BCIC

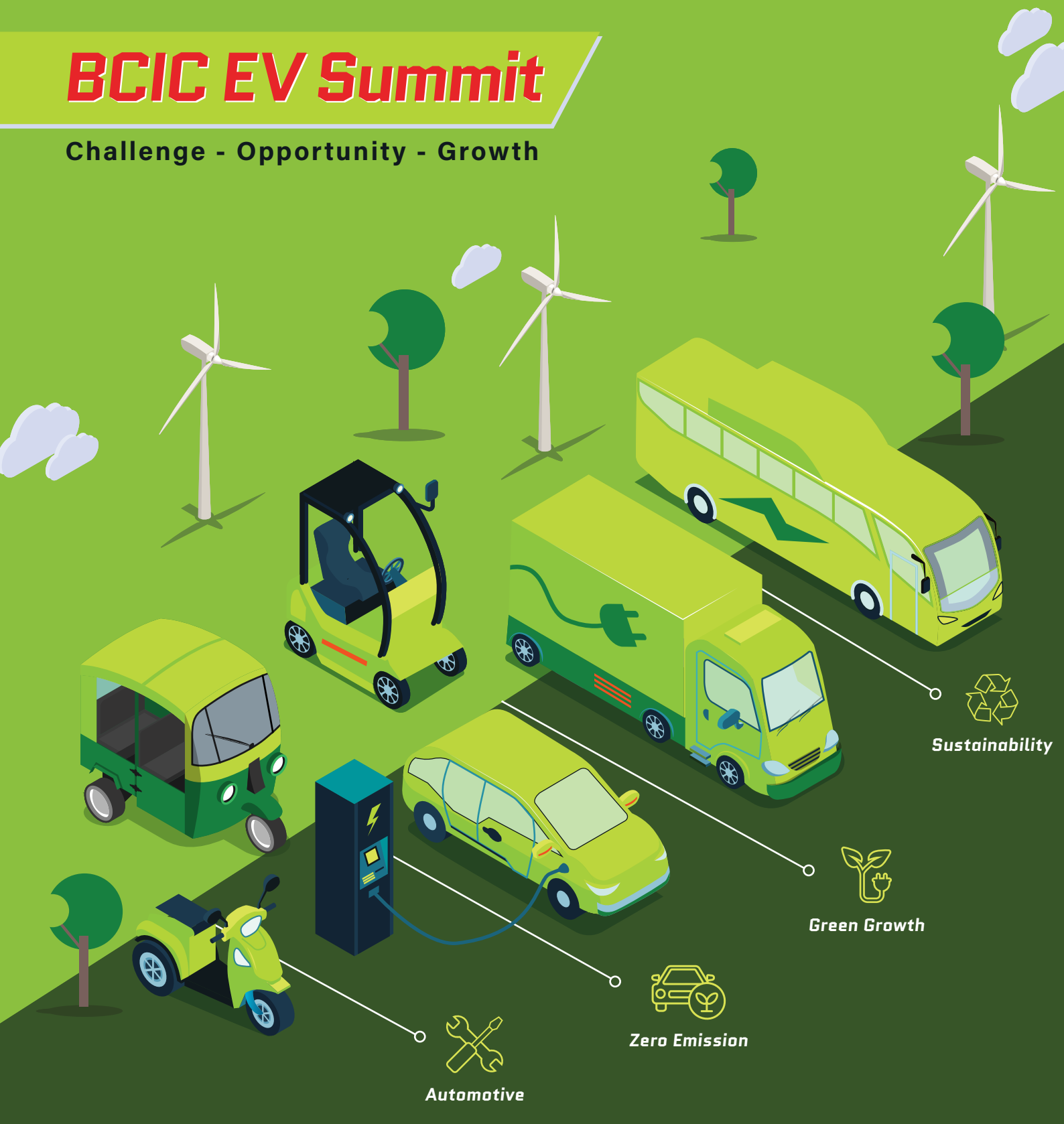
Bangalore Chamber of Industry and Commerce

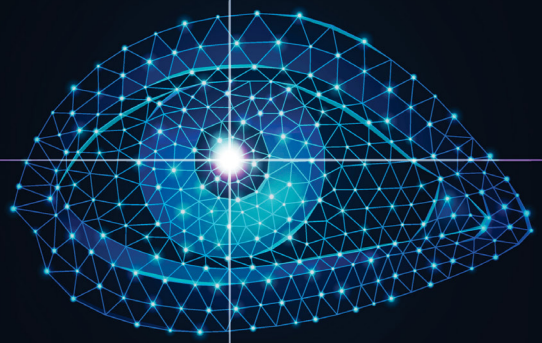
e-Synergy

Volume 14 | May 2023

BCIC EV Summit

Challenge - Opportunity - Growth





MISSION

Namma Karnataka-
Gateway to Future India

VISION

Look Beyond

Together We Should

BCIC Office Bearers

President

Dr. Ravindran L
Managing Director & CEO
Wealthmax Group of Companies

Senior Vice President

Dr. S Devarajan
Senior Vice President
TVS Motor Company Ltd

Vice President

Mr. Vineet Verma
Director
Brigade Hospitality Services Ltd.

Immediate Past President

Mr. K R Sekar
Partner
Deloitte Touche Tohmatsu India LLP

Leaders of Publications and Corporate Branding Expert Committee

Chairman

Mr. Rabindra Sah
Chief Engineer
Tata Technologies

Co-Chairperson

Ms. K S Harini
Corporate Communications
TVS Motor Co Ltd

Mentor

Mr. Raju Bhatnagar
Partner
ITI Consultants

Contents

EV Summit: Challenge - Opportunity – Growth

Mr. Rabindra Sah
Chief Engineer-
Tata Technologies

BCIC Electric Vehicle (EV) summit is all about working towards circular economy to achieve a) Net zero emission b) Sustainability and c) Green Growth in automotive Sector. It means rejecting the linear economy (take-make-waste) and adopting a regenerative model: using processes that restore, renew or revitalize their own sources of energy, materials and wasting as little as possible.

Theme of the EV Summit was coined as Challenge, Opportunity and Growth. This is very much relevant today in current state of Green Growth.

In the EV summit, large no of industry professionals, Academia, Startups and Government officials participated. Distinguished industry experts shared their knowledge and insight on following focus areas:

EV – Trend, Growth, Challenges & Opportunity (2W,3W,4W)
EV – Design, Development, Technology & Manufacturing
EV – Hydrogen based Fuel cell, IC Engine and Lithium Battery
EV – Battery and Batter Management System (BMS)
EV – Testing, Validation and approval
EV – Policy and regulations
EV – Charging infrastructure
EV – Net Carbon Zero Emission (Sustainability)
EV – Total Cost of Ownership (TCO)
EV – Skill, Startup, OEMs, Tier-1, Service Provider
EV – Vehicle in Displays

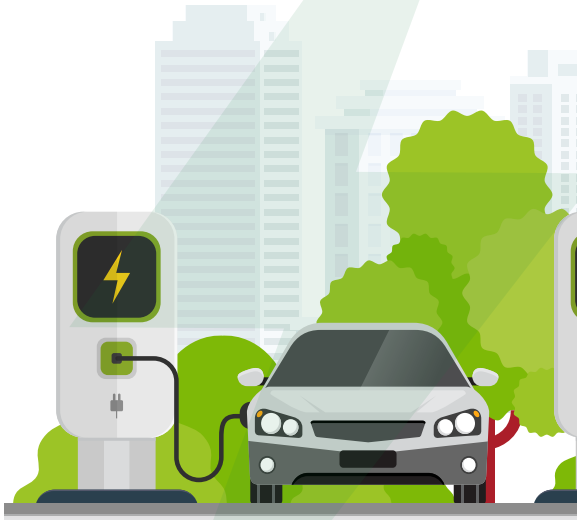
United Nations Member shares the Sustainable Development Goals (SDGs) which aim to transform the world. The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. It addresses the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace, and justice.

One of the goals is “Climate Action” out of 17 Sustainable Development Goals (SDGs). It is about taking urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.

The Paris Agreement came in effect on 04-Nov-2016. The Paris Agreement is an international treaty on climate change. Adopted in 2015, the agreement covers climate change mitigation, adaptation, and finance. Our country signed this agreement with stronger commitment to achieve that. Our government has taken strong measure to achieve that. A lot of initiative is taken by country as “Green Growth” supported by industry, institute and community.

Automotive is the one the core sector where this initiative appears on the dashboard of CXO to strategically plan and act to achieve in the entire product Lifecyle journey which includes mainly in three categories - Product design, manufacturing and supply chain.

Heartiest Congratulations to Manufacturing Expert Committee & others for grand success of EV Summit.



Manufacturing Expert Committee BCIC EV Summit: 10 April 2023.

Mr. Prakash G
Chairman - Manufacturing Expert Committee – BCIC
Chief Operating Officer - Ace Designers Limited

It was indeed a great honour to host the BCIC EV summit under the aegis of the manufacturing expert committee. It is a long-awaited event from the manufacturing expert committee for the last 2 years since the Covid pandemic broke out.

I would like to recall 24th Feb 2023 -The MC meeting and presidents' reunion day. On this day we as Manufacturing committee very well supported and guided by Dr Devarajan – Mentor & Sr Vice President BCIC and Mr Karthikeyan-Co-Chair made the promise to the President Dr L Ravindran who was very keen to see BCIC coming back with focus on Manufacturing industry to hold the EV summit in less than 2-month time. The President leadership and Dr Devarajan encouragement kept the ball rolling with Mr Rabindra Sah Pitching in swiftly to push the accelerator pedal. It was ably supported and coordinated by the secretariat team Mr Shama Prasad, Mr Niranjan and Mrs Roopa to name a few.

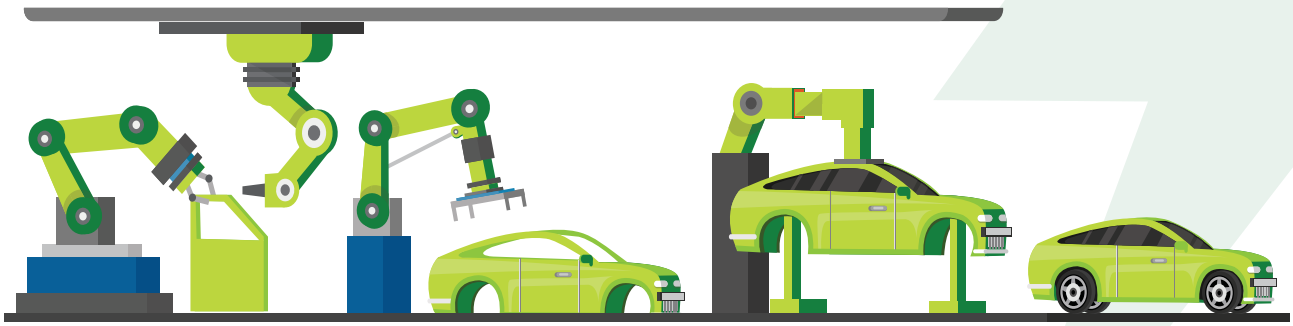
The Positive response to the EV summit has encouraged us start working on the subject of ***"Mega Manufacturing Conclave – Make in Karnataka for USD 1 trillion economy 2030"*** in the few months from now.

My sincere thanks to our distinguished guest, Past Presidents, Sponsors, Industry leaders and the speakers, for not only sparing their invaluable time but also for enlightening us with their experience and knowledge on the various topics of EV.

There are many key take aways from the speakers ranging from technology, infrastructure, leadership, skill management and new business and service models and the same will be published for your kind perusal.

I would also like to extend my gratitude to our 150 + delegates who actively participated till the end of the summit and their organizations who have nominated them from across the industry sectors. I am also appreciative of the point that students from academic institutions both technical and Management taking interest to attend and understand the developments in EV field. I am sure each one of them have a big take away from this summit to prepare their organizations for future challenges of EV disruptions.

Last but not the least a big thanks to our MC Mrs Richa sarna – Founder and COO of Teksands.ai for steering all the sessions of the EV summit.



Following is the gist of the key points of speakers.

SL	Speaker	Key Points
1	Dr. Devarajan – Sr. VP- BCIC & TVS motors	Setting the Context. Positivity on India's GDP growth, Industry joining the hands of Government to make Environment better and open to adopt new technologies and how India can become the global leader in hydrogen technology.
2	Mr. Gnanedra Kumar-Addl Commissioner of Transport GOK	Drastic increase in registration of EV in Karnataka and mostly in Bangaluru
3	Mr. Kamal Bali – President & MD Volvo Group India	Partnership is the new leadership. The transition phase is going to very challenging and will be very costly. Its not going to be easy. New business models will have to embraced.
4	Mr. Ashim Sharma	Clear analysis of EV world map. We need to work on both sustenance and sustainability.
5	Dr. P A Laxminarayanan	Green Hydrogen as fuel for ICE is the most economical option. Clear analysis and justification with facts and figures of green hydrogen as fuel for ICE was explained to all in an easy-to-understand graphics.
6	Mr. Girish Ramaswamy	Leadership is key to paradigm shift in business and Product strategy.
7	Mr. Sudeep Dalvi	Toyota policy of customer first, provide solutions to align with needs of each country rather than sticking to one type of fuel. Achieve net zero by 2035.
8	Mr. Gopi Shanker	Evolve architecture and modular designs to meet various products of EV. Its important also consider upskilling CV driver skills for EV.
9	Mr. Rahul Mathur	Technology Connects Humanity and Every connection Counts.
10	Mr. T R Parasuraman	Manufacturing is grown leaps and bounds due to various technology available such as IOT, AI, Robotics, etc
11	Mr. Rabindra Sah	Immersive experience, game engine platform, test it before you make it using digital technologies.
12	Mr. Karthikeyan	Digital Vision and Robust design flow.
13	Mr. Prashant Doreswamy	Challenges of Climate change, environmentally friendly materials such as Green Calliper for brakes. Technology transformation means Job transformation.
14	Mr. Bala Phanikumar	BCIC skill development gearing up to meet the need of Industry skilled manpower in the era of IOT, EV manufacturing.
15	Mr. Ravi Kiran	New Models are emerging. Energy as service, need to evolve standards through IEEE standards association.
16	Mr. Sivakumar	EV – Development and validation Challenges. Use of Attention Matrix.

EV Summit Welcome Note

Dr. L. Ravindran
President - Bangalore Chamber of Industry & Commerce
Managing Director & CEO - Wealthmax group of companies

This event was conceived in the month of October 2022. We were towing with the idea that we should have a series of programs starting in the month of October'22 and culminating before March'23. However, things could not take shape. But all of a sudden, there was a new gush of wind and in the month of February / March of this calendar year, we again started building up this concept. And here we are and close to about 150 people in attendance. Thank you very much for joining us today.

BCIC has always been at the helm of affairs in terms of shaping up a plethora of ideas and especially new ideas as and when it is conceived. I remember in the year 2016, if I remember correctly, when the demonetization came up, within the first three days, we were able to come up with a program on demonetization. The start up india event was organised within 5 days of the start up india announcement in the 2019-2020. Then on and off as and when the governmental policies have struck a new chord, we have been able to bring to the fore for our members benefit the various facts, the truth and unfolded anything else that required to be deliberated upon.

Having said that, today's event has been made very successful in our own way. Dr. Devarajan requires a special applause. Mr. Karthikeyan, Mr. G Prakash and Mr. Rabindra Sah have been able to spin this event to fruition in a flat 20 odd days.

Importantly, one of the gentlemen who stood to the task and took the initiative upon himself and built this theme into a grand success, has been none other than Mr Shama Prasad, Secretary, BCIC. He had his own personal anxieties, a couple of disturbances on the family front but still he has been able to get this organized. Thank you, Mr. Sham Prasad. Supporting him has been Mr. Niranjan, Ms. Roopa, Ms. Rajashree, Mr. Purshotham, Mr. Leo and everybody else. Our secretariat is very efficient and they always bring about quality work with ease.

The data on EV's I leave it to the experts. But as far as I understand close to about 1.01 million EV vehicles have been sold in the year 2022. And this is mammoth threefold increase between 2021 and 2022. And I was recently in Nagpur for the G-20 meeting. There is a sub group called C-20 and it deliberates upon 14 different working groups. One of them happened to be on renewable energy. Then another one is rivers and sustainability, water management and more importantly on electric vehicle too. And I am given to understand that world over electric vehicles are going to hold a special place. And India would possibly be on a special wicket and would counter a growth of nothing less than about threefold increase in the next five years. And that's a good number to begin with.

I am not too sure if I have seen the Pie chart published by a reliable source of the EV statistics and it does not give a great indication of the four wheelers versus the three wheelers and two wheelers. It is at the moment stacked towards the two wheelers and three wheelers.

Having said this once again, I welcome each one of you for having made it to this mornings meeting. Have a wonderful day. Thank you very much.

Heartly Welcome BCIC EV Summit...

Opening Remarks EV Summit

Dr. S Devarajan
Sr. Vice President – BCIC
Sr. Vice President – TVS Motor

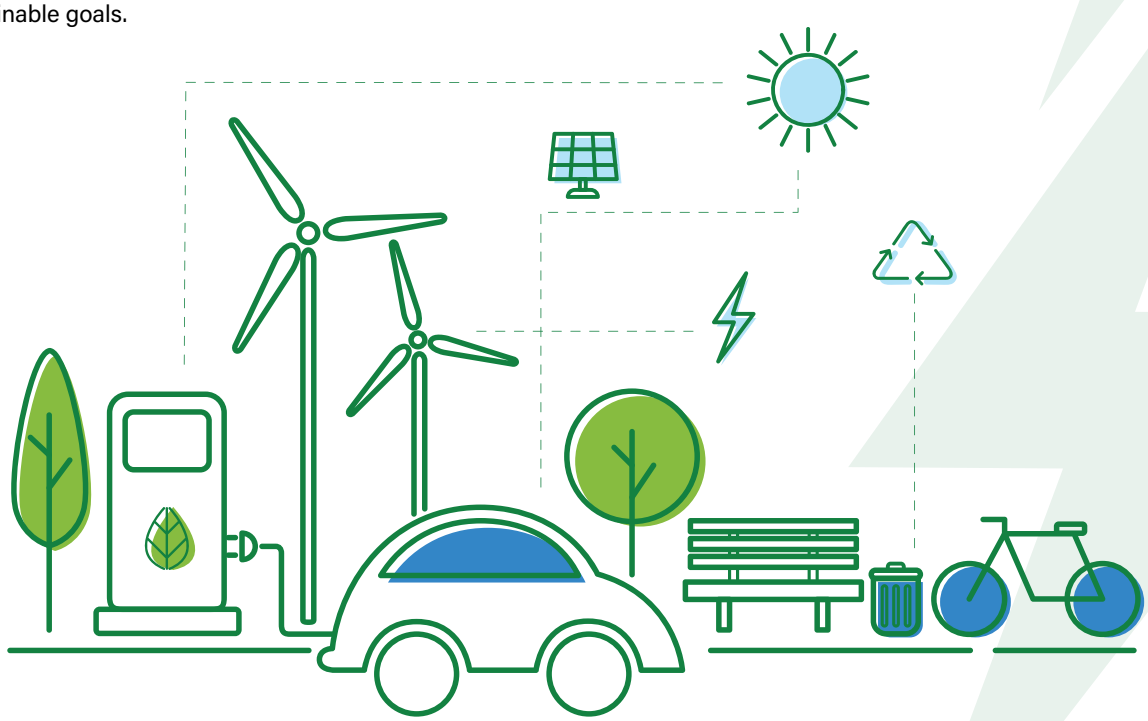
India's growing economy driving towards top 5. By 2030, with growth around 5 to 8 % of GDP, we will be among the top 3. Automobile is key for growth as Mobility is LIFE. India is key signatory of Kyoto and Paris protocol. The Key is sustainability and Disruption in the field of automobiles. Push from the Government towards the Sustainability – BS 3 to BS 6 emission norms to be met ahead of the schedule, which was achieved, boosted the confidence of the manufacturers. India being growth market and also with exports caused the pull to the entire mobility. The centre being the customer – 360 deg - of the product, process, environment and community drives the change.

This drives the change from Internal combustion engine to Electrical vehicles. Demand of the Customers of the improvement of Range of the charge drives the light weighting of the process, materials towards aluminium, multi material to ensure the weight of the vehicle is not increased inspite of the battery weight.

EV vehicles dependency of Lithium ion for battery is also challenged due to depleting lithium ion sources and also on the overall emission. UN SDG goals also demands cleaner fuel. Alternate fuels of Electric, Hybrid of Diesel and EV/ Petrol and EV and to cleaner Hydrogen. Hydrogen – Grey, Blue or Green is the new fuel and India has the chance to lead the world in Hydrogen technology use in Vehicles.

The challenge for the Automobile sector is to improve the range, reduce the cost of EV, work towards improved process. Government schemes of PLI (Production linked incentives) also helps the companies towards localisation of EV, motor through " AtmaNirbar".

Circular economy drives from the design, manufacture, assembly, usage and reuse back is another key initiative in the entire EV mobility sector India is an anvil of "Technological Revolution" through EV and this also focusses towards maximise Customer benefits. This win-win of Customer, Government, Environment and Society is the "FOCUS NXT". Along with Skill enhancement of educational institute- industry interface, India is set to achieve the goal of being among the top 3 in GDP with meeting the UNSDG Sustainable goals.



02

Electric Vehicle - Challenge, Opportunity, Growth & Policy

Article 1

Emerging Trends and Imperatives for the future Success

Mr. Kamal Bali
President & Managing Director - Volvo Group, India

Theme of EV summit is very important and compelling topic which we are all faced with. Our world is undergoing a profound transformation. Something not witnessed in generations. And this is going to have a huge impact on way we live our lives or we do our business or relate with one another, wherever we are, whoever we are. Indeed, this is also one of the most exciting, disruptive and eventful times of industry. So it is in this connection, what I have chosen to really share about some of the high-level mega trends and the imperatives for success to be able to look at this. So, I am going to share 10 mega trends upfront below:

Trend#01 - Challenges & opportunities:

- We are at the **crossroads of change and paradoxes.** Why I say so, we have impending challenges on one end, which includes climate change, congested cities, inequitable global growth. The poor are getting poor, the rich are getting richer, resource scarcity. This is **one set of challenges** across the world.
- And at the same time, we are presented with some **excellent opportunities.** Thanks to technologies and digital transformation which is happening. So, it's a very paradoxical situation. **Large number of challenges, equal number of opportunities.** I think that's the **first takeaway.**

Trend#02 - Net zero science-based targets:

- It is now abundantly accepted, especially after COVID, that we need to operate within the boundaries of our planet. Just about imagine about six years back, only **3% of the total emissions** were committed by countries to become **net zero.** Today, **78% emissions** are committed by countries.
- Likewise, six years ago, only 300 odd companies had committed to science-based targets. Today, more than **3000 companies** have committed globally on net **zero science-based targets.** So, I think that's another shift which is happening big time.

Trend#03 - Decoupling the negatives of fossil fuel on growth path:

- The **transition of energy is going to be complex.** it's going to be daunting. It's going to be costly.
- It's because why? Let us look at India itself. India is going to go from **3.5 trillion economy to 30 trillion** economy by the time we turn 100. If it is **eight to nine times growth,** we can imagine the amount of additional **mobility** we need. The need for mobility is going to **grow tremendously.** And how do we therefore provide that mobility while **decoupling the negatives** of this? We **can't have more fossil fuel** into the **environment.** We will be killing each other.

Trend#04 - Sustainability is not just environment:

- Sustainability is much more than environment. I think this is a mistake which we always make whenever we talk of sustainability. We get stuck to the very important point of environment alone. **Sustainability is not just environment.** Environment is **one part of sustainability.** Sustainability means:
  a. Whatever we do, has to be economically viable which **means more output for less input.** So **economically viable,** better productivity. That is sustainability.
  b. Whatever we do has to be **socially inclusive.** That's also sustainability. We can't ignore one sections of society. We can't ignore women who are only playing 25% role in the whole economic cycle in India. We can't become a superpower or top three in the world with only 20% of the women playing the game. 50% (Half) - both genders have to have to contribute to this. So, sustainability is everything. Being diverse, being inclusive, being environmentally friendly, being ethically moral. So, all those **four boxes** have to be ticked if we really want to talk about sustainability.

Trend#05 - Human potential:

- How do we realize full human potential? I think this is something very important, because to be able to transition to new technologies, to new ways of working, we will need more skills, more human power, more realization of human potential and therefore upskilling, education and well-being of people is going to be very important.
- We, all of us, whether it is industry or otherwise we will have to get more and more people centric.

Trend#06 - Role of Leadership:

- Role of leadership is very important. As we move forward and build new ecosystems and navigate various pathways, we need to exercise choices. It's not easy sitting at the top today because leaders will have to make choices. Choices will be very expensive.

  Do you go hydrogen way? Do you go hydrogen fuel cells? Do you go lithium ion? Or do you go use IC engines with different fuels? All of that and each one is billions and billions of dollars of investment and five to six years of time frame. So, whether what choices you make today is going to decide your future day after tomorrow.

- So, it's not easy. So therefore, leaders have to be not known it all kind of people. **Leaders will have to be learners.** You will have to move to leadership which is a learning leadership which is also very importantly to be collaborative, caring, inclusive, inspiring, agile (very important), and visionary. So, I think that's a major shift coming in leadership as well.

Trend#07 - Digitalization, Automation & Net Zero:

- There are three aspects - Digitalization, Automation and pathways to Net Zero are going to define the future of mobility. How do we get to net zero and therefore different fuels will come in. This is detailed out towards end of article.

Trend#08 - Era of accelerated innovation:

- We are entering an era of accelerated innovation. That is why it is very important because innovation is going to be the bridge between the challenges and the opportunities which I mentioned. At one end we have huge challenges, other end we have opportunities. It is the innovation which can work to really bridge the gap between the two so that we can absolutely move on a path of growth. So therefore, why innovation is so much easier and possible today? There are following key points:

a. **Point#1:** We all are united by the concerns we have globally. Everybody is united about that. Whether it is geopolitics, whether it is people, whether it is inequitable growth, whether it is **climate challenges.** All of us are **united.**

b. **Point#2:** The time from **ideation** to action has reduced dramatically because if we have a good idea, **finance** is available today. 20 years back, we would not get money.

c. **Point#3:** Next point is **DATA.** We get **insights** which are backed up by data. During our time, it used to be intuitive management. Today we have objective management because of data availability.

d. **Point#4:** The last point is that we can **collaborate** across **domains.** It means, we can look into if you want to innovate, we need to get out of our domain into another domain because otherwise we will get more of the same. We will not get great ideas by looking only into the automotive industry. Automotive industry has to probably look at pharma industry. And one can ask what will a pharma do for automotive? There's a lot of **cross learning** which happens there.

Trend#09 - Era of Partnership:

- Partnership is the new leadership. No company, no organization can afford to say that they will do the 360 degrees of giving the final outcome to the customer by themselves. We will have to partner. If you had asked me four years back that Volvo will partner with Daimler. Daimler is our competitor. But today Volvo is a partner to Daimler for hydrogen fuel cells. We are doing it together. If you had asked me this question three years ago, I would have said no way. Today we have partner. We have partnered with NVIDIA; we have partnered with Samsung.

- So, the era of partnerships has started and I think future leadership is all about partnerships.

Trend#10 - Regulations:

- Regulations will have a very key role to play. Data privacy versus open data. Who owns the data? Impact of AI on IP? Just the way everything is connected, Regulators across ministries and domains will also have to connect with each other because working in Silos, even in government, will not be able to sort some of these challenges.

Above 10-trends which I really wanted to make upfront to say that these are the trends and if we really want to succeed going forward, we need to really tick all these ten boxes so that we are on the road to the future.

Additionally, I would like to detail out eight specific points below:

#01 Options of energy transition & Government Initiatives:

- We will need to use all tools in the box to really make energy transition. It means that we will have hydrogen, we will have battery electric, we will have hydrogen fuel cell electric, we will have hydrogen being used on IC engine directly. We will have many other alternate fuels. We will have methanol, we will have so many other fuels, LNG, and so many other things which will happen. So, it's not going to be just battery electric only.

- So game is much bigger than just one putting all our eggs in one basket. So, it's very important to understand that all tools in the box will have to be tackled to handle this. There is no other silver bullet.

- I am so happy that India is taking the same path. Indian government has

really brought out **PLI schemes** for **hydrogen fuel cells.** They have brought PLI schemes for ADAS systems. So, I think it's very interesting that the government is moving very quickly. So, we believe that two wheelers and three wheelers will work on more and more on Lithium-ion. City transport can work on Lithium-ion battery. It could be buses; it could be taxis. But I think long haul hub to hub transportation will have to happen with many other methods. And hydrogen could be one. And I think, of course, hydrogen fuel cells are still in infancy, but it's going to be interesting to watch the journey they are going to have.

#02 Electromobility - EV landscape

- Topic of electromobility or the EV landscape is very important. Electromobility as just a way of addressing climate change. It is one of the ways. But I think more importantly, it is once in a lifetime transformation process for the entire system of mobility. We are actually getting a chance to relook at mobility. We don't want the congestion in the cities today with diesel engines or petrol engines to be replaced by congestion in the city with electric vehicles. That's not sustainability. We don't want that situation to happen.

- So therefore, we need to really **plan our entire public transport system.** We need to plan our ride hailing system, we need to plan, we need to have various things and therefore electric mobility or clean mobility, green mobility helps us because it is highly digital, it is highly electronic, it is highly software based. It gives us many opportunities to be able to play in that game. So, I think that's one thing. It is actually much more than climate. Climate is one part but it is an opportunity for us to fix our woes with mobility in a big way.

#03 Logistics Efficiency

- Other important point is **logistics efficiency.** For an example, today how inefficient the logistics system in the world is today? We will be surprised to know that less than 50% is the efficiency of a truck globally, not only in India. So, India may be even lower than that. So why? Because at more than 50% of the time the truck is moving air and not moving cargo. It is wasting more than 50% of the fuel time and resources of everyone. So, I think that's a great opportunity. Therefore, there lies the opportunity in the entire value chain of the trucking. What do I mean by that? I mean load management, route management, vehicle to vehicle interface, vehicle to infrastructure interface. All of this, if somebody can solve these problems and say for hub-to-hub transport, we will have full loads available all the time. If somebody can prepare an algorithm to do that, you can monetize that balance 50% of the trucking industry.

- Trucking industry is a large logistics industry and that is why if our logistics efficiency or the cost of logistics in India is 14% of GDP, it can come down to 7-8 % of GDP. I think just imagine 6-7% amount saved of our GDP. It can take care of health care of entire India. So, I think those are the kind of opportunities. I want you to look outside electromobility just from the narrow perspective from fossil fuels to electric vehicle or hydrogen. We should not stand there alone, just take it much ahead. Widen the envelope, I think push the envelope big time.

#03 Collaboration

- What are the challenges which we are going to face in this journey? **I think one is building partnerships and electromobility ecosystem.** I think all this, as I said in the beginning, is going to be a game of partnerships. Again, for charging infrastructure in Europe, a company like Volvo, we have signed up a joint venture between TRATON, Daimler and Volvo. Three companies have come together to build infrastructure, charging infrastructure and we compete with our vehicles, but we partner to create the infrastructure. So, I think in the past we have been obsessed with the word competition. All MBA books taught you how to beat competition. Strategies for competitive advantage. I think, we will have to forget that word for some time. I think we will have to get obsessed with the word **collaboration.** And that's going to be the key name of the game going forward.

#04 Energy Management

- Energy management is going to be a key focus area. It includes - the second life, the circularity, the second life of batteries. When do we shift the battery from use case A to use case B? And I am very happy that India is taking lead there. Battery management systems are getting built up. Very nice algorithms are built up that the moment battery health goes below 80%, it has to be removed from the truck or from the vehicle and put into applications which are lesser demanding. And therefore, the battery life is much, much enlarged. So, I think that is something very important.

#05 New Business Model:

- And then new business models are going to be built. As alluded to that a bit that if you look at the complete ecosystem of mobility, there are hundreds of other things. Instead of just moving from point-A to point-B, there are several other elements in the game. And that's what I said. Software, digital technology, AI, machine learning is going to play a huge role in really making life of people much much better.

- I gave you the example of logistics efficiency. There lies a huge opportunity if anybody can monetize that $400 billion of waste in a logistic system, just imagine, amount of wealth you can create and number of problems which you can solve for the entire world. I think this is something very critical to my mind as well.

#06 To Become Leader in R&D

- There is a huge chance for India, which I see today, is to really become leaders in the R&D to capture the next round of development in the energy transition space. And I think the good news here is that nobody has a lead over you. Unlike in other things we said, India is

30-Years, 40-Years behind US or maybe 50-Years behind us and 20 years behind China.

- I think the good news here is that the starting line is now redrawn. Everybody is the same starting line. It is advantage for India because we have the talent. In another 20 years from now, 20% of the global talent will be from India. One out of every five people working in the world will be from India. Why not use those opportunities? I think that is something very important to take back to my mind. So, that is another thing which I want to say that R & D setups and more and more companies are looking at India big time.
- Earlier they used to look at India because of cost arbitrage, because we were cheaper. But no, today they are looking at India. I can tell you, and you will be very happily surprised that they are looking at India not only because of cost. Cost is just one element. They are looking at India because of competence, which we give. They are looking at India because that they can **trust** us. That is the biggest compliment. We all can pat ourselves in the back that they can trust us. We are **competitive** and We are **capable.** So, all these three elements all put in one. So, I think that's something wonderful. Therefore, R&D can be a huge opportunity for us when it comes to electromobility or when it comes to green mobility going forward.

#07 Skills & New Jobs

- Few challenges which we have are skills and the new jobs. That is at times little scary, if we stick to our past. The jobs are going to shift dramatically. Some of these jobs are not going to exist, but many more jobs will exist. Many more new jobs will happen.
- Now, if we remain stuck to our not getting out of our comfort zone, then we have a problem. We will have to get out of our comfort zones. All of us, right from CEO till a graduate engineer, all of us will have to shake off our comfort zone because that's very important. Because if we remain in our comfort zone, we will not have jobs. We will say we don't have jobs. The industry will cry that they don't have people and people will cry that they don't have jobs. So, I think that mismatch. We need to invest both private sector, public sector and government.
- We all need to work in tandem as teams to really upskill people, to unlearn the past from the past and learn new skill sets. Of course, there will be some skill sets which will remain constant, but there will be many, many skill sets will change dramatically. So, I think that's one thing which worries me a little, but that also is an opportunity for new India. Because we are a younger new India. Youngsters can learn. We are the youngest country in the world. Whereas overseas people are very old. They cannot learn as much. So, this is again advantage India if we take it in the right way.

#08 Charging Strategies

- We will have to see how do we charge? Do we have a swapping system or do we have standard chargers who charges where do we use the same set of infrastructure? Do we create new ones? I think that is another thing which we need to deal.

Closing Remarks:

- I want to say we remain in the midst of a massive transformation, something which has not been seen in the past many many years.
- When I go abroad today, I see the kind of spotlight on India like never before. And remember, the spotlight is not because we have our GDP is growing at 6 or 7% or we are the fastest growing large economy. No, it is not only because of that, I think it is because of resilience which we all have demonstrated during COVID period. 2 billion doses administered. The best COVID certificate on digital certificate which you could carry on your mobile phone. Whereas countries like America, they used to have a paper certificate and carrying which they will not find. It was phenomenal stuff.
- Of course, very quietly, a lot of reforms happened. We have scrapped so many archives clause. So many compliances have been reduced. So, I think that has happened big time.
- Huge spend on infrastructure has happened. $1.4 trillion is being spent on infrastructure during a time frame of four years. This is more than what United States of America spends. But this goes unnoticed because we are quite cynical about our own country many times. We should take pride in some of the good stuff which is happening.
- Then, of course, reaching out to the vulnerable, people said, Indians will die of starvation. I think no one died of starvation. I think there was a great thanks, and behind all this was the digital backbone, the DBT- Direct Benefit Transfer, the Jandhan accounts, the Aadhaar cards and the mobile phone. I think the trinity of these three things really did wonders for India.
- So, I am very gung-ho on the India story, but, yes, we need to make some shifts which are very, very crucial and those shifts must happen now. But I think seeing the young India, I think I am very confident that India will be 'second to none.'

Best of Luck.

Article 2

Electrification: Journey so far, and the road ahead

Learning from the successes in EV manufacturing, business, & regulatory environment of EV forward countries while being cautious of the failures faced in those markets can propel India on a growth path. Building the automotive industry of tomorrow will be a collaborative endeavour of academia, start-ups, industry, and the government

Mr. Ashim Sharma
Senior Partner & Group Head Business Performance Improvement Consulting (Auto, Engg. & Logistics) - Nomura Research Institute

The world is embracing the advent of electric mobility. This shift is driven primarily by two factors: Environmental benefits, which is the need for clean air & usage of green energy as well and by Energy Security, which is reducing dependency on imported sources of power.

Globally, a total of 10.5 Mn passenger EVs were sold in 2022 which constituted nearly 16% of all passenger vehicle sales. China led the global market and grew at a rate of 55% CAGR from 2019 to 2022, followed by US & Europe which grew by 48% & 32% respectively. In case of 2W, China led the market with over 9 Mn vehicles sold.

India has shown great progress which can be seen from the impressive year-on-year EV growth of 157% across all segments with penetration levels reaching 2.5% for e-Cars, 6% of e-Scooters, 52% for e-3Ws, and 7% for e-Bus. The installation of charging stations ramped up in the recent years with the current tally at over 4K with the addition of over a 1K swap stations. Akin to the success stories of US, EU, China etc. India too has received tremendous reception of its FAME incentives and PLI schemes thereby boosting the EV industry.

The rapidly growing EV market in India has produced a number of lucrative whitespaces that new age businesses are attempting to fill. An incredibly competitive startup ecosystem has now emerged in Cell and battery manufacturing, EV dealerships, after sales services, & EV recycling in addition to EV manufacturing.

Stakeholder perspectives

The many participants of the EV ecosystem have varied motivations to make the switch to EVs. While EVs are a promising form of sustainable mobility, sustenance also plays a major role in defining the future course of action for different stakeholders. For the customer, sustenance matters the most, for the OEMs it's a fine balance between sustenance and sustainability, whereas for the Government, global commitments to become carbon neutral (sustainability) take precedence.

EV trends – Technology

Across the globe, EV technology is improving on a micro scale to provide better performance, better range, lower cost and to keep the vehicle and components light weight. Technology is also being adapted to suit the weather conditions and terrain of the local markets.

Another important technological trend picking up in the global EV industry is a faster than expected shift towards high voltage systems. Typically, passenger car EVs are rated at 400V or lower. A switch to a higher voltage system leads to multiple benefits such as lower motor losses and hence enabling smaller motor with similar performance, lower switching losses and theoretically faster charging times because of lesser heat dissipation.

Similarly, alternate battery chemistries that are having a higher lifespan, wider availability of raw materials, more resistance to heat are being explored and deployed e.g. LTO, LFP, etc. Motors are also witnessing the use of alternate materials and improvements in efficiencies.

EV trends – Supply chain

In the recent years, there have been many instances of disruption in traditional EV supply chains due to geo-political reasons which have led to the exploration of lateral opportunities. The use of alternate materials, emphasis on ethical sourcing, indigenous manufacturing etc. have all been picking up pace. Near shoring of supply chains, development of alternate sources, upstream and downstream capability augmentations and even technological changes are fast being undertaken to solve the supply chain related issues.

EV trends – Emerging skills

The creation of a lucrative EV ecosystem will necessitate skill upgradation in the specific engineering disciplines such as Software, Materials, Electronics, Chemical engineering and the need to tailor the curriculum in order to incorporate EV design.

India's EV development could shape into an economic growth engine and serve as an integral part of a vital sustainability transition. Learning from the successes in EV manufacturing, business, & regulatory environment of EV forward countries while being cautious of the failures faced in those markets can propel India on a growth path. The Indian electrification push will not only support the development of an EV industry, but will also have a positive spill-over effects on other industries facing the same sustainability transition challenges. Building the automotive industry of tomorrow will be a collaborative endeavour of academia, start-ups, industry, and the government and an incredible opportunity lies on the other side of this transition.

03

Electric Vehicle - Design, Development, Sustainability & Net Zero Emission

Article 3

Hydrogen as a Fuel for ICE & EV: Development, Storage and Challenges

Dr. P.A. Lakshminarayanan
Former Technical Advisor - Simpson & Co. Ltd.

Abstract

Hydrogen as a fuel for transport is a high priority in India not only from the point of greening but also to save precious money leaving the country. At present, blue hydrogen is more economical than green or grey hydrogen and in this case, carbon dioxide emitted during the development of grey hydrogen is captured or utilized usefully elsewhere. For automotive applications, the fuel cell route or internal combustion engine is possible. Each is having its advantages and disadvantages. The extremely low density of hydrogen gas makes transportation and storage difficult onboard a vehicle. Storing cryogenic hydrogen as a liquid has its problems. A compromise seems to be compressed cryogenic hydrogen at 240 bar.

Introduction

India is planning 3.36 MMT per annum of hydrogen in three years with production-linked incentives and government grants. The heat content of hydrogen is about 2.8 times that of diesel. Thus, it more than replaces the diesel currently consumed at the yearly rate of 3.35 MMT. It can be used in other industries like steel and cement that contribute to carbon dioxide in the ambient. Though most of the hydrogen produced today is considered dirty or grey from coal and methane, the simultaneous development of green sources of electrical energy from wind, wave, nuclear and solar routes would support the production of green hydrogen by electrolysis or fuel cell. To produce work from hydrogen, fuel cells are efficient because they avoid the heat engine route that abides by the classical laws of thermodynamics. However, an internal combustion engine (ICE) is far simpler to develop and implement in a vehicle that requires bursts of power continually. The fuel cell is incapable of this demand and seeks to have a storage battery as a buffer and as an electric motor. What is more, the efficiencies of the two types of power sources are no different at high load factors posed by off-road vehicles and trucks. The biggest disadvantage of hydrogen as a fuel is its low density. Special engineering to contain it economically in manageable volumes is challenging.

Hydrogen Production

Today, 76% of hydrogen is produced by two-step steam reformation of methane (natural gas) or coal gas for economic reasons. Carbon dioxide (CO2) is a byproduct let into the atmosphere. It is dirty since CO2 is global warming and hence coded grey. However, techniques are emerging to capture CO2 or store (CCS) it underground or utilize it to produce biofuels like methane and methanol or other products like refrigerants, building materials, plastics and concrete. Also, it can be used directly in fire extinguishers, pharma, food and beverage industries as well as the agricultural sector. Since the CO2 is suppressed this hydrogen is coded blue indicating it is less pure than green which is produced by electrolysis or a fuel cell using renewable energy sources like wind, sun and waves. The environmental impact and the economics of the green and blue hydrogen from different sources with 90% CCS are graphically shown in Fig. 1 [1]. Today, 21.5% of the hydrogen produced globally is blue and only 2.5% is green.

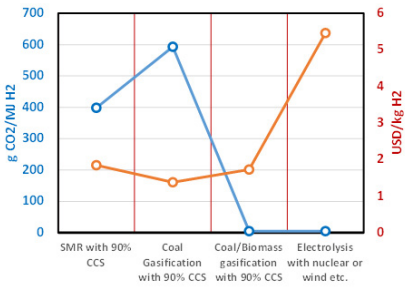


Figure 1 Economics and Environmental Effects of Green Hydrogen and Different Types of Blue Hydrogen[1]

Automotive Application of Hydrogen

Hydrogen can be used in fuel cells or internal combustion engines for powering an automobile. An ICE drives the vehicle directly unlike a fuel cell which needs a battery to store the energy to drive the vehicle through an electric motor. The medium of battery is required because a fuel cell is not able to give bursts of power demanded by a vehicle. The system using a fuel cell is far more expensive than an ICE. The important product of a power source using hydrogen is harmless water with nil impact on the environment. While the efficiency of an ICE is moderated by the second law of thermodynamics and friction, theoretically there is no limit to the efficiency of a fuel cell. Practical maximum

efficiencies, however, are 70% for fuel cells and 40% for ICEs, Fig. 2 [2, 3]. The peak performance of the fuel cell is at a load factor of 10%-20% of the rated load and drops with an increase in load, whereas it improves monotonically for an ICE. The efficiencies of the two sources intersect at about 70%-80% load factor at which heavy-duty vehicles like trucks, tractors and earthmoving machinery operate. This observation and the overall economics make hydrogen ICE attractive for heavy duty vehicles.

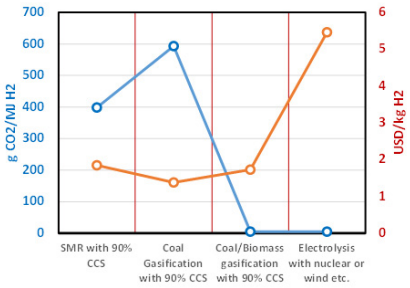


Figure 2 Efficiency versus load factor: Gasoline, Diesel, Fuel Cell, H2ICE and Electric Vehicles [2, 3]

Fuel Cell

A hydrogen molecule is split into protons and electrons at a catalysed electrode (anode). The protons travel through a proton exchange membrane (PEM) or an alkaline electrolyte to the catalysed cathode, where it combines with oxygen to produce water. This journey across the cell builds a potential difference (PD) between the two electrodes. If an external load like an electric bulb, a battery or a motor is connected across the anode and the cathode, a current passes by the PD through the load. The full PD is not available at the load because of activation loss due to polarisation. Further, the voltage drops with increasing load current due to the internal resistance of the fuel cell. The current is limited by the water accumulated at the cathode. To improve the current output the mass flow rates of hydrogen and oxygen are increased by feeding at high pressure. Hydrogen is already available at high pressure in the containers. Highly filtered air from the atmosphere is compressed by a turbo-compressor and fed.

Fuel Cells demand 99.99% pure hydrogen to avoid poisoning the catalyst at the electrode. For example, iron from pipelines is an impurity known for its ill effects. The required purity of hydrogen is given in the standards.

Internal Combustion Engine

The engine can be a derivative of conventional gasoline or diesel engine and could be produced in the existing manufacturing lines. The queer properties of hydrogen ask for special features in the engine. the high knock resistance of the fuel enables the use of very high compression ratios unusual for a spark ignition engine running on natural gas or gasoline, and consequently at high thermodynamic efficiency. If the fuel is admitted in the inlet port, the low density of hydrogen reduces the volumetric efficiency by 34% for stoichiometric composition and about 16% for an air excess ratio of 2.2, meaning potential loss of power. Therefore, direct injection is preferred to maintain high volumetric efficiency. The high diffusivity of hydrogen is not conducive to stratification and hence would disallow copying the design of conventional gasoline direct injection (GDI) engines. In addition, hydrogen will be in contact with the walls of the combustion chamber for a prolonged time to cause embrittlement. Also, the conventional three-way catalyst used in stoichiometric gasoline engines cannot be used in a stoichiometric hydrogen engine because the reducing agents in the form of carbon monoxide and hydrocarbons are completely absent. This would force the use of the expensive selective catalytic reduction technique. The other option is to run the engine lean at an air excess ratio of 2.2 at which the flame temperatures are very low to produce only traces of nitric oxides. Though the flame velocity of hydrogen is many times higher than that of gasoline or natural gas, such lean mixtures can be effectively burnt only if the turbulence is intense. For solving all these problems, active prechamber combustion is used. Here, in a small prechamber (Fig. 3) made of special stainless steel to withstand embrittlement, the fuel is injected near a spark plug. Even when the overall mixture is as lean as 2.2, it is rich enough in the prechamber to be ignited by a spark. The partially burned fuel-air mixture ferociously exits through many radial holes at the bottom of the prechamber creating intense turbulence, towards the bowl in the piston. Leaning the mixture, of course, demands a high boost by a turbocharge; but, it helps in improving fuel consumption by up to 10%. Such designs are productionized by many leading manufacturers of heavy vehicles.

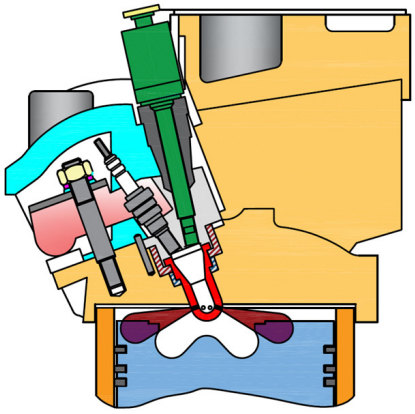


Figure 3 Hydrogen Engine with Active Prechamber

Incidentally, an ICE works with impure hydrogen and hence extreme care is not needed to maintain the high quality of the fuel unlike in the case of a fuel cell.

Storage

22.4 litres of hydrogen weigh only 2 grams at NTP, i.e., the density is 0.09 g/litre as against 820 g/litre of diesel. Considering the heating value of hydrogen superior to diesel by a factor of 2.8 it is equivalent to 5.6 grams of diesel. A heavy truck usually has a tank of size 250 litres (205 kg) to cover 700 km. Then, the capacity of the hydrogen tank should be 8,20,000 litres if filled at NTP. Compressing to 700 bar is a possibility which will reduce the requirement to 1,171 litres by increasing the density to 62.5 g/litre. Though it can be managed the walls of the cylinders must be sufficiently strong and therefore very thick reducing the payload capability of the vehicle.

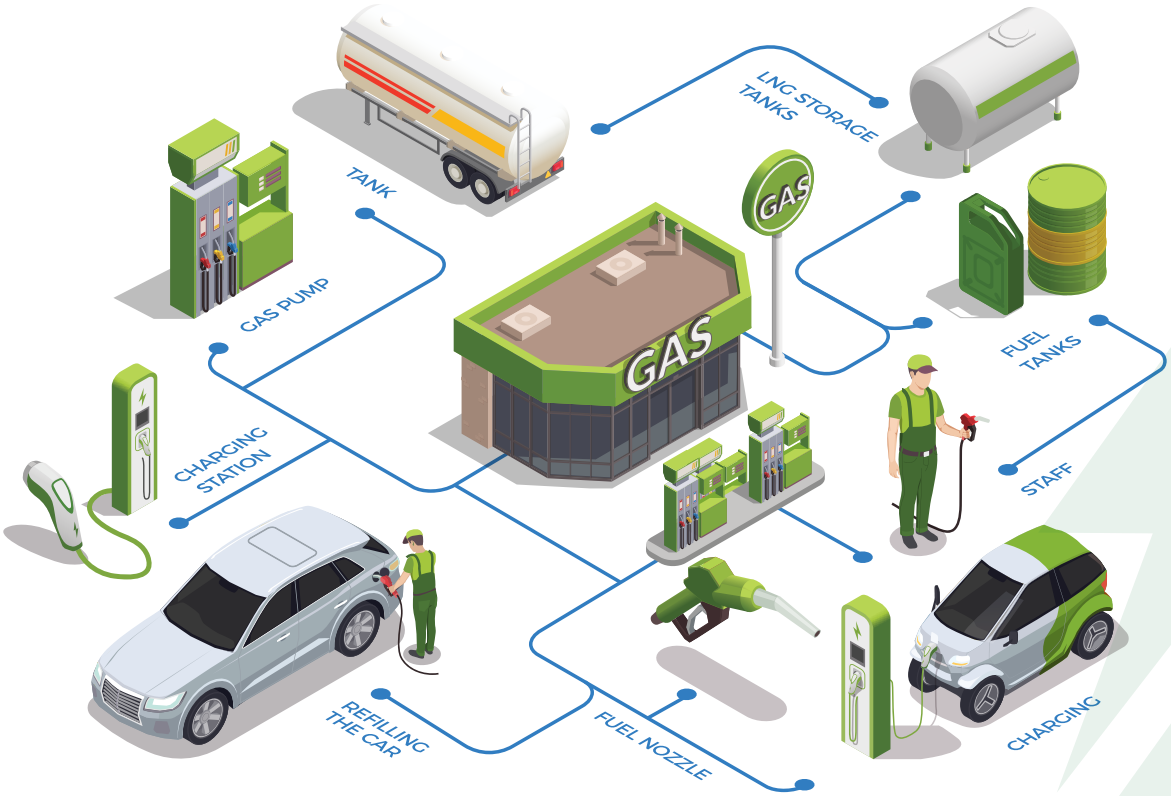
Storing the fuel as a liquid at minus 250 degrees C and room pressure is a possibility to achieve a density of 80 g/liter. The cryogenic cylinder is a special two-walled Dewar vacuum flask with shiny faces on the two walls. The inner wall itself is insulated to reduce conduction losses. Even such a sophisticated system is unable to stop all the heat and the fuel is allowed to evaporate to maintain the temperature. If the vehicle is dormant, the vaporized fuel cannot be used and hence it is let into the atmosphere as waste. In case the pressure

due to evaporation is not relieved, there is a danger of an explosion. Therefore, this solution is not preferred for storage in automotive applications.

A medium solution seems to be compressed cryogenic hydrogen. The gas is compressed to 240 bar which is usual in CNG applications and the temperature is maintained at minus 73 degrees C [4, 5]. This achieves a density of 40 g/litre. At lower temperatures, the density would be higher. The cylinder is a Dewar flask as described above. Since there is no liquid which can evaporate dangerously, the method of storage is safe and also there is no loss of fuel.

Summary

Green hydrogen can be produced economically, in the far future. However, for the foreseeable time blue hydrogen will be economical and environmentally friendly. Either a fuel cell or an ICE can utilize hydrogen in a vehicle. The application of a fuel cell is more contrived than an ICE. Also, it asks for 99.99% pure fuel. The efficiency advantage of the costly fuel cell over an ICE disappears in applications where the load factor is high. The biggest problem, however, is the storage of fuel onboard. Compressed cryo-hydrogen appears to be viable.



References

1. *Hydrogen Strategy - Energy, Enabling a Low Carbon Economy, Office of Fossil Energy, US Department of Energy, Washington, DC 20585*
2. *Töpler, Johannes. "Hydrogen as energy-storage-medium and fuel-A strong partner of renewable energies." Renewable Energy and Environmental Sustainability 1 (2016): 31.*
3. *Heid, B., Ch Martens, and A. Orthofer. "How hydrogen combustion engines can contribute to zero emissions." McKinsey & Company2021 (2021).*
4. *Langmi, Henrietta W., Nicolaas Engelbrecht, Phillimon M. Modisha, and Dmitri Bessarabov. "Hydrogen storage." In Electrochemical Power Sources: Fundamentals, Systems, and Applications, pp. 455-486. Elsevier, 2022.*
5. *Klaas Kunze, BMW, Cryo-compressed H2-Storage – Recent Advances and Experimental Results, FCHE Conference 2011, February 15th, 2011, Washington D.C.*

Article 4

How Electric Mobility Is Powering the Future

Mr. Girish Ramaswamy
Head of Engineering - Vitesco Technologies

The electric mobility trend is gaining momentum in the automotive industry. Electric vehicles (EVs) are becoming increasingly popular, and their numbers are growing rapidly. EVs are no longer a futuristic idea, but a tangible reality, and the rise of electric mobility is not just a trend, but a necessary shift toward a more sustainable future.

Why Electric Mobility is a necessity today?

Electric mobility is a necessity today for several reasons Electric mobility has become a necessity today due to a variety of factors. First and foremost, it is a critical step in reducing carbon footprint and its potential to combat climate change. According to the International Energy Agency, the transportation sector accounts for approximately one-quarter of global greenhouse gas emissions. Switching from traditional internal combustion engine (ICE) vehicles to EVs is one of the most effective ways to reduce carbon footprint.

Additionally, EVs offer several advantages over ICE vehicles, including lower running costs, less maintenance, reduced emissions, ease to drive, and quieter operation. EVs are also more energy-efficient, as they convert a higher percentage of their energy into actual vehicle movement compared to ICE vehicles.

The Growth of Electric Mobility in India.

In recent years, the Indian government has been pushing for the adoption of electric mobility to build a sustainable transportation sector. The Indian government has launched several initiatives to promote electric mobility, including the National Electric Mobility Mission Plan (NEMMP), which aims to achieve 30% electric vehicle penetration by 2030. The government has also set a target of installing 6-7 million charging stations by 2025 to support the growth of electric vehicles. To encourage the adoption of electric vehicles, the Indian government has introduced several incentives, including tax exemptions, subsidies, and lower GST rates for EVs. The adoption of electric mobility in India is on the rise, with a growing number of people opting for electric scooters, three-wheelers, and cars. To reduce dependence on imports, the Indian government has been encouraging local manufacturing of electric vehicles and batteries. Several major automobile manufacturers have also announced plans to launch electric vehicles in the Indian market. Many Indian cities have also been introducing electric buses and trains to reduce air pollution and improve public transportation services.

Challenges for E-Mobility

While the growth of electric mobility is encouraging, several challenges need to be addressed for it to become a widespread and mainstream transportation option. One of the biggest challenges for electric vehicles is the limited range of their batteries. While the range of electric vehicles is increasing, many people are still concerned about running out of charge and being stranded on the road. However, the range of EVs is increasing, and the growth of fast charging stations is helping to alleviate range anxiety. The lack of charging infrastructure is another main barrier to EV adoption. A robust charging infrastructure is critical for the widespread adoption of electric vehicles. Governments and private companies need to invest in charging infrastructure to make EVs a viable option for more people. Battery technology is improving, but it is still expensive and has limited capacity. Improvements in battery technology are necessary to make electric vehicles more affordable and increase their range. Electric vehicles are currently more expensive than traditional vehicles. While the cost is decreasing as technology improves and economies of scale are achieved, electric vehicles remain out of reach for many people. Despite the growing popularity of electric vehicles, many consumers are still not aware of their benefits or how to operate them. Awareness campaigns are needed to encourage more people to switch to electric vehicles.

Innovations in the Electric Mobility Sector

Innovation in the electric mobility sector is rapidly advancing, with new technologies and solutions emerging all the time. These innovations are helping to address some of the challenges facing electric mobility.

Solid-State Batteries

Advancements in battery technology are improving the range and reducing the cost of electric vehicles. Solid-state batteries are an emerging technology that offers several advantages over traditional lithium-ion batteries, including faster charging times, higher energy density, and improved safety. Toyota is one company working on developing solid-state batteries for its EVs. Solid-state batteries are also lighter and more compact than lithium-ion batteries, making them ideal for use in electric cars.

Wireless Charging

Wireless charging is another innovation in the industry, allowing EVs to charge without the need for cables or plugs. Several companies, including Qualcomm and WiTricity, are working on developing wireless charging solutions for EVs. Wireless charging can be particularly useful in public charging stations, where the need for cables and plugs can be a hindrance.

Renewable Energy

The use of renewable energy sources for charging EVs is another emerging trend, with solarpowered charging stations becoming more common. Solar-powered charging stations can be particularly useful in remote areas where access to the grid is limited. Additionally, renewable energy sources can help reduce the carbon footprint of charging EVs.

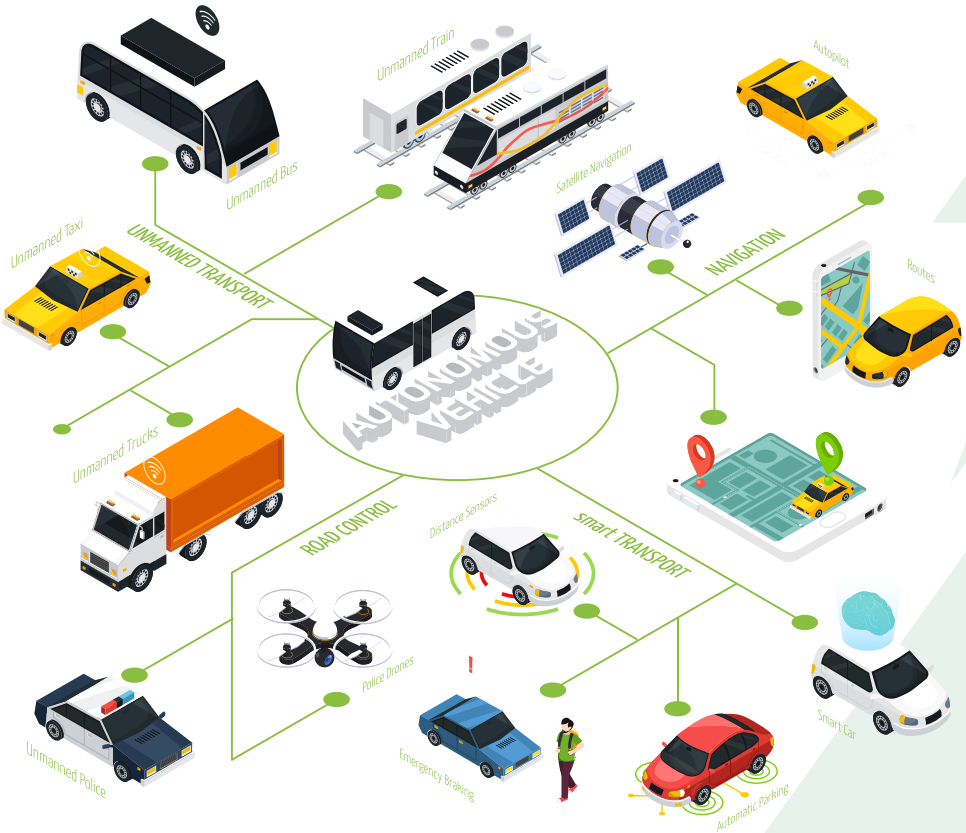
Autonomous Driving

Autonomous driving technology is also becoming more prevalent in the industry, with several automakers, including Tesla and Waymo, developing self-driving EVs. Autonomous driving technology can reduce the need for human drivers and make transportation more efficient. It also has the potential to improve safety on the roads, as autonomous vehicles can make split-second decisions and respond to potential hazards more quickly than human drivers.

Vehicle-to-Grid Technology

Vehicle-to-grid (V2G) technology is another innovation in the electric mobility sector. V2G technology allows EVs to send excess energy back to the grid, helping to balance the supply and demand of electricity. V2G technology can also be used to provide backup power during emergencies, such as power outages.

The electric mobility trend is here to stay. The growth of electric vehicles is being driven by their low operating costs, government policies aimed at reducing carbon emissions, and advancements in battery technology. While there are challenges to be addressed, such as the lack of charging infrastructure, innovations in the electric mobility sector are helping to overcome these obstacles. With the continued development of new technologies and solutions, electric mobility will continue to transform the transportation industry and help reduce our carbon footprint.



Carbon Neutrality Pathway

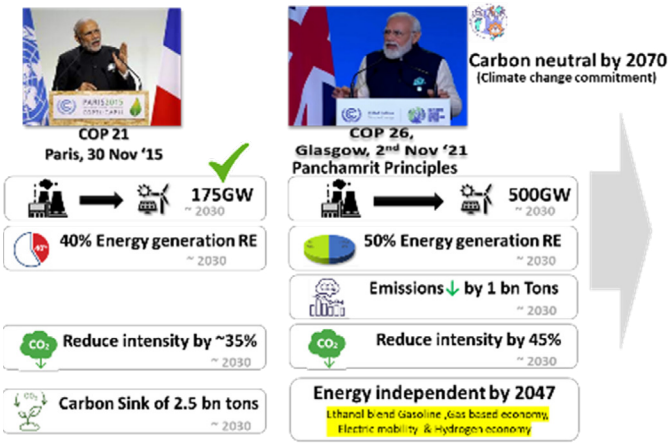
Mr. Sudeep Dalvi
Senior Vice President and Chief Communication Officer - Toyota Kirloskar Motor

Toyota's multiple approaches towards achieving Carbon Neutrality

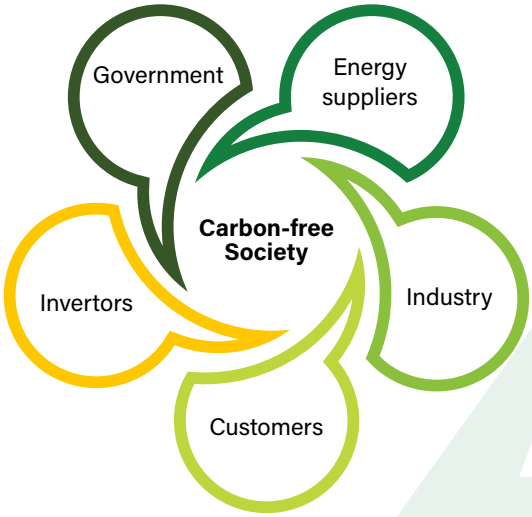
We are witnessing an unprecedented climate change resulting from human activities. The primary cause being the Greenhouse Gases (GHGs), causing major environmental impact. Towards this, globally, strong efforts are being undertaken to minimize the carbon footprints. The Paris agreement has been an important milestone focusing on the reduction of GHGs globally and 'to achieve a balance between anthropogenic emissions by sources and removal by sinks of greenhouse gases, in the second half of this century.' Many countries have come forward and signed the agreement, which is just the beginning of the journey towards Net Zero.

India is the 3rd biggest emitter of GHGs. With the rapidly growing economy, industrialization and urbanization, the per capita emissions are expected to increase in India. Hence, India requires strong, proactive steps towards Net ZERO, and thereby contribute to the reduction of climatic impacts.

In this direction, Hon'ble PM Modi announced the country's commitment towards achieving Carbon Neutrality by 2070. India is taking rapid actions such as use of alternate energy and multiple technological pathways to achieve Net ZERO.

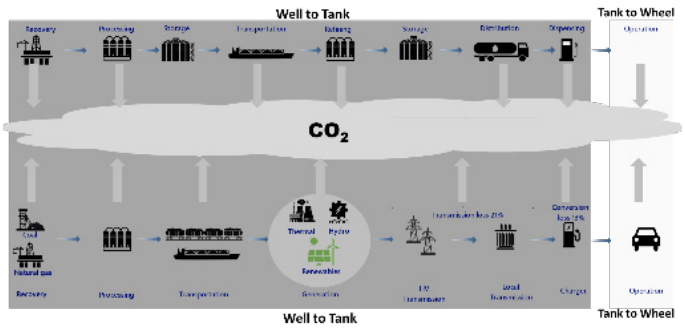


As per a study conducted using the India Energy Security Scenarios (IESS 2.0) model published by NITI Aayog, the data reveals that by 2047, renewable energy will be dominant (at 30%), however petro-products will co-exist. The energy demand for transport sector is estimated to double by 2047. Further, alternate fuels' share would increase, and conventional fuels are expected to co-exist. This clearly demonstrates that Net ZERO is achievable with the usage of alternate energy sources.



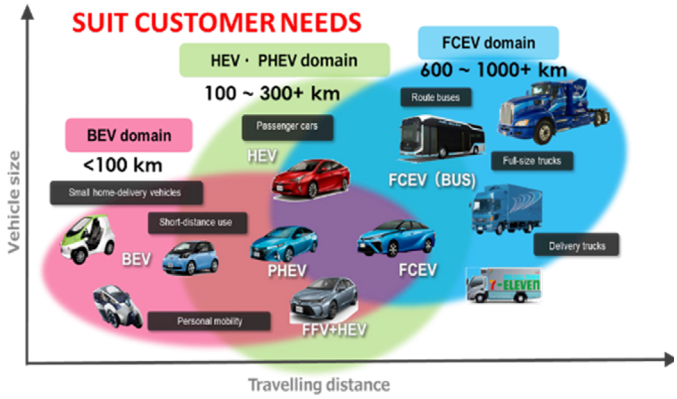
This calls for collaborative efforts, involving all stakeholders – Energy Suppliers, Industry, Investors, Customers, and the Government, equally taking part to achieve carbon neutral goals. Towards becoming energy self-reliant and carbon free society, the Government of India has taken many proactively steps & announced various policies and regulations. This includes various impactful initiatives at both the supply side such as Carbon Trading, Make in India, Green Hydrogen Mission as well as demand creation with FAME 2, setting up of charging infrastructure, conducive state policies for EVs and more. This also widely covers the promotion of alternate transport fuels, thus enabling multiple pathways towards Net ZERO targets. Further, the investors and the energy suppliers have made remarkable progress to set up the entire supply chain for CNG, CBG, thermal energy and hydrogen.

Another notable stakeholder is the industry, working towards bringing in low-carbon emission vehicle technologies such as Strong Hybrid Electric Vehicles (SHEVs), Plug-in Hybrid Electric Vehicles (PHEVs), Battery Electric Vehicles (BEVs), Fuel Cell Electric Vehicles (FCEVs), that continues to effectively contribute to our national goals. Further, a holistic well-to-wheel approach is needed. The entire supply chain emission reduction must be enabled, to achieve Carbon Neutrality.



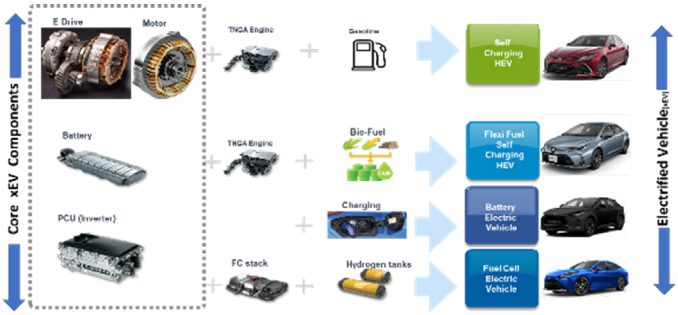
Over the years, Toyota have been working on low carbon-based sustainable mobility. Keeping with the principle of 'Respect for the Planet', Toyota announced the 'Toyota Environmental Challenge 2050' in October 2015, comprising of six environment challenges, including the goal to achieve lifecycle zero carbon (CO_2) emission that goes well beyond zero carbon emissions from new vehicles and manufacturing activities. This reinforces, Toyota's commitment to build a better, smarter, more sustainable future, creating a net positive impact on the planet and society.

Globally, Toyota being a pioneer in electrified vehicle technology (xEVs), has sold a cumulative of 22.5 million EVs, which is equivalent to CO2 emissions reduction of approximately 7.5 million battery EVs. The basic premise of Toyota's thinking way is that the technology adoption should be based on the local energy mix of the country, infrastructure readiness and consumer acceptance. E.g. Norway is highly electrified, BEVs are most suitable, Japan has good potential for hydrogen, hence FCEVs. Brazil is very high in ethanol; hence their vehicle technology is increasingly based on FFV (Flex-fuel Vehicle). The company's focus is to expand the product line-up in a sustainable and phased manner. Toyota Kirloskar Motor recently announced pilot projects with IISc to gather data in Indian conditions and enable them conduct deeper study about life-cycle carbon emissions, well-to-wheel energy efficiency and CO2 emissions of FFV / FFV-SHEV that uses ethanol.



Notably, Technology is just the enabler. To elaborate, a BEV can meet short distance travel or last mile connectivity. But to transport heavier loads, over longer distance, an FCEV is more desirable, whereas a SHEV, PHEV would cater to meet the daily commutes and weekend travels. Toyota has created an array of electrified models, using varied clean technologies and fuels, to match different customer requirements. Toyota in India

Furthermore, Toyota uses common and scalable EV components for all its electrified vehicles, supporting high volumes and thereby achieve cost effectiveness. These affordable products further help to enhance good customer acceptance, thus leading to sustainable growth. With this, we are confident of making orderly transition towards Net ZERO without disruptions.



Toyota believes that adoption of various clean vehicle technologies with sustainable alternate fuels will contribute towards achieving Net ZERO CO_2 on a faster pace. To defeat our common enemy - GHGs conclusively, and to build a carbon neutral society, it is desirable to adopt multiple technological pathways.

Last, but not the least, creating awareness among all the stakeholders about various cleaner vehicle technologies are extremely essential. Toyota has been continuously working with Government, academia, people, etc., to widespread the awareness about carbon neutral based technologies, economic advantages, and their contribution towards the conservation of environment. These efforts continue to enhance the increasing acceptance towards adopting carbon neutral solutions, thus leading to a more sustainable growth perspective.

Article 6

New Energy in Commercial Vehicle

Mr. Gopi Sankar M
VP & Chief Engineer - Ashok Leyland

Abstract

Currently leading the New Energy transformation at Ashok Leyland that includes development of commercial vehicles powered by Natural gas, Hydrogen and Electric. Earlier, as Chief Engineer of the AVTR platform delivered India's first Modular MHCV Platform. Prior to AVTR, had led Ashok Leyland successful foray into light commercial vehicle segment as Chief Engineer of the "Dost" and "Partner" platforms, developed in collaboration with Nissan in India. A senior automobile professional with over 25+ years' experience in New Product Engineering through the entire lifecycle from concept startup to commercial production and customer connect.

Climate change has been a critical issue and automobile industry has been working on the emission roadmap from year 2000. We are now in BS6 whereby there has been significant reduction in emission but with expected increase in vehicle volumes inline with the growth of India GDP, there is a need for alternate fuels – both to meet the net zero target as well as to reduce import bills.

The decade 2020 to 2030 is going to be the decade of transition to new energy for the commercial vehicles. Until 2020, it was primarily diesel driven vehicles with few CNG and EV passenger bus in specific zones. In this decade of transition, we will be having higher percentage of vehicles moving into alternate fuels. Going forward, beyond 2030, we will be seeing a significant lower number of diesel vehicles, restricted to specific applications, while a majority of vehicles would have moved to alternate energy. This transition will have a profound impact in the entire value chain both direct and indirect.

Commercial vehicles have multiple options of alternate energy, broadly classified into Natural Gas, Hydrogen and EV,

The Natural gas options are primarily in the form of Compressed natural gas (CNG) and Liquified Natural Gas (LNG). The CNG version is already on roads in specific regions such as NCR - Currently, about 4,500+ CNG stations are operational and there is a plan to ramp up to 8,000 stations by 2024. This will enable longer distance operations particularly haulage applications. The LNG version is nothing but the same CNG in liquid form. The Vehicles uses cryogenic cylinders to hold the natural gas at sub zero conditions in liquid form. This allows higher amount of fuel to be stored and thereby increasing the range of the vehicle. Reports suggest an expected investment of INR 3L Cr by 2026 for infra development is expected in LNG sector. Currently, 50 LNG stations are under various stages of deployment. LNG, in addition to haulage segments, will also enable utilization in tractor models due to higher range possibilities.

Hydrogen fuel is considered as a clean and renewable source of energy and government has recently unveiled the country's National Hydrogen Mission to create a hydrogen economy in India- INR 20K crore initial outlay for the Green Hydrogen mission and an annual green hydrogen production target of 5 MMT by 2030. In addition, major corporates, have committed significant investment in green hydrogen generation. The global focus for using hydrogen as fuel has been primarily on Fuel Cell vehicle with Hydrogen ICE (Internal combustion engine) Vehicles still being in early stages of development and deployment. However, in India, Hydrogen ICE could make significant impact owning to less complex technology and lower capital cost.

The Hydrogen internal combustion engine is typically modified from traditional combustion engines. The absence of carbon means elimination of main greenhouse gases such as carbon mono oxide CO, carbon di oxide CO_2 and hydrocarbons HC. However, as hydrogen combustion occurs in an atmosphere containing nitrogen and oxygen, marginal nitrous oxide will be emitted. As a result, hydrogen combustion engines are considered as zero carbon vehicles and not Zero emission. One key downside is that hydrogen is difficulty to handle. Due to the very small size of the hydrogen molecule, hydrogen is able to leak through many apparently solid materials in a process called hydrogen embrittlement. Hydrogen accumulation of more than 3% can lead to safety issues such as fire incidents. Obviously, necessary precautions and safety sensors needs to applied for handling hydrogen on the vehicle. Type 4 composite cylinders are used to store hydrogen and the number of cylinders can be varied based on the range requirements.

Fuel cells are electrochemical devices that convert chemical energy of hydrogen into electrical energy directly, promising power generation with high efficiency and low environmental impact. Typically, On the anode side, hydrogen gas diffuses and dissociates into protons and electrons. The protons are conducted through the proto exchange membrane to the cathode while the electrons are forced to travel in an external circuit. On the cathode, oxygen molecules react with hydrogen protons to form water. Fuel cells are typically twice as efficient as hydrogen ICE in terms of energy conversion but also needs very high quality of hydrogen. As the output of the fuel cell is electric power, the rest of the drive train is similar to an Electric vehicle – the battery capacity can be significantly reduced as fuel cell can provide continuous power. Fuel cell vehicle also solves the key issue of charging time as hydrogen can be refilled significantly faster.

Electric vehicle in commercial vehicle is a direct extension of passenger cars. Typically, you have different battery capacities, multiple motor capacities and power electronics – that needs to be carefully specified and integrated for an optimum vehicle performance and cost. EV commercial vehicle will meet specific applications such as short range-continuous operations. The other benefit of EV drive train is the high torque availability which may help higher depth mining applications. The charging time will be a point of concern that may have to be taken care with super fast chargers to avoid trip loses.

The vehicle architecture is expected to be upgraded significantly to accommodate various fuel systems. Ashok Leyland had launched an innovative modular platform – AVTR – during BS6 migration. Modularity in simple terms is equivalent of creating lego blocks in the vehicles - this allows parts interchangeability and vehicle variants more closer to customer requirements. In AVTR, many industry-first vehicle configurations such as single tyre lift axles in 6x2, dual tyre lift axles in 8x2 and many more could be quickly launched due to the advantage of Modularity. Ashok Leyland alternate fuel vehicle will be based on this innovative platform to gain the advantage of multiple configurations.

The design of alternate energy commercial vehicles is also having certain key challenges. They can be grouped in four major areas: Safety, Thermal, Efficiency and Application. Safety is a key aspect that needs lot more precautions and safety systems across the operating chain. Necessary technologies are available for both in vehicles such as hydrogen leak sensors etc as well as external such as ADAS. With the advent of hydrogen and battery, thermal is also a critical challenge that needs attention. This may need innovation in thermal conductive as well as insulator materials. Efficiency will be critical and can be the USP, if designed properly. Multiple regen technologies may need to be evaluated and deployed based on the operating conditions. Finally, application has to be selected such that the TCO is positive to customer. Recent study indicates that in certain specific applications, battery vehicles are faring better than diesel even at current cost structures.

While design and development are one part of the puzzle, there are many other parameters that are also needed to ensure a successful migration to alternate energy. The most important parameter is the availability of Energy infrastructure. The second critical could be the Finance and business models for high capex-low opex vehicles. This may include insurance and resale as well. Last but not the least is the GOI support to encourage faster migration in terms of zero emission zones, incentives and subsidies.

The Commercial vehicle industry is now at the start of the transition – but has several exciting options of different alternate energies. We will be in for significant changes in the entire industry eco chain – and will bring in lot of new business models. Just like the basic telephones which exploded into different mobile forms, commercial vehicle industry is set to take various shapes and utility – don't be surprised if in future people vacate their home and buy an EV bus to live! Ashok Leyland with the double decker EV bus can provide Duplex house options as well!!

04

Electric Vehicle – Manufacturing, Technology & Battery Management System (BMS)

Article 7

The future of Manufacturing Industry in the EV era

Mr. T. R. Parasuraman
Executive Advisor - Toyota Group

Mr. T R Parasuraman, BCIC Past President and Executive Advisor – Toyota Group, Toyota Kirloskar Motor Pvt. Ltd, while delivering at the EV Summit spoke on the future of manufacturing - a new era punched with advancements in technology, and the path ahead.

He mentioned that for a country like India, progressing rapidly with strategic steps in this golden era of "Amrith Kaal", propelled by the Hon'ble Prime Minister of India Shri. Narendra Modi ji, many laudable things are happening. He said India is going to be a knowledge power and a great economy in the world in the coming decade.

The contribution of manufacturing to GDP is at 17% now. Whereas, as a comparison to Europe, Japan or China, their manufacturing contribution is upto 25% of GDP. In India, the contribution of Services Sector is 60% today to GDP. Therefore, in the years ahead, the manufacturing sector is likely to leapfrog upto 30-35% of the GDP. With India enjoying a young population, adorned with well known educational institutions, the Indian youth today is more energetic and forthcoming on adopting new technologies, and focussed on tapping new avenues in manufacturing sector. India not only has a large market in itself, but also poses to be the destination as the factory of the world.

We all know $ 1.2 Trillion is pumped into capex and infrastructure spend. The recent Central Govt. budget had an outlay of about Rs. 13 Lakh Crores. There are vast improvements in connectivity – be it road, rail, ports or airports, easing of doing business, setting up of Plug & Play industrial parks and multi modal logistics parks, the PLI Schemes, all this and more are going to drive manufacturing in a large way. All the schemes of the past too have aided manufacturing and helped in nation's growth.

The Automobile sector in particular is likely to have radical changes – be it EV, Hybrid, flexi fuel, hydrogen fuel cell and emerging technology agnostic solutions will take over. It is estimated that by 2030, India will produce 10 Million Passenger Vehicles. EVs can grow at a pace of 47% CAGR. Therefore, in the next 20 years, there is a noticeable demand for advanced technologies with lesser emissions, lesser vibrations in vehicle and better fuel efficiency.

India is well equipped to take up this imposing challenge. As we know, the jump from Euro 4 to Euro 6 for automobiles was done in a single shot. CAFÉ 2 is advancing to CAFÉ 3. The Govt. is also trying its best to reduce emissions.

There are 16 factors which will influence the growth of technology and manufacturing across the globe.

Sustainability. This is key and foremost. The Covid-19 pandemic has thought us a lot on this.

Internet of Things (IoT) is changing the world with breakthroughs in innovations.

Artificial Intelligence (AI) is helping the change. Today, ChatGPT is well integrated. Large Information is available by a touch of a button. The human brain has always been agile. Even with all the recent advancements in technology, it constitutes only 0.01% of the capacity of brain. There is so much in AI. Human brain in itself cannot be substituted at any point in time. You have heard about Sophia, a humanoid robot which helps in R & D and in Operations.

Cyber Security is gaining importance in protecting the information of the organisation. Lots of research is happening in strengthening Cyber Security. This will help in turn manufacturing.

Genomics is going to become the next growth engine. I understand that this is a $ 400 billion dollars industry. With research, the average age of a human can get enhanced beyond 80 years. Many of the discoveries will support manufacturing.

Drones are getting substituted with Amazon messengers. Food deliveries/ Courier services, military services, agro services are all done by drone today. This will only scale upwards.

Robos are running the factories and warehouses. Robos will take charge in production centres. There is a great demand for quality at source.

Digitally connected factories will drive new technologies – predictive maintenance, condition monitoring, spares are prepared and available based on data available.

Nano Technologies is fast growing. New material science and composites will be explored to aid manufacturing.

Renewable Energy is another game changer for sustainability. Wind, Solar, and Geothermal possibilities are huge. Today, we are still a 80% fossil dependent economy.

VR – Virtual Reality through hallograms, simulations in factories, safety training in factories will further boost manufacturing.

Shared Services is the order of the day. We are moving towards availing shared services in every gamet of today's life like commutation, travel & tourism, repair and maintenance, food purchase, fintech etc.,

E-Learning is going to change the face of the world – Covid 19 pandemic has seen the world transiting towards E-Learning. We can connect seamlessly with each other as a global village.

Data Analytics – Big data is churning data and throwing various decision aiding reports in no time. This will help manufacturing.

3D printing is mind blogging – This is going to be a game changer. This will drive mass production with lesser time and better quality. 3D printing can be compounded with normal manufacturing. Human organs, dentistry can be printed.

Circular manufacturing, coupled with Sustainability as core, will further enhance recycling, reusing and reducing of scarce natural resources.

Therefore, to sum up, the manufacturing sector in the EV era must operate and be hands-on with the overarching new methods, processes and systems in manufacturing techniques. The Industry must adopt to suit customer expectations. We have to live with the changing times and be ever vigilant all around than before to gear up to the challenges that lay ahead.

Article 8

Top Digital Engineering trend in Electric Vehicle - Design for Immersive Experience

Mr. Rabindra Sah
Chief Engineer - Strategic Projects, Global Practice - Automotive & Industrial Heavy Machinery - Tata Technologies

Digital Engineering technology trend for design and development of Electric Vehicle is primarily presented below in two major areas to explain for an Immersive Experience:

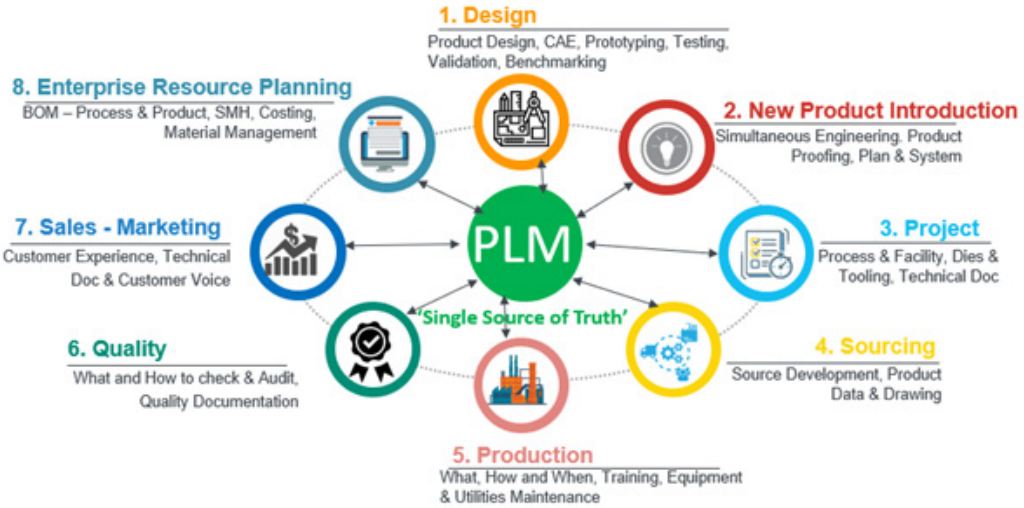
A. Technology for Product Design

B. Top Digital Engineering for Immersive Experience

A. Technology for Product Design: -

a. Adoption of Product Lifecyle Management (PLM) solution:

- Product lifecycle management (PLM) is process of managing the various stages of lifecycle of a product from its concept to design and manufacture, to sales, service and its disposal. It integrates engineering product data, processes, resources and business systems.
- PLM data could be graphic and non-graphic data. PLM is applicable across the industries and across the enterprises- small, medium & large. It is backbone of the companies and referred as "Single Source of Truth". It provides advantages in faster time to market across all prime 3 -Technology Driving green Automotive domain - Battery Electric Vehicle, Hydrogen Fuel Cell and Hydrogen Powered IC Engine. OEMs, Suppliers and startup to use PLM for their transformational journey
- Below diagram shows an integrated approach of PLM across all agencies



b. Software OEM Provides Integrated and Collaborative Platform based Experience

- Earlier we had point software & modules for various domains like design, CAE, Manufacturing', PLM and levers of Industry 4.0. It was about Silos way of working. Also, we were using many third-party tools & plugins for data exchange which resulted into disconnect in data continuity and Data loss.
- Therefore, way forward is the aadoption of Integrated, Collaborative and Platform based engineering software Solution instead of Point based Software solution. It provides single Version of Truth, Faster Time to Market and saving of Time & cost
- Additionally, its platform for collaboration with internal agencies and partners. It also offers Project Management to track, monitor, control, Dash boarding and so on. One can subscribe roles and app as per requirement. User can pay and use. It is available with option of on-cloud and premises.

c. Digital Engineering Technologies

- Various software OEMs provide engineering software which meets all stages of product Lifecyle stages of product development.

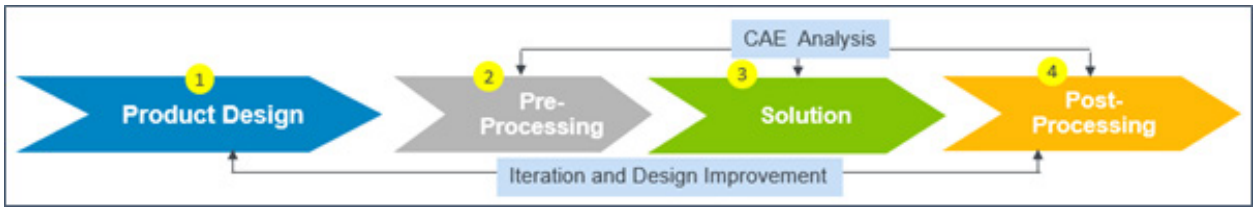
- It includes Product Life Cycle Management-PLM, Product Design-CAD, Product Validation-CAE, Digital Manufacturing, Metal Flow Simulation, Smart Manufacturing, AR-VR-Visualization and more. Faster time to market of product is achieved by adoption of these technology by OEMS and suppliers.

d. Foundation for Transformational Journey:

- It is important to set up workflow to ensure that Digital Approval is made mandatory before any Physical work to initiate in product development stages.
- To maximize the benefit of digital Transformational, users need to adoption digitalization of Product and Manufacturing Eco-systems

e. CAE led Product Design on Single Platform

- For faster and quick designing of the product, Designer to carry out concept level CAE analysis by themselves. It provides faster and better design. Once final design is carried by designer, then detailed CAE analysis can be carried by CAE Analyst. Based on CAE Analyst findings, designer can perform design changes and improvement but whole process gets speed up.
- So, there will be two stages of CAE led Product Design Process on a Single Platform:
  - Stage-I: Concept Analysis be Designer
  - Stage-II: Detailed Analysis by CAE Analyst



f. System Engineering

- System Engineering is RFLP (Requirement, Functional, Logic, Physical) based Interdisciplinary approach on V-Cycle framework. It facilitates cross discipline collaboration between customers, different engineering departments, partners and suppliers, providing a common view to all.
- It focuses on defining the customer needs and required functionalities early in the development cycle, documenting the requirements, preceding with the design synthesis and validating the system while considering the complete problem.
- In this, results include systems level qualities, properties, characteristics, functions, behaviours and performance which ensures final product meets the customer requirements in a cost-effective, timely and quality efficient way
- System Engineering is being highly adopted in automotive with V-Cycle framework

B.Top Digital Engineering for Immersive Experience

a. Metaverse / Gamification:

- Technology of Game engine platform is being used by OEMS for engineering applications of automotive. Major areas of applications are Augmented Reality (AR) and Virtual reality (VR), Collaborative Design Review and visualisation, Autonomous Vehicle, ADAS, Metaverse, Virtual Production, Sales and Marketing, Human Machine Interface (HMI) and so on. Augmented Reality (AR) and Virtual reality (VR) is penetrating heavily in design. Manufacturing, Training, Maintenance and sales marketing.

b. Design Thinking

OEMs & Tiers are heavily focusing and using framework of Design Thinking to innovate and improve their product & process. It is helping to get into problem statement to come up with unique solution to solve problem. Design Thinking framework has provided systematic methodology to the Startup community to become global leading automotive OEMs.

c. Collaboration & Partnership

- It becomes difficult and challenge by OEMs to get involved in design and development of each and every part of vehicle. Therefore, there is global trend for collaboration and partnership by OEMs. OEMs collaborates with start-ups and others to get solution developed. OEM reserves fund for partners to solve problem. It speeds up success journey and product development
- Automotive OEMs strongly adopt Scrum Framework in the product development cycle. It is an empirical process against the waterfall approach which is a defined process. It deals efficiently with the changing situations. Work gets split into iterations. Flexible to priority changes due to the situation.

d. ADAS-AV

- There are large number of accidents happening worldwide due to Human driving a vehicle due to Human error considering perception, performance, vehicle and environment situations.
- Auto OEMs, Startup, Software OEMs, Hardware OEMs and Engineering service providers are working to develop autonomous vehicle and Advanced Driving Assistance Systems. Globally technology is being developed and tested to make vehicle driving safe, accident free and enjoyable experience. Vehicle developed happens on SAE defined level.
- Advanced Driving Assistance Systems like Lane Departure Warning, Blind Spot Warning, Parking Assistance, Automatic Lane Change and more are being developed and provided in the vehicle.
- Combination of software from engineering, game engine and hardware are being used to develop AV and ADAS functionalities.
- Primarily there are following three standard for Automotive embedded system, safety & Security These are being adopted in the lifecycle of design, development and update on vehicle by OEMs for their autonomous and ADAS journey:
  - ISO 26262 – Functional Safety
  - ISO/PAS 21448 – Safety of the Intended functionality (SOTIF)
  - ISO/SAE DIS 21434 – Cybersecurity Engineering

e. Design for Circular Economy:

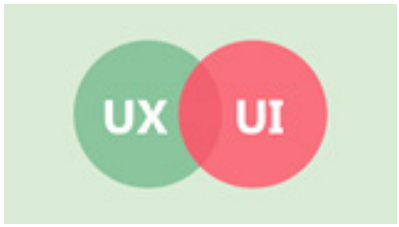
- OEMs and suppliers are working on to switch from linear economy to circular economy. They are going from 'Cradle to Grave to 'Cradle to Cradle' business model. Ecosystem is being developed to design product with recycled and reuse material to reduce wastage.
- Various levers of Fourth Industry revolution are being used to support net zero carbon emissions for a sustainable Circular Economy. It is primary focusing in three major areas - Product Manufacturing Operations and Supply Chain.

f. HMI & Digital Cockpit:

- Every OEMs are working with their partner to create unique Human Machine Interface, infotainment systems and interior to provide their customers enhanced and better immersive experience. It leads to creativity, innovation and value proposition. HMI & Digital Cockpit experience is the one of the prime factors for users to decide purchasing of vehicle.
- Combination of software from engineering, game engine and hardware are being used to develop HMI & Digital Cockpit functionality.

g. CAR as a Companion:

- Nowadays car is being considered as second living room. Prime considerations for designers are how immersive experience can be created considering more Space, Spatial Audio, ergonomics of Seats, Infotainment systems, Comfort, Safety and new Features,
- User Experience (UX) and User Interface (UI) skill set is being highly used to create a better product and better experience for users. It leads to high demand of User Experience experts. US & UI provides an engaging user with product & eco-system for new level of experience.



h. OEM Develops Community

- OEM focuses on their User Community Development to build Brand. OEM takes various initiative to engage their users and involves them in their success journey. OEM sets up Users Advisory Board involving users. In Users Advisory Board, OEMs invite suggestion & ideas from users for improvement of product. It creates sense of belonginess to the users with OEMs.
- OEM invests to create clubs for their users. They organise regular events where users participate. OEMs provides budget to their users for corporate social responsibility (CSR). In this, users take active part to use budget in doing social work. It makes users to be proud owner of vehicle. Once user become owner of OEMs vehicle, they remain loyal users for life time.

i. Features of PV in CV

- **Global trend is to create new business opportunity in Commercial sector. Global OEMs are targeting to use various features of Passenger Vehicle and implementing in Commercial Vehicle. These features and offerings are in Safety, Human Machine Interface (HMI), infotainment system, enhanced digital cockpit and better User Experience features.**

j. Subscription Based Business Model

- A new business model has come up in automotive. It is being termed as "Flexibility is the new Premium". Car can be subscribed. Buy or rent vehicle as you need. Options are being provided with flexible rate and duration. Options are flexible to meet user's budget. User can decide vehicle as they need. Even users can switch cars as much time as one need.

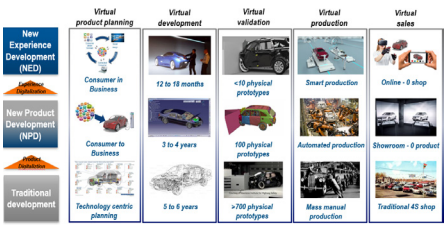
Comprehensive Electric Vehicle Development by EV Startups & addressing their Business Needs

Mr. V Karthikeyan
Chief Technology Officer -
EDS Technologies

Mr. Srikumar Maganti
General Manager – Technical
EDS Technologies

EV has been a buzz word in India and across the Globe for last 7to 8 years. More than 480 EV Startups have started their business operations in India with an aspiration to meet the demands of 2W/3W/4W segments and to develop and establish their market share. **Faster time to market** with Cost effective and Quality vehicles on road has gained the paramount importance for all the EV players. India as a nation is fast catching with the likes of China, Norway, Sweden and America in the EV revolution.

EV Startups need to **Start Small, Think Big** and **Grow faster** with their sustainable innovations meeting the local and global demands. In this scenario, EV startups have to adopt **digital strategy** taking support from Virtual Design, development, Validations in a **PLM framework, Systems Engineering** and Virtual Showrooms.



Digital Strategy includes delivering a digital vision, developing performance-driven prototype and achieving collaborative development.

Delivering a Digital Vision:

Some of those business challenges include defining vehicle packaging with over constrained systems, developing aesthetic vision of the product in a short time and ensuring innovative vision introduction with less cost.

Exploring concepts & alternative design studies with limited resources, delivering quickly Class A surfaces for perceived quality review and manufacturing and innovating in consumer content by using integrated high realistic rendering and VR reviews.

Performance Driven Prototype:

Some of those business challenges include small Engineering teams, improving quality and avoiding issues late in the process, defining architecture to reduce risk of warranty and recall and delivering better performance.

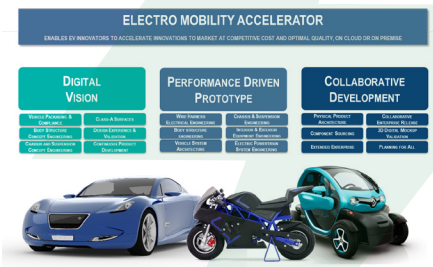
Mastering architecture complexity of multi-domains like mechanical, electrical, electronic and hydraulic systems through Systems Engineering definition, Creating digital mockup of electrical wiring harness with End-to-End environment from schematics through 3D design up to manufacturing preparation and **Performing virtual Simulations** on Cell Engineering for predicting electro-magnetic performance, thermal runaway behavior, cooling behavior , ageing behavior and validating the structural integrity of battery system.

Achieving Collaborative Development:

Some of those business challenges include Control release and change while keeping speed and flexibility, finding the right component at most affordable price from suppliers, visualize and take action on 3D Directly and govern the multiple projects efficiently

Invisible governance with no loss of productivity, 3D Based collaboration understood by all stake holders, delivering projects on time and on budget and suppliers management online through extended access.

Dassault Systemes Solutions for comprehensive Electric vehicle development



In summary, EV Startups would benefit immensely from adoption of digital strategy and thus deliver sustainable innovations.

Article 10

Into the Future of Electric Mobility

Mr. Prashanth Doreswamy
President and CEO - Continental India

The E-mobility Transformation

In the European Union, achieving the accelerated scenario of around 75 percent EV sales by 2030 will have implications for the entire EV value chain and ecosystem. In parallel, the industry must decarbonize the full lifecycle of vehicles to get closer to a net-zero target. Incumbent automotive suppliers need to shift production from ICE to EV components. Europe will have to build an estimated 24 new battery giga-factories to supply local passenger EV battery demand. With more than 70 million EVs on the road by 2030, the industry will need to install large numbers of public chargers and provide maintenance operations for them. Renewable electricity production needs to increase by 5 percent to meet EV charging demand. Finally, emissions from BEV production must decline, since BEVs currently have 80 percent higher emissions in production than ICE vehicles

Major Shift in Components & Technology

The transformation of the automotive industry toward electrification will disrupt the entire supply chain and create a significant shift in market size for automotive components. Critical components for electrification such as batteries and electric drives and for autonomous driving like LiDAR sensors and radar sensors will likely make up about 52 percent of the total market size by 2030. Components only used in ICE vehicles such as conventional transmissions, engines, and fuel injection systems would see a significant decline to around 11 percent by 2030—about half the size of 2019 levels. Such a drastic shift will force traditional component players to adapt quickly to offset decreasing revenue streams.

The scale of disruption will be significant: according to the Institute for Economic Research (Ifo) in Munich, more than 100,000 jobs will change in the German automotive industry by 2030. That is roughly five to ten times the scale of jobs compared with the phaseout of coal power that Germany announced for 2038

With electric mobility, Suppliers are taking the next big step on the road to becoming a software-oriented mobility provider. After all, electric cars are increasingly setting themselves apart through their digital capabilities for motorists. The first high-performance computer in volume production worldwide, the so-called body high-performance computer (HPC), is a key part of the transition to an integrated and centralized vehicle architecture for connected and increasingly automated driving. The principle: instead of distributing vehicle intelligence between up to 100 electronic control units, it is bundled into a few high-performance, intelligent central computers on board. These constitute the decisive data hub and connection point between the vehicle and the digital world and make the vehicle part of the Internet of Things (IoT). This also opens the door to third-party apps and cloud services and supports hardware-independent software integration. However, electric cars are susceptible to extreme temperatures that can cause unexpected malfunctions and lead to high costs if the battery needs to be completely replaced.

For greater range, fast charging and a longer battery life, a sophisticated thermal management system with several cooling circuits is therefore indispensable

The Million Dollar Question: How to Make EVs Profitable?

Ford's quarterly investment call - The second generation of Ford's EVs will be "radically simplified," with only three body styles a handful of orderable combinations that could garner up to 1 million units each in sales, but with a smaller bill of materials and lower manufacturing costs. Ford went through a learning process in designing its first cycle of EVs — the Ford E-Transit, F-150 Lightning, and Mustang Mach-E. "We didn't know that our wiring harness for Mach-E was 1.6 kilometers longer than it needed to be," "We didn't know it's 70 lbs. heavier and that's worth $300 (more) a battery. We didn't know that we underinvested in braking technology to save on the battery size. … We didn't know that we needed the world's best aerodynamics to get the size of the battery smaller." These issues are being addressed in the second cycle, which according to Lawler will allow Ford to meet its more immediate and modest goal on EVs of 8% EBIT (a different calculation than gross profit).

05

Electric Vehicle – Skill, Testing and Infrastructure

Article 10

Skill development initiatives for EV segment

Mr. Bala Phani Kumar
Director Skill Development - Brigade BCIC Skill Development Academy

India is a country with a population of over 1.3 billion people, making it the second-most populous country in the world. With most of the population under the age of 35, India has the potential to become a global powerhouse if its citizens are skilled and equipped with the necessary tools to contribute to the economy. An educated and skilled population is essential for creating, sharing, and using knowledge, which is crucial for the progress of societies and economies.

The education and skilling system should focus on practical and application-based learning to better prepare students for the workforce. The government and CSR institutions should create a pro-innovation environment and individuals and organizations should invest in developing skills in areas like IT, healthcare, renewable energy, and manufacturing to improve employment opportunities.

A recent Confederation of Indian Industry (CII) in a report stated that "the Indian economy has the potential to grow from the current $3 trillion to $9 trillion and to $40 trillion by 2030 and 2047, respectively. But this is possible only if the working age population is productively employed."

Skill India Mission

This brings us to the relevant topic of how skilled are our youth? With a mission to empower the Indian youth, especially the youth of Rural India, Skill India was launched by several state governments. This is an initiative to train and upskill over 40 crore Indian youth, both men and women, in different industry related jobs. The objective behind this is to create an empowered workforce with the help of various education schemes and training courses. Government of India has allocated INR 1500 crore towards upskilling and reskilling programs and educational curriculum that will benefit the youth of rural India, who today make up 68% of India's population and are in need of better vocation and employment opportunities.

Rural Youth Development

According to the National Sample Survey Office (NSS0), the unemployment rate among rural male and female youth stood at 17.4% and 13.6% respectively in 2020. These numbers indicate that regular jobs with additional benefits are hard to come by for rural youth. It is these issues that have given birth to the Skill India Mission program. The primary motive of this program is to help the youth focus on their work and enhance their technical expertise.

Once these youngsters are adequately educated, they will get their desired jobs. And that is possible only by skill development and training, which is the solution to this problem. The initiative undertaken by the Government will empower the rural men and women with knowledge, skills and capabilities that will allow them opportunities to better themselves and support their families.

Skilling in EV segment

"The electric vehicle industry is predicted to employ a significant number of people over the next 7 to 8 years. One milestone we are looking forward to is 2030, by when we are likely to have a huge number of trained people for electric automobiles... If we are able to develop a robust talent supply chain for the EV industry, we would be able to become the largest supplier of skilled workforce for this industry in the world," said Mr. Arindam Lahiri, CEO, of Automotive Skills Development Council (ASDC).

Upskilling and reskilling for the EV industry

"Upskilling and reskilling will be crucial for the electric vehicle (EV) industry. Industries are making initial efforts primarily focused on upskilling rather than skilling new people, where there is a need to interact with numerous academic institutions, colleges, and polytechnics. There is a need to develop or upgrade the curriculum in this sector.

Although the automotive sector has a sizable pool of talent, this personnel lack in talent relevant to the EV segment. For example, Mechatronics the technology that combines Mechanical and Electronic engineering is now finding takers. This segment is very critical for the EV market.

On the other hand, courses offered today by various players include Automotive Skills Development Council (ASDC) has launched its Electric Mobility Nano Degree program in association with DIYguru –an online learning platform for Engineers across India. MG Motor has partnered with ASDC and Autobot India to launch Dakhsta – training program specializing in Artificial Intelligence.

Conclusion

Industry and academia have to often meet in preparing this sector for achieving the ESG targets of 2030 and also to position EV Segment in the market, especially in the Human capital development space.

Lot of capacity building activities need to be planned at the school level so as to create interest among youth to take up courses in AI, Mechatronics etc and indirectly populating the EV concept among Indian customers so as to increase the momentum I in customer preference to EV segment.

Industries, Industry bodies need to make a hard pitch with Government of India for funding options to EV Skilling initiatives similar to that being offered to Solar and Renewable energy courses.

Article 11

Evolution and Impact of EVs

Mr. Ravikiran Annaswamy
CEO and Co-Founder -
Numocity Technologies

Electric Vehicles (EVs) are revolutionizing the automotive industry, and their adoption is rapidly increasing worldwide. The EV market is witnessing different perspectives from various stakeholders - from the government's viewpoint of reducing carbon emissions to the customer's perspective of reducing fuel costs. In this article, we will explore EV trends from different stakeholders' perspectives, the reasons behind the adoption of EVs, the value chain for the ecosystem, EV charging station adoption, and how it affects the environment and supports sustainability.

The history of electric vehicles can be traced back to the 1830s when Scottish inventor Robert Anderson invented the first crude electric carriage. Over time, EVs have gone through several technological advancements, but their adoption remained low due to several challenges, including high costs and limited range. However, in recent years, the global shift towards sustainable transportation has significantly increased the adoption of EVs.

From the government's perspective, the primary reason behind promoting EVs is to reduce carbon emissions and achieve climate goals. For the same reason they are encouraging incentives, subsidies, and tax benefits to promote the adoption of EVs. The automotive industry sees EVs as an opportunity to tap into a new market and offer eco-friendly vehicles. Customers see EVs as an opportunity to reduce their fuel costs, environmental impact, and benefit from the latest technology.

Starts at home

At work

At Parking

Wherever you are

At Public places

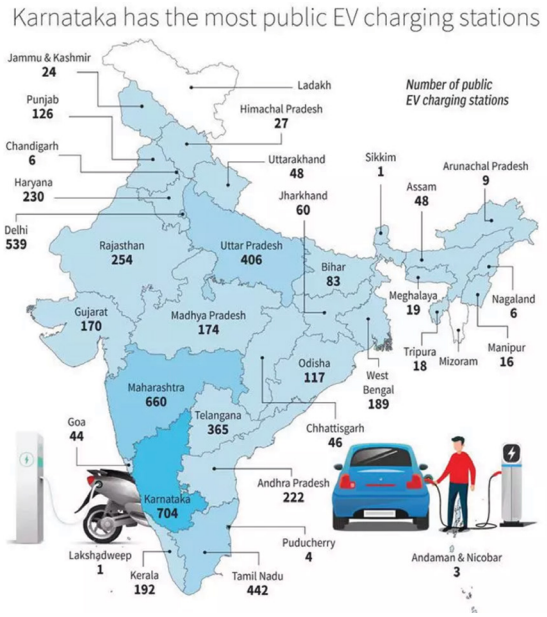
At Highways

At Transport Hubs

Electric vehicles have several benefits over traditional gasoline-powered vehicles. They are environmentally friendly, emit zero emissions, and require less maintenance. Additionally, EVs offer smooth and quiet rides, better acceleration, and lower fuel costs. The EV market comprises different segments, including two-wheelers, three-wheelers, and four-wheelers. Currently, two-wheelers and three-wheelers dominate the EV market due to their affordability and utility. One of the significant challenges in EV adoption is charging infrastructure.

However, with the increase in EV adoption, charging infrastructure is expanding rapidly. Soon, EV charging stations will become a future fuel station in apartments, hotels, workplaces, highways, and everywhere. EV charging stations are becoming ubiquitous in urban areas, and governments are setting up charging infrastructure to support EV adoption.

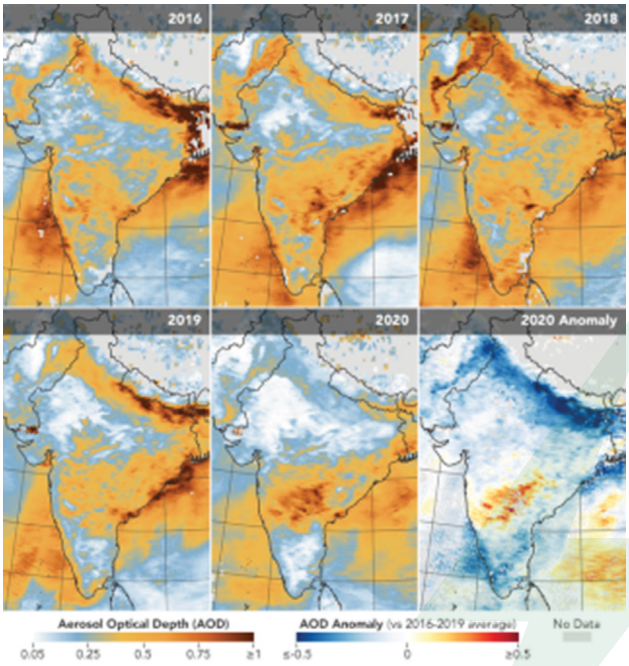
At present, there are 6,586 charging stations across the country catering to a total of 20.65 lakh EVs*. The government of India has set an ambitious target of 30% EV adoption by 2030. To support this goal, the government has announced several incentives, including a reduction in GST, a waiver of road tax, and direct subsidies for EV buyers. Additionally, the government is promoting the installation of EV charging stations by offering subsidies to the charging infrastructure providers.



The EV ecosystem has several components, including the source of energy, energy transactions, and consumption. The source of energy for EVs is the electric grid, which is powered by renewable and non-renewable sources. Energy transactions involve charging infrastructure and batteries. EV batteries are becoming more advanced, and new technologies are emerging, such as solid-state batteries, which offer higher energy density and longer range. One of the significant challenges in the EV business is flat charging. EV charging requires a high amount of power, which can overload the grid. To address this, load management techniques are used to optimize the charging process. Additionally, the shape and size of the charger are a challenge. With several charging standards, charging infrastructure providers must cater to multiple charging standards. Ubiquitous charging is also a challenge, and the charging infrastructure must be expanded to support EV adoption.

Electric vehicles (EVs) are becoming increasingly popular as more people become environmentally conscious. One of the most significant advantages of EVs is their positive impact on the environment and how they support sustainability.

The COVID-19 pandemic brought about a reduction in travel and a shift to remote work. As a result, there has been a significant drop in emissions, leading to improved air quality. During the lockdown, NASA satellites detected the lowest aerosol levels in 20 years over northern India. This reduction in pollution has highlighted the importance of adopting more sustainable modes of transportation, such as EVs. They emit zero emissions, making them a cleaner and greener option than traditional gasoline-powered vehicles. According to a study by the International Energy Agency, the global EV fleet's carbon emissions could be reduced by up to 1.5 billion tons by 2030. Additionally, EVs can significantly reduce air pollution in urban areas where transportation is a significant contributor to pollution.



Conclusion:

EV adoption can have a positive impact on reducing particulate matter emissions by up to 70%, according to a study conducted by the National Renewable Energy Laboratory.
Moreover, as the EV charging infrastructure continues to grow, the adoption of EVs is expected to increase, leading to a cleaner, more sustainable future.

Source:

https://auto.hindustantimes.com/auto/electric-vehicles/7432-ev-fast-charging-stations-to-be-set-up-india-centre-sanctions-rs-800-cr-41680068831408.html#:~:text=The%20installation%20is%20expected%20to,charging%20stations%20across%20the%20country.

https://earthobservatory.nasa.gov/images/146596/airborne-particle-levels-plummet-in-northern-india

Developing an Electric Vehicle Validation and Product Strategy Grounds Up

Mr. Sivakumar Balakrishnan
Vice President - Product Quality and Validation - AtherEnergy

Abstract:

Electric Vehicles (EVs) are different from Internal Combustion Engines (ICE) vehicles in the way importance is equally given to mechanical, hardware, software and connectivity in case of EVs. Also, EVs also handle lots of data true to their being smart, connected vehicles. Further, unlike ICE vehicle development, which can take a basis from enormous field data, there is no baseline available for EV vehicles. These architectural dis-similarities with ICE necessitates a fundamental approach to EV validation and grounds up recreation of testing platforms and standards.

This write up addresses developing an EV vehicle validation strategy with a few examples:

Motor vehicles have been in existence for more than a century now, with internal combustion engines dominating most of that period, which has matured a lot in the last couple of decades. There is enough knowhow available on the testing and validation of these Internal Combustion Engines (ICE) vehicles. However, this is not the case with Electric Vehicles (EV) for the following reasons: 1) EVs have an equal distribution of mechanical, electronic, software, and cloud connectivity content in them. This is very different from ICE vehicles, which are mostly mechanical in nature. 2) EVs lack a baseline as there are no benchmarks available which can be referred to. This means that all the test standards have to be developed from scratch for an EV and that too without a correlation with existing field data.

The first step in validating an EV is to set a target as a product is often validated against a predetermined target. While the target setting happens across different attributes (like performance, vehicle dynamics etc.), Figure 1, explains the approach adopted for reliability target setting. The target depends on factors like carry forward content, impact of change in the new program, the overall development plan and the risk mitigation plan. Once a target is set, it is important to identify the focus areas for development and validation (High risk components) and that is achieved through an attention matrix. It is a 2x2 matrix of application vs. design and the highest focus area for the company has to be a component, which has both a new application and a new design.

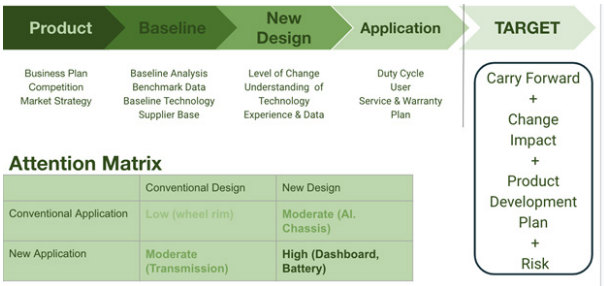


Figure 1. Reliability target setting approach

The next step is to arrive at a process & methodology of validation. The validation of a product typically happens as per the flow given in Figure 2. While the specifications flow down, the validation flows up. Product specifications are broken down from a vehicle level to a component level, while validation begins at the component level and gradually progresses to the vehicle level. A few of the benefits of testing at the component level is the ability to accelerate testing to a very high degree and mix various environmental and noise conditions to produce the desired outcome. For instance, the vehicle acceleration performance is broken down into a motor and controller specification, which in turn gets validated first, well before the vehicle is validated.

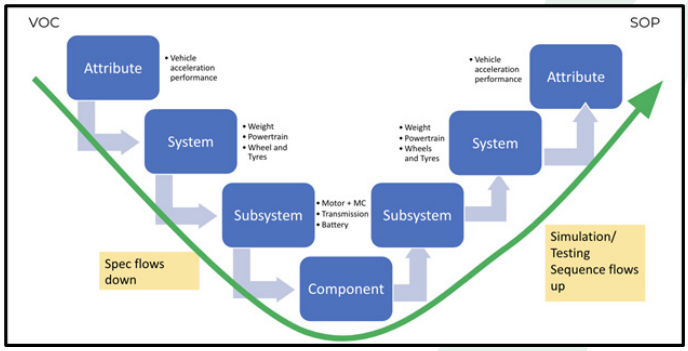


Figure 2. Specifications vs. Validation flow

An example of the integration challenges faced during EV development can be understood from the mix of hardware, software, mechanical and cloud connectivity in the vehicle. Hardware components become obsolete quickly due to rapid technological changes as compared to mechanical components. As a result of this, the new components that replace them should work in the same manner within the interaction framework and unless the component validation is robust, it is impossible to achieve similar performance and results.

Figure 3 explains a typical software architecture in an EV. The different vehicle microcontrollers network not only needs to talk within themselves but also with vehicle sensor networks and charging infrastructure. The data individually and from these interactions is then sent to the cloud from where it gets connected to the mobile application. A vehicle validation engineer has to be hands on and have the knowhow of all the above mentioned areas and their interactions to build a robust validation.

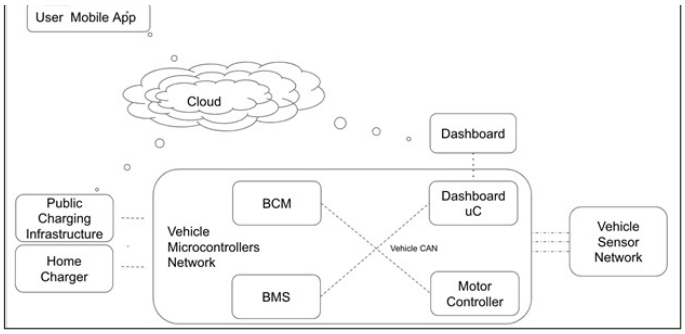


Figure 3. A typical software Architecture in an EV

The dashboard in Ather 450X is another classic example of the challenges faced during validation. The dashboard is open to the environment and hosts a whole bunch of electronics inside it. There is no existing standard which can be adopted to validate the dashboard and neither a benchmark vehicle is available that could be used for referencing. An multilayered innovative and robust approach was adopted to validate the dashboard, where it experienced environmental stresses including sunlight, water, dust, etc., equal to 10 years of field use.The test standards were established using a combination of theoretical calculations and real-world experience. Needless to say, the approach was a success considering the fact that the dashboard has had one of the lowest complaints from the field so far.

A validation set up in any organization should have the following elements built into it:

1) Constantly pushing the boundaries by questioning the existing tests & standards.

2) Focus always on left shift, moving vehicle level tests to components and so on.

3) Know how to gather and use data.

The EV industry is at its nascent stages and there are still a lot of things to learn in terms of validating an EV. However, doing things innovatively has helped us to set up a state of the art validation lab from scratch and in doing so, meeting the quality targets as well.

Glimpses of EV Summit

Glimpses of EV Summit

Bangalore Chamber of Industry and Commerce

101, Midford House, 1, Midford Garden, MG Road, Bengaluru – 560 001
Tel: +91 80 25583325/26/27 | +91 80 25582232 | Fax: +91 80 25580062
Email: info@bcic.in

www.bcic.in

BCIC BRANCHES: Mysore and Dharwad
BCIC INTERNATIONAL OFFICE: Tokyo, Japan
MEDIATION CENTER: Tie-up with BIMACC, Bangalore
START-UP AND INCUBATION CENTER, MG Road, Bangalore