electric vehicles. Testing for crash performance in EVs has different criteria from that of an ICE vehicle.

Question: **The automotive industry needs a step-change to create a workforce that can participate in making electric vehicles. What steps are you taking at the ARAI Academy to overhaul education and training modules in line with the emerging EV market?**

Ms. Urdhwareshe: In our view, it is very important that we enhance skilling of human resources at all levels. First and foremost, we look at research and development capabilities. In fact we need specific skill sets even here at ARAI, for testing purposes, for example. This is an interdisciplinary field, so it includes power electronics, control systems, digital electronics etc. So truly speaking, a different skill set is required. Therefore, we design specific training programmes at the graduate level, the post graduate level and even at the PhD level - these programmes are run through our partner universities. In addition, we collaborate with various academies of OEMs and deliver to them programmes for their own captive use. Because we only have limited capacity in our academy, we partner with others. The purpose of these partnerships with OEMs, automotive institutes and organisations is to broaden our reach and scale-up the skilling programme across the country.

UPDATES FROM THE WORLD

Bolivia steps up in anticipation of demand for lithium | *Policy and Strategy*

As the demand for electric vehicles rises, so will the requirement for raw materials needed to make electric vehicle batteries. For instance, by 2025, China will need 8,00,000 tons of lithium carbonate annually to meet the growing demand for electric vehicles. Seeing the voracious appetite in the market, Bolivia is ramping up lithium production. The country, advantageously placed in the lithium triangle of South America, has one of the world's largest lithium reserves (Uyuni Salt Flat) but thus far lacked the capacity to produce the mineral commercially. Now, the state-owned lithium company, Yacimientos de Litio Bolivianos (YLB), is aiming to make Bolivia the largest producer of lithium by 2021. **Read more**

Takeaway for India: Countries rich in lithium are ramping up production by setting up new companies. Accordingly, aggressively developing markets are securing an advance supply of these minerals to make EV batteries. It is critical for India to recognise that these mineral reserves are natural and hence limited. Far-sighted statesmanship is needed if India desires to create a transport sector that runs on clean energy. Currently, clean energy is powered by minerals like lithium, cobalt and other rare earths; and India is both deficient, in primary reserves, and lacks the downstream industries to manufacture products out of them.

Apple's iPhone recycling robot can take apart 200 iPhones an hour— can it dismantle the company's footprint? | *Technology*

Learnings from this article can be applied to electric vehicle batteries. Conventional thinking dictates that to recover maximum raw materials, from spent batteries, specialised and high performing recycling technologies are needed. Certainly, having advanced recycling methods is a plus. However, equally important is the role product design plays in enhancing recycling performance. For example, how easy is it to remove a battery from the main body, and how small and intricate are the parts of the product that allow for the recovery of materials such as rare earths or lithium.

Takeaway for India: Recycling old batteries, to mine raw materials for making new batteries, is an important strategy for India - both for managing battery waste as well as reducing the need for importing raw materials. To make this process viable, the manufacturers and designers of battery storage systems must keep the end-of-life of batteries (and other components in an electric vehicle) in mind while designing them. Furthermore, recyclers and makers of batteries should be incentivised to work closely together. **Read more**

Sweden's Uniti points the way to affordable, practical electric cars | *Technology*

While most automotive companies are planning to make electric vehicles for the big or luxury car segments, a company called Uniti in Sweden is making a three-seater car - Uniti One. It offers a choice of two battery sizes, and range of up to 300 kms (190 miles), which can be charged from 20% to 80% in just 17 minutes with a 50 kW CCS charger. This all-electric car would cost USD 19100 in Britain after a subsidy of USD 4100. Uniti has planned the first deliveries in Britain and Sweden by 2020. The small size of the car is also helping the automaker comply with the ambitious CO_2 limits in the European region.

Takeaway for India: India's fleet profile is dominated by small and affordable cars - something that must be recognised in the electric mobility strategy of policymakers. Businesses would be able to increase sales by designing smaller and lighter cars. Smaller electric vehicles are more resource efficient for not only are they more affordable, they are also lighter and use less resources. **Read more**

UPDATES FROM INDIA

Indian Oil is developing batteries from indigenous metals to power India's EV ambitions | *Strategy and Market*

Indian Oil Corp. Ltd. (IOC) is developing metal-air batteries that produce energy by oxidising metals such as iron, zinc and aluminium. These batteries are recyclable as the metal oxides can be reduced again to produce metal. While motorists will not be able to recharge these batteries, they will be able to replace the plates, within three minutes, at a refurbishment centre. The metal batteries can also be locally produced and recycled unlike lithium-ion batteries whose upstream and downstream value chain is nearly absent in India. **Read more**

Electric vehicle lithium battery policy to incentivise recycling entities | *Strategy and Market*

India's upcoming lithium-ion battery recycling policy will offer tax breaks and special incentives to recycling entities. It will also put special onus on the vehicle manufacturers to collect used batteries under the extended producer responsibility norms. Establishing a recycling system will help obtain minerals critical for making batteries thus reducing the dependency on imports. Additionally, battery recycling has substantial market potential that has not been explored before. **Read more**

Ratan Tata to invest in electric two-wheeler startup Tork Motors | *Market Development*

Mr. Ratan Tata is investing an undisclosed amount in Tork - an electric vehicle startup based in Pune. The firm is about to commercially launch its flagship product, T6X, an electric motorcycle that can travel up to a speed of 100 km/hour with a range of 100 km on a single charge. The battery can be charged to 80% capacity in an hour. Made indigenously, the vehicle uses Tork's TIROS system - Tork Intuitive Response Operating System - an intelligent system that gathers data of every ride, manages the power and intuitively learns from how a rider rides. **Read more**

EV @ WRI

Co-adopting hydrogen-fuelled EVs, with battery-operated EVS, could bring about 'disruptive transition'

By Subrata Chakrabarty, Climate Program, WRI India

In the days following the 2015 Paris Agreement, several governments drafted their new climate commitments to limit the global mean temperature below 2 degrees Celsius. To achieve these new targets and to adopt a low-carbon pathway, a 'disruptive transition' -- which shakes up the established systems and paves the way for new, cleaner and more sustainable technology -- was needed. **Read more**

EVFEATURE

Nobel Prize Winner Says Battery Recycling Key to Meeting Electric Car Demand

by Masumi Suga | October 2019 | First posted in bloomberg.com/technology

Recycling batteries is the key to securing enough raw materials to power the surge in electric vehicle demand, according to a winner of the Nobel Prize in Chemistry.

“The point is whether EV batteries can be recycled,” said Akira Yoshino, a Japanese chemist who was awarded the prize, with two others, for his pioneering work on modern lithium-ion batteries that are used in smartphones to cars. “The cost should pay off if all waste car batteries in Japan are collected and processed.”

The world’s transition to battery power, including in electric vehicles, is set to boost demand for commodities from copper to nickel and cobalt. But there are also concerns that miners won’t be able to expand raw material supply fast enough, and any shortfall will offer bigger opportunities for recycling. China has already emerged as a leader in the field.

Solar, Wind

The next mission for the industry is to increase the amount of solar and wind energy that can be stored in batteries used in cars, Yoshino, 71, said in an interview on Wednesday.

After around 2025, when Yoshino predicts EVs will make up about 15% of new car sales worldwide, the auto industry will likely see electrification incorporated into car-sharing and self-driving vehicles, he said. “The ideal style for the future is people don’t own a car and a self-driving vehicle is coming whenever anyone wants to use the service.”

Yoshino, of Asahi Kasei Corp. and Meijo University, was awarded the prize alongside M. Stanley Whittingham, a British-American professor at the State University of New York at Binghamton and German-born John Goodenough, professor at the University of Texas.

Whittingham, 77, first discovered in the 1970s it was possible to shuttle lithium atoms from one electrode to another at room temperature, facilitating recharge-ability. When the battery material -- lithium -- proved prone to catching fire, it took the work of Goodenough, 97, to make it into a usable device. Yoshino's research on ensuring chemical stability crowned the current lithium-ion battery.

Lithium-ion batteries have "revolutionized our lives" since they first entered the market in 1991, the Royal Swedish Academy of Sciences said in a statement on Wednesday. "They have laid the foundation of a wireless, fossil fuel-free society, and are of the greatest benefit to humankind."

Takeaway for India: Battery storage is a key component of India's electric mobility and clean energy strategy. However, India doesn't have most of the primary raw materials needed for making lithium-ion batteries. Given this scenario, a logical first step would be to create incentives for the recycling of old batteries to mine raw materials that can be used to make new batteries. Battery recycling also manages the hazardous waste from spent batteries. Furthermore, given the limited availability of raw materials worldwide, recycling also reduces the need for mining. There are a handful of recycling companies in India, however speedy innovation and well-coordinated action at the national and state level is urgently needed.

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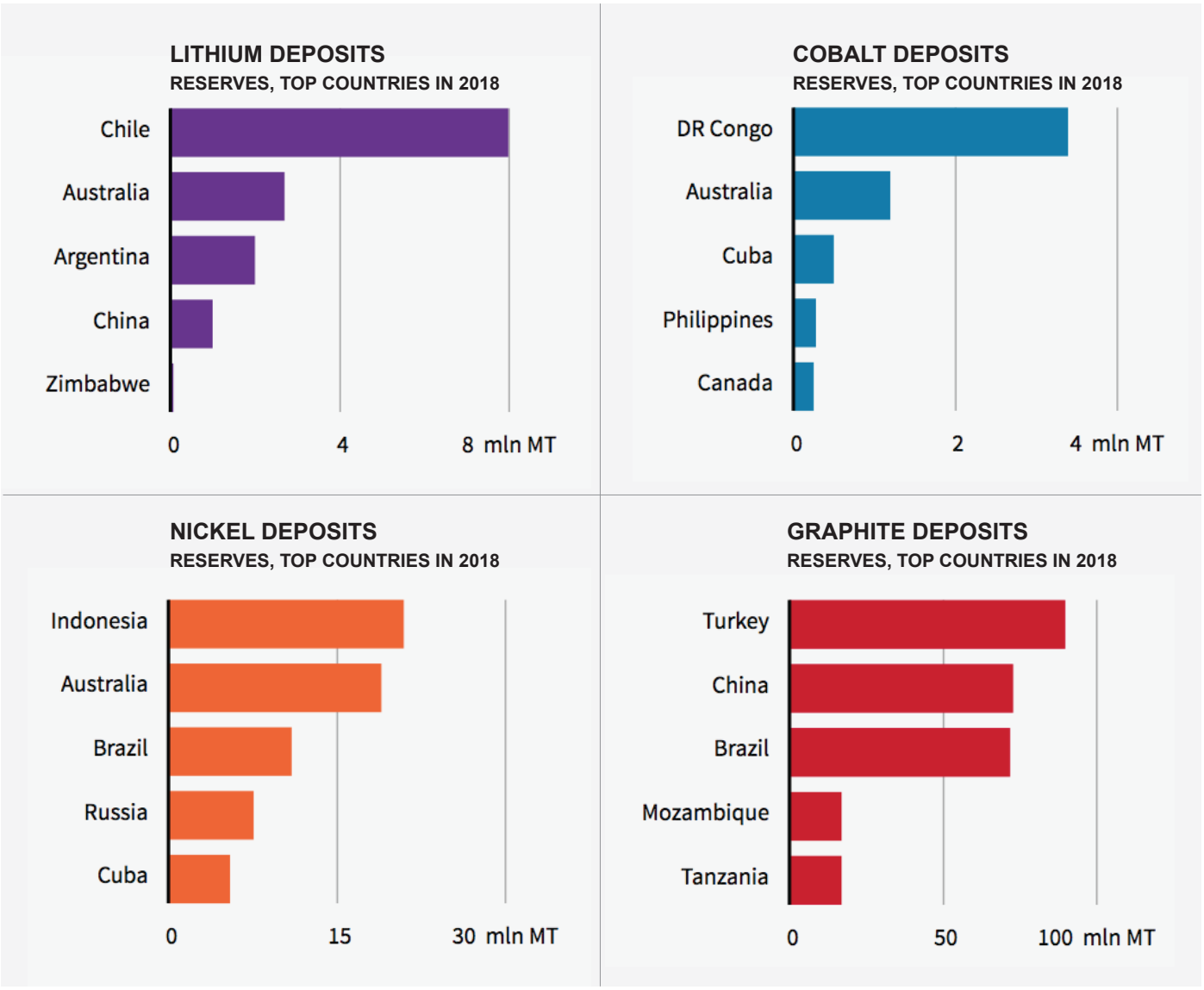

CLOCKWISE

Lithium reserves: (Purple graph) Lithium-ion batteries are key components for most consumer electronics, especially electric vehicles. Much of the world's lithium comes from an area called the "Lithium triangle" in Chile, Argentina and Bolivia. U.S. Geological Survey data shows that the United States has 35,000 tonnes in lithium reserves in 2018, a figure that the agency and industry executives see as conservative.

Cobalt deposits: (Blue graph) Cobalt, a silver-grey metal that is produced mainly as a by-product of copper and nickel mining, is also an important ingredient of current batteries. More than 60% of cobalt is mined in the Democratic Republic of Congo.

Graphite deposits: (Red graph) Graphite, an allotrope of carbon and a little-known component of lithium-ion batteries, is booming thanks to a unified global pushback against fossil fuels and a commitment to clean energy. Most of the world's graphite comes from Turkey, with China and Brazil placing second and third in 2018.

Nickel deposits: (Orange graph) Nickel and cobalt are two of the metals expected to benefit most from the electric vehicle revolution. Both are key inputs to most types of lithium-ion battery. Indonesia and Australia have the largest nickel reserves.

Source: https://graphics.reuters.com/ELECTRIC-VEHICLES-METALS/010092JB38P/index.html

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