WRI INDIA

EVCONNECT

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NEWSLETTER

INSIDE THE ISSUE

FROM THE CEO'S DESK

Dear Friends,

I am delighted to present to you the sixteenth issue of EVConnect.

We have published 15 issues of EVConnect. During this process, we collected news items and spoke with important stakeholders on building an electric vehicle market, battery production capacities and charging infrastructure. We also looked at overarching assets – skills, financing models, governance – in the interviews and write-ups we included. In this edition we extract the main learnings in the form of a blog piece. In addition, we bring you a conversation with Dr. Prabhjot Kaur of Center for Battery Engineering and EVs of IIT Madras to weigh in on issues surrounding battery technologies and the analyses needed to make high-performing battery packs for Indian conditions. We also include a synopsis of one of WRI's publications on integrating renewables and electric vehicles.

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.

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

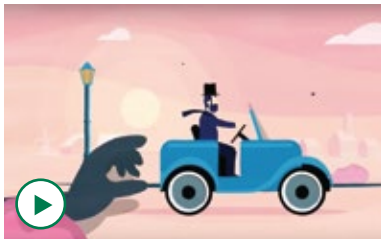
Sincerely,

Dr. OP Agarwal
CEO, WRI India

WATCH

Presenting the monthly EV Connect Powertalk interviews exclusively discussing insights from EV experts. We also present one hand picked video to showcase EV innovations from across the world.

Power Talk with Dr. Prabhjot Kaur,
CEO, Centre For Battery Engineering And EVS (C-BEEV), IIT Madras, Chennai



Charging electric cars and cybersecurity

WATCH the full interview **here**

POWERTALK

IN CONVERSATION WITH DR. PRABHJOT KAUR,

CEO, CENTRE FOR BATTERY ENGINEERING AND EVs (C-BEEV), IIT MADRAS, CHENNAI

Interview taken by Neha Yadav WRI India

Interviewer: **Let us start with the electric powertrain of Electric Vehicles (EVs). In your opinion, is India technology-ready to manufacture energy-efficient powertrains for different EV segments?**

Dr. Kaur: Today, 99% of the motors in EVs, across segments, come from China and there is not even a single large Indian manufacturer of motors capable of supplying power trains to electric vehicles. There is a glaring gap in supply but I think the Indian Government has taken a good step by focusing on 'Make in India' and subsiding vehicles as part of FAME 2. Hopefully, this will give a much needed push to the industry to start making motors in India. There are a number of R & D centres, like us, in the country who are designing and developing motors for vehicles across segments – 2, 3, and 4-wheelers.

"Data monitoring is important because we cannot risk the safety of EV drivers, even if incidents are far and few. If we ignore these battery data monitoring steps, that ensure consumer safety, we are going to be very badly hit in the electrification mission of the country. In addition to safety, battery data monitoring is important for tracking trends, patterns, and comparing chemistries, package forms and how their performance varies."

Interviewer: **India has extreme climatic conditions which will adversely impact battery safety, performance and life. We also have a diverse fleet of 2, 3, 4-wheelers and buses. What would be the top 3 features of battery thermal management strategy for different EV segments?**

Dr. Kaur: You rightly said that India has a mix of 2, 3 and 4-wheelers which is not the case in developed countries. When you look at countries where the EV market has picked up, there are no 2 or 3-wheelers there either, with China being the sole exception. Now, if you consider the different mix of batteries, the engineering solutions have to be thought of very differently to make the right battery thermal management system. As far as battery thermal management strategies are concerned, we can club 2 and 3-wheelers (light) in one category where we utilise air cooling and some very smart use of passive cooling for the batteries. For 4-wheelers, we don't have much choice and will have to go with the active thermal management of batteries. This will have to be done from day one considering the extreme temperatures we have in the country. For buses and trucks, the batteries are large and again we don't have a choice but to opt for active cooling again.

"The industry-academia linkage is very important. A good understanding of research and development, aligned with commercial thinking, is a very good combination. Unfortunately, there are very few strong bonds between industry and academia in India. If we look around – be it in the automotive sector or elsewhere – you wouldn't find strong collaborations at large."

Interviewer: **The working of EV batteries includes collecting a lot of real-time data and communication. So how will this data be used to improve vehicle performance and safety? How will you secure this private data?**
Dr. Kaur: We are just starting with EVs in the country and the battery chemistries, trends and performance keep changing every month. Battery enhancements are outpacing our speed of grasping battery characteristics. For example, once a new chemistry is launched, we rapidly move to making packs out of it to ensure better performance and better volume to weight density – properties that are beneficial for the vehicle. In this scenario, it is of utmost importance that we keep monitoring the data.

While the battery is in use, we check whether the electro-chemical processes inside the battery are safe for operating the vehicle. Data monitoring is important because we cannot risk the safety of EV drivers, even if incidents are far and few. If we ignore these battery data monitoring steps, that ensure consumer safety, we are going to be very badly hit in the electrification mission of the country. In addition to safety, battery data monitoring is important for tracking trends, patterns, and comparing chemistries, package forms and how their performance varies. These analytics must be done from the very beginning. This will help in determining what is the most high-performing battery pack solution that suits the mobility scenario in Indian cities.

Coming to the second point about how we are going to secure this data. We have banking applications, mobile and financial transactions, so globally there are very good data security and cyber security rules and largely, data privacy is being ensured. There are rules and policies that have been framed. I think the vehicle and battery data rules won't be vastly different from what is happening in other applications. I do not foresee any security threat to this data.

Interviewer: **The EV battery offers an opportunity for better grid integration of intermittent renewable energy sources. From your expertise in batteries, do you see any techno-economic barriers in Vehicle-to-Grid (V2G), Vehicle-to-Building (V2B) and Vehicle-to-Home (V2H) services?**
Dr. Kaur: First things first, battery back-up systems, that allow us to store intermittent renewable energy, are the future energy solution. Making the renewables work smoothly 24x7 would definitely add to our costs. But as far as a vehicle's connection to the grid, to the building, and to our home is concerned, we have to see the status of the grid. For an individual vehicle to feed back to the grid, we need to look into key questions - what are the costs involved, how much instability will it add to the grid etc. So, if there are norms, if the equipment is good, this will happen. We also need to look into the commercial angle. Technologically, I don't see much of a challenge because there are a lot of engineers and companies who have been doing good work in making the equipment. Making the right equipment and syncing it with the grid is not a problem but I think one should consider the commercial angle and real-world application.

Interviewer: **Electric mobility technologies require industry and academia to work closely - to innovate and to create a workforce together. What is your opinion on the current status of this linkage and what are some of the barriers that need to be overcome?**
Dr. Kaur: The industry-academia linkage is very important. A good understanding of research and development, aligned with commercial thinking, is a very good combination. Unfortunately, there are very few strong bonds between industry and academia in India. If we look around – be it in the automotive sector or elsewhere – you wouldn't find strong collaborations at large. There are a few projects and collaborations that result in commercialisation but that doesn't happen very frequently. Academicians and the industry largely work independently. But we have also seen that when problems and issues arise, during such collaborations, they can be quickly resolved.

There are not many barriers to kickstart this, but the mindset must change. Firstly, the technology employed often comes from outside the country and the industry merely adopts it and starts manufacturing. Secondly, being in the academic side, we are not worried about commercialisation, expecting that to change with time. A commercial angle, added to research and development, offers a lot of benefits for the country and society at large.

UPDATES FROM THE WORLD

BYD, Toyota to set up research venture to develop electric vehicles | *Market Development and Technology*

BYD and Toyota plan to set up a research and development company to build battery electric cars. The company will be set up in China and both companies will split the investment in half. Toyota may have entered the electric vehicle market relatively late, as compared to its peers, such as Nissan, but it intends making 50% of its global sales electric, including gasoline hybrids, by 2025.

Takeaway for India: Investing in research and development, to make high-performing electric vehicles for Indian conditions, is fundamental. Thus far, automakers in India have spared only modest amounts in building their research and development capacity. This needs to urgently change if automakers in India want to stay relevant even as transport systems get electrified. A starting point could be building strong bonds with academic institutions and working closely with them to make their inventions commercially viable. **Read more**

With blackouts, California's electric car owners are finding new ways to charge up | *Strategy and Market Development*

During the recent power outages in California, the community of electric vehicle owners found themselves in a conundrum over locating charging locations. There were two interesting outcomes, nonetheless. The electric mobility community crowdsourced information and used it to help fellow drivers find charging locations - they used social media platforms to stay connected and share information. Secondly, many vehicles owners, who had solar powered electric cars, used the stored energy as a generator for their homes.

Takeaway for India: California's case once again highlights the relevance of battery storage for solar-rich Indian cities. Renewables, stored in EV batteries, can be used for domestic purposes. One aspect to be considered would be the user safety of cross-application of battery storage systems. Safety standards and guidelines would be immensely important in these situations. **Read more**

Electric cars are changing the cost of driving | *Strategy*

A shuttle company, Tesloop, with a fleet of Teslas based in Southern California, has clocked 2.5 million electric kilometres in the last five years. Their data shows that electric vehicles can help fleet operators save on maintenance, and wear and tear, lowering the overall operating costs that are essential for fleet operators to stay viable. Their maintenance data also shows that none of the EVs are facing issues of ageing – there are glitches, as in any new technology, and human errors such as drunken collision. This implies that EVs can last far longer than conventional vehicles. Eventually, this could create a used electric car market.

Takeaway for India: Electric vehicles make business sense for fleet operators. Several fleet operators are already building an electric vehicle fleet, but many more can benefit from low operating costs (Rs per km) - a major share of costs after depreciation. In addition, shared fleets make mobility efficient in congested Indian cities. This is promising and holds potential for many other fleet operators in India. However, there is a need for more clarity on what will be the costs of battery replacement, and how Indian road conditions would impact the drop in vehicle quality and fuel efficiency. **Read more**

UPDATES FROM INDIA

Tata Motors to supply 500 electric cars to Lithium Urban Technologies | *Market Development*

Tata Motors will be supplying 400 Tigors to Bengaluru based Lithium, an all-electric fleet operator, by the end of the fiscal year. The auto major will also be supplying 100 units of its compact SUV, Nexon. Lithium will integrate its LUTEC (LithiumUrbanTec) EV mobility utilisation software with these new vehicles. At a later stage, the two companies might also explore tailor-made transport solutions for the freight segment. **Read more**

MG Motor eyes selling up to 3,000 units per annum of ZS EV electric SUV in India | *Strategy and Market*

MG Motors aspires to create a complete ecosystem of electric mobility with vehicles, charging infrastructure, and a subscription model for buyers, to name a few propositions. Later, in December, the company intends launching its all-electric SUV, MG ZS EV. This variant's battery offers a storage capacity of 44.5 kWh and a range of 300 kms on a full charge. SAIC-CATL, in Liyang (China), is manufacturing the batteries and is cognisant of the need to balance product quality with affordability keeping in mind the Indian market. **Read more**

Mobility startup Bounce joins hands with Exicom Tele-systems | *Market Development*

Bounce has begun a pilot with a few thousand scooters in Bengaluru. The company will provide last mile connectivity via dockless scooters while Exicom is providing the lithium-ion battery and charging infrastructure. This is the largest deployment of electric two-wheelers in the Indian shared mobility space. **Read more**

EV @ WRI

4 emerging ways to pair electric vehicles and renewable energy

By Lori Bird and Norma Hutchinson

Today, transportation accounts for almost 30% of all greenhouse gas (GHG) emissions in the United States. The good news is that passenger vehicles in the U.S. are electrifying at an unprecedented rate. In 2018, one million electric vehicles (EVs) were on the road, and recent studies project that by 2030, approximately 20 million EVs will be deployed across the country. Globally, this number could surpass 250 million EVs by 2030, according to the International Energy Agency (IEA). **Read more**

EVFEATURE

EVConnect Journey: Five insights on e-vehicle adoption in India

by Neha Yadav, WRI India | November 2019

In August 2018, WRI India launched its first edition of a monthly newsletter on electric mobility, 'EVConnect'. It was clear that although electric vehicles' sales and growth in charging infrastructure was embryonic and sporadic, its ecosystem had the potential to benefit Indian cities and states, which warranted further exploration. Electric vehicles offer a host of benefits such as curbing tailpipe emissions from vehicles, the ability to store renewable energy in vehicle batteries and reduced foreign oil imports, to name a few. Actualising these benefits requires substantial collaboration between the transport and electricity sectors – two domains that, at least in India, are only modestly aware of each other's workings. New knowledge is needed to realise the potential for collaboration between both sides.

Therefore, the goals of EVConnect are: (1) To track the developments in markets, technology and the policy landscape of electric vehicles in India and in other nations (2) To draw takeaways that fit India's unique needs and curate this information in one place (3) To build the capacity of actual doers, on-ground, in city and state governments - i.e. those who will need a basic understanding of vehicle, battery and charging technologies to begin implementing targeted and cost-effective projects.

Specifically, every edition includes key summaries of emerging trends, the latest global and national news, and a focused interview with a thought leader in the electric vehicles landscape. We revisited the past 15 issues of EVConnect and found five learnings for policymakers and businesses going forward:

1. The need for policy coordination

Eight states in India have approved electric vehicle policy drafts, namely, Andhra Pradesh, Delhi, Karnataka, Kerala, Maharashtra, Telangana, Uttar Pradesh and Uttarakhand. While this is a step in the right direction, the drafts do not mention the joint effort required by several departments to ensure that electric vehicles are deployed and the requisite charging and swapping infrastructure is set up. Most notably, the transport and power departments would need to work closely together, with active support from departments like industrial development, finance and land authority. Electric vehicles are a new technology and obstacles will emerge along the way when projects are implemented. However, a multi-departmental effort will improve problem solving at the ground level and send a clear signal to consumers, building their trust towards adopting electric vehicles.

2. Urgency behind securing battery raw materials

Electric vehicles draw power stored in battery packs that are made from minerals available in limited quantity and acquired mainly from overseas locations in China, Australia and the South Americas. With the sale of EVs picking up, the demand for these minerals is rising steadily. As a result, many governments and vehicle manufacturers are making advanced purchases for future manufacturing requirements. Two approaches can be explored for the Indian context. Firstly, pacts can be signed with foreign businesses that own mineral reserves to secure raw materials. However, this option needs to be pursued with careful geopolitical analysis. The second and a more self-sufficient option is to create a market for recycling waste batteries and mine raw materials. The battery recycling industry is estimated at a potential of USD 1000 million, with 22-23 GWh of waste batteries ready to be recycled by 2030. This is an untapped business opportunity which needs policy and financial support in the early days, supported by extensive research, development and entrepreneurship. A hybrid approach that makes use of both foreign partnerships and local recycling methods could be a suitable option.

3. India's auto export destinations are growing local EV markets

India's auto industry has been a leading exporter in the Internal Combustion Engine (ICE) based two and three-wheeled vehicles in South East Asian countries such as Indonesia and Thailand. These countries have a sparse auto industry to make Internal Combustion Engines (ICE) vehicles. However, they are now planning to create a local industry for electric vehicles by inviting foreign players and ambitiously overhauling their auto regulations in favour of electric vehicles.

India's auto industry and policy makers need to rapidly assess the market scenario in EV export markets and double-down on making innovative products or else they will lose out. Auto markets that didn't have an ICE vehicle industry will find it more convenient to develop a local electric vehicle industry. With ICE technology gradually fading away, EVs are a viable new industrial opportunity for them as it will entail a much lower setting-up cost - versus making the more demanding transition from a conventional vehicle industry.

4. Greater opportunities for women to join the EV workforce

The manufacturing and delivery of electric vehicles will require far lesser mechanical tasks that are perceived to be heavy-duty. Instead, digital and IT related skills that are more cerebral and 'strength neutral' will be needed. This opens the possibility of expanding the participation of women in the auto industry workforce, which has historically been lopsided. Some vehicle manufacturers in India have set up women only shop floors, but mainstreaming and systematic efforts are needed.

The share of women working in the auto industry worldwide has barely been at par with their male counterparts. Studies show that gender parity improves problem-solving, leading to increased profits. This is unlikely to become a reality for India without concrete actions, which may include: (i) Stronger marketing of skilling courses for women (ii) Incentivising industry players who maintain gender balance in diverse roles across the sector (iii) Establishing labour and on-the-job welfare systems for equal benefits, job growth and safety for women working in the transport industry.

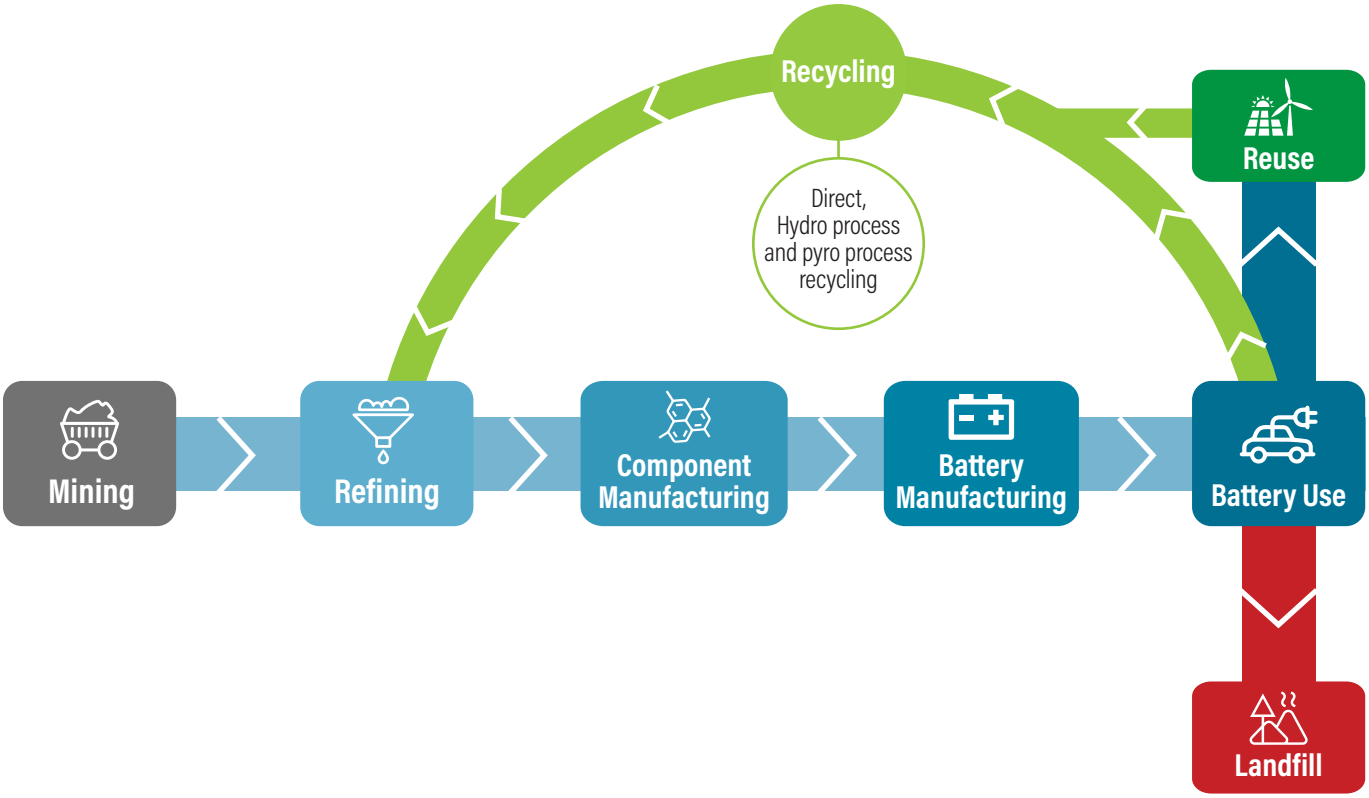
5. Battery storage can strengthen linkages between transportation and renewables

The use of battery storage has the potential to affect a big change in transportation. Not only will vehicles be able to run on fossil-free energy, but this energy can also be supplied back to the grid. It will thereby help to expand the share of clean energy in the total energy mix. Vehicles that sit idle for prolonged periods would be perfect for consideration in this regard. Technologically, the vehicle to grid connection is feasible but to actualise such technologies, the right set of commercial compensation for EV owners to participate in 'vehicle to grid' programmes need to be defined. In addition, the infrastructure needs of the grid must be studied further.

Conclusion

The latest developments from a local and global perspective, combined with a detailed review of the lessons learned by thought leaders (as shared every month in EVConnect), have made it clear that electric mobility could be the gateway for India to create fossil-fuel free societies. There are many challenges that must be addressed to fast-track the growth of this new technology. Moreover, a shift from the conventional 'departmental' ways of implementing policies is needed as clean mobility undergoes tremendous changes in the years ahead. The first step in the transition to electric vehicles involves setting aside disciplinary boundaries and political differences to work towards a common goal.

LITHIUM-ION BATTERY RECYCLING



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