



**Report on program organized by FIPI on
'Future of IC Engines and liquid fuels for
transportation'**



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Federation of Indian Petroleum Industry (FIPI) and SAE India in association with Automotive Component Manufacturers Association of India (ACMA) and Society of Indian Automobile Manufacturers (SIAM) organized a program on 04 December, 2017, at New Delhi, on “Future of IC Engines and liquid fuels for transportation”. The program was organized with the objective of understanding the landscape of fuel consumption in transport sector, opportunities and challenges associated with e-mobility and its impact on IC Engines and liquid fuels in future. The program was attended by dignitaries from the Oil & Gas and Automotive industry.

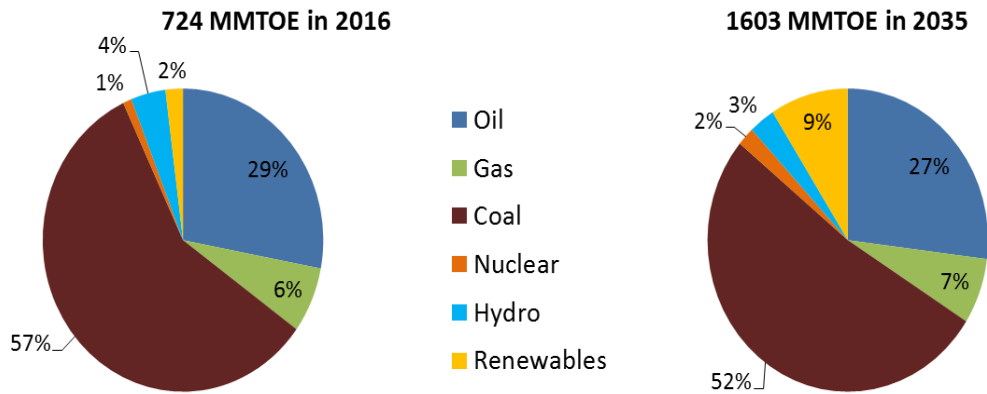
Inaugural address by Dr. R.K. Malhotra, Director General, FIPI



Dr. R.K. Malhotra, DG, FIPI & SAE India President delivering the opening remarks and welcome address.

Inaugural address for the event was delivered by Dr. R.K. Malhotra, Director General, FIPI and President, SAE India. Dr. Malhotra in his address highlighted the present domination of fossil fuels in global and India’s energy mix and that this trend will continue in future. He mentioned that though the share of renewables is expected to increase in the energy mix as reported by various global energy agencies, still it will not be able to displace major share of fossil fuels from the energy mix. As per projections the demand for oil in India is expected to more than double by 2035, primarily driven by demand from transportation and petrochemicals sector. On the other hand, there have been widespread talks on various forums, globally and in India for a mass scale transition to e-mobility, which has led to confusion in energy and automotive markets.

India's primary energy mix



Source-BP Energy India insights 2017

Dr. Malhotra in his address discussed the challenges associated with e-mobility such as, high battery costs, lithium availability, price and associated geopolitics, lack of charging infrastructure, long charging time, issues related to range of electric vehicles (EVs), and issues of grid stability and energy storage while considering renewables for power generation for EVs. He summarised his speech by saying that in view of the projections for oil and challenges associated with EVs, the dependency on liquid fuels may continue in future, and IC engines may coexist with EVs. He concluded by wishing the program success and hoping that the presence of imminent speakers at the event who would share their insights and experiences will help in paving the right path of progress for the future.

Panel Discussion

The inaugural address was followed by an insightful panel discussion on “**Future of IC Engines and liquid fuels for transportation**”. The panellists for the discussion were - Dr. Teich Christian, VP - Bosch, Dr. SSV Ramakumar, Director (R&D) - IOCL, Mr. Vikram Gulati, Country Head & VP (External Affairs) - Toyota Kirloskar Motors, Mr. Ashok Taneja, Managing Director & CEO - Shriram Pistons & Rings and Mr. Harjeet Singh, Executive Advisor-Tech, Hero Moto Corp. The panel discussion was moderated by Mr. Deepangshu Dev Sarmah who is the Editor-in-Chief of Auto Tech Review and Head of Professional Publishing at Springer Nature India.



Panel discussion moderated by Mr. Deepangshu Dev Sarmah, Editor-in-Chief, Autotech Review.



(L-R) Mr. Harjeet Singh, Executive Advisor-Tech, Hero Moto Corp; Mr Ashok Taneja, Managing Director & CEO, Shriram Pistons & Rings Ltd; Mr. Vikram Gulati, Country Head & VP (External Affairs), Toyota Kirloskar Motors; Dr. S. S. V. Ramakumar, Director (R&D), IOCL; Dr. Teich Christian, VP, Bosch.

Panel discussion commenced with the presentation by Dr. T Christian, VP – Bosch on **“Future of IC Engine in India”**.



Dr. T. Christian, VP, Bosch delivering the presentation on ‘Future of IC Engine in India’.

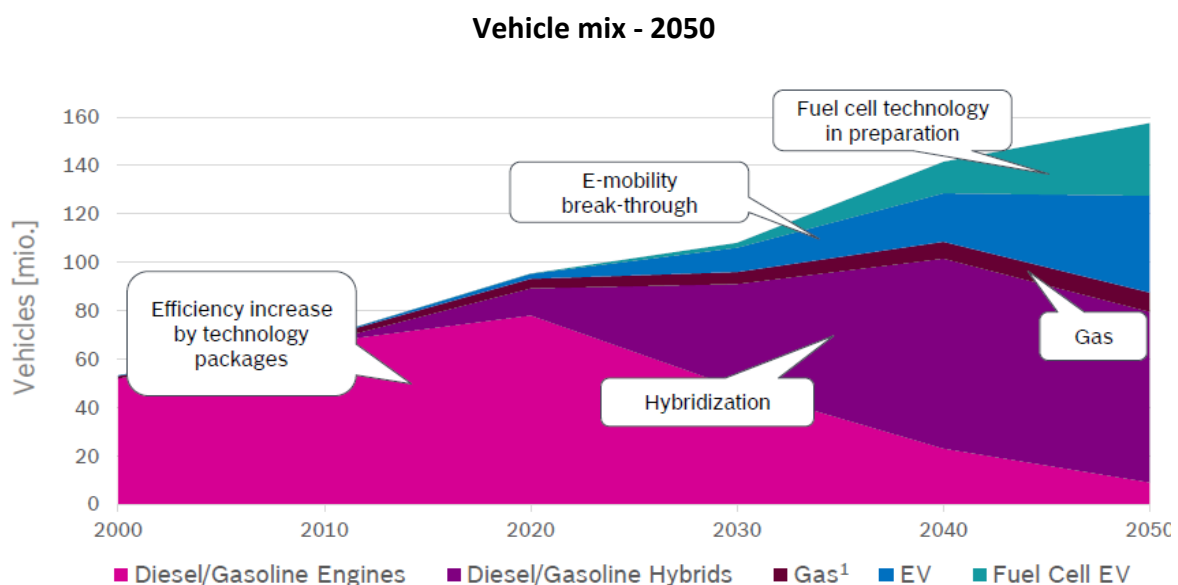


A section of participants.

Key points shared by Dr. Christian in his presentation are as follows:

- Mobility is going to be redefined in the future and will be driven by three major factors globally:
 - There will be 6 billion people living in cities by 2050,
 - Traffic is going to increase by three times from present in 2050 and,
 - There will be more online shops leading to more product deliveries

- For changes in mobility market in India he stated that:
 - In India, 17% of car sales in 2020 will be in commercial segment, which will grow at a CAGR of 25% over the 2015 – 2020 period
 - By 2030, India will be the 3rd largest automobile market in the world
 - Consumers in India, will continue to have a value orientation
- Electric mobility is a good idea but will take time to develop in India
 - The short and mid-term energy mix is not expected to enable emission reduction in India
 - There are challenges associated with electrical infrastructure, specifically in the last mile connectivity (transmission & distribution) side
 - There are limitations to availability of key battery materials such as Lithium, Cobalt, etc.
 - The range vs. cost paradigm for EVs is going to exist for foreseeable future. Cost of battery goes up significantly for long range requirement
- Future IC Engine technology can lead to significant reduction in emissions. For India, particulate matter reduction is a major challenge; only 2% of particulate emission is because of fuel, rest 98% of particulate matter is contributed by tire wear, brake and street abrasion. Application of new technology in IC engines can reduce NOX emissions by 68% and particulate matter by 82%
- To meet the target of reducing global temperature by 2 degree C, a mix of fuel types in vehicles will play a key role in achieving the objective. Bosch projects that by 2050, IC engine, hybrids, gas, E-mobility and Fuel cell vehicles will all be present and be a part of vehicle mix.



Source: IEA, Energy Technology Perspectives, high H₂ case, Bosch

Post Dr. Christian's presentation on future of mobility and IC engines in India, Dr. SSV Ramakumar Director (R&D) - IOCL presented his perspective on "BS-VI fuels for IC engines".

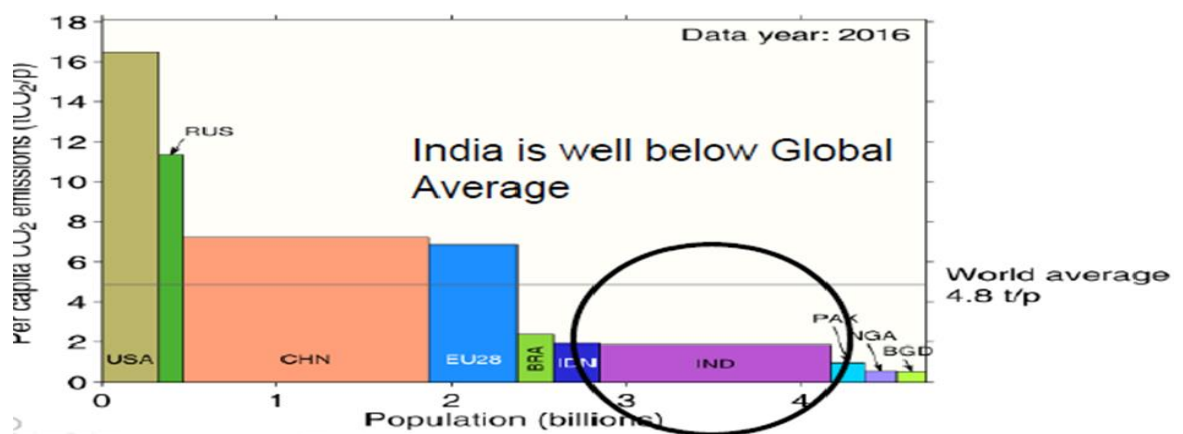


Dr. S. S. V. Ramakumar, Director (R&D), IOCL shared his perspective on 'BS-VI fuels for IC engines'.

Key points discussed by Dr. Ramakumar in his presentation are as follows:

- Per-Capita CO₂ emission in India at around 2 tonne per person is much below the global average of 4.8 tonne per person. As India's commitment to achieve INDC targets, CO₂ emission is declining in vehicles since 2007 and it has been declared that it will be reduced from 129 gm/km in 2017 to 113 gm/km in 2022.

Per Capita CO₂ emission



Source: Global Carbon Budget 2017

- The carbon emission reduction target is enabled by "Fuel economy standards" for passenger cars which are in place from April 2017 and "Draft fuel economy standards" for heavy duty vehicles which are expected to be applicable from April 2018.
- IC engines in BS VI scenario will lead to significant reduction in particulate matter, and NO_x emissions in both light duty and heavy duty segment. Sulphur content in fuels will come down from 50 ppm in BS IV to 10 PPM in BS VI.

- Refining companies in India have made significant progress in moving towards high grade fuels way before the stipulated timeline. India's oil & gas sector has made a collective investment of Rs. 80,000 crore to transit from BS III to VI fuels. Oil companies have agreed to introduce BS VI fuels in NCT of Delhi from April 2018.
- The improvements in emission reduction by using BS VI fuel in BS IV vehicles will only be marginal. Particulate matter from heavy duty diesel vehicles may reduce only by 0.4%, while no change in NO_x is expected. In gasoline vehicles, HC, CO and NO_x emissions may reduce by 7%, 12% and 16%. IOCL R&D is carrying out studies to quantify benefits of using BS VI fuels in BS IV in-use Indian vehicles.
- For BS VI fuels compliance, fuel additives and lubricants also have to be in compliance with BS VI fuel for achieving emission reduction targets.
- Dr Ramakumar summarised his presentation by highlighting the following points:
 - CO₂ and fuel economy legislations will govern future engine technologies
 - BS VI emission compliance imposes stringent fuel specifications
 - Ultra-low sulphur fuels need major changes and investment in refineries
 - Fuel additives and engine oils contribute towards fuel economy and they require continuous R&D interventions.

Post the presentations, the panel discussion commenced with views of panellists on role of IC Engines in our energy future:

- Mr. Harjeet Singh initiated the discussion by putting forth the background of e-mobility plan in India. National Electric Mobility Mission plan was launched by Government of India in 2013, which set the target and also gave the way forward for sale of 6-7 million EVs annually by 2020. As a next step, FAME scheme was launched in 2015 for faster adoption and manufacturing of hybrid and EVs in India which had a provision for incentivizing EVs. Mr. Singh being a part of the two wheeler industry, discussed about the opportunities and challenges in two wheeler industry and highlighted the fact that, to compete with the overall economics of existing two wheeler IC engine vehicle, cost of two wheeler EVs will have to be reduced by around three times. Consumer acceptability remains a major challenge, where consumers are not ready to compromise on cost, range and speed of the vehicles.



Mr. Harjeet Singh, Executive Advisor-Tech, Hero Moto Corp sharing the background of e-mobility plan in India.



Mr Ashok Taneja, Managing Director & CEO, Shriram Pistons & Rings Ltd sharing his views on e-mobility.

- Mr. Taneja stressed on recognizing the ultimate objective which is affordable mobility for all, and keeping emission levels within permissible limits and working towards it. The pathways for achieving the end objective should not be defined by the government. IC Engine technologies are developing at a rapid pace, and in future the well to wheel emissions by ICEs will be equivalent or lower than battery vehicles. The focus of the government should be towards reducing vehicle congestion on roads and promoting shared mobility. The society and government should work towards ensuring fuel quality compliance, pollution control, maintaining vehicle compliance, scrapping of old vehicles and targeting such similar low hanging fruits. Minimizing number of vehicles on road and promoting public transport with BS VI vehicles will lead to lower overall total cost of ownership than stressing to move to an all-electric platform.
- Mr. Gulati discussed about various scenarios by agencies, for e-mobility penetration in market by 2030 which has led to confusion among the industry members. E-mobility is going to happen in future, however it is not possible to exactly replicate in numbers the extent of EV penetration in 2030. The key part that people are missing out is that electrification does not mean all electric. Along with battery vehicles, there will be a host of technologies such as hybrids, plugin hybrids, fuel cell vehicles etc. which will be contributing to achieve the end objective of emission reduction.



Mr. Vikram Gulati, Country Head & VP (External Affairs), Toyota Kirloskar Motors discussed the various scenarios by agencies, for e-mobility penetration in market by 2030.

- The panel discussion was followed by a question answer session, where panellists addressed questions from the audience.



Q&A session in progress.

Few of the key questions that were put forth to the panellists were:

- Role of alternative fuels in India's future: The question was responded by Dr. Ramakumar, who shared his views on alternative fuels such as methanol, ethanol and hydrogen and how hydrogen as an energy carrier holds promise if renewable routes for hydrogen production are explored.
- Development of technology in next 10 years with coming of EVs by 2030: To which the panellists had a consensus that different technologies should be allowed to evolve over the period, and let the market and society choose the best alternative.
- There were other questions also in relation to cost of EVs in two wheeler and four wheeler segments, future penetration of EVs and new technologies, which were aptly responded by panel members.

The panel discussion concluded with felicitation of panellists and moderator by Mr. Rajeev Bahl, Director (Finance, Taxation & Legal), FIPI.

Post the panel discussion, Douglas Patton, President - SAE International and Executive Vice President & Chief Technology Officer - DENSO International America was invited to present on "The IC Engine – Is it dead again".

Presentation by Douglas Patton, President SAE International

In his Presentation Mr. Patton highlighted the globally changing scenario in the field of mobility, with a push towards electrification of mobility.

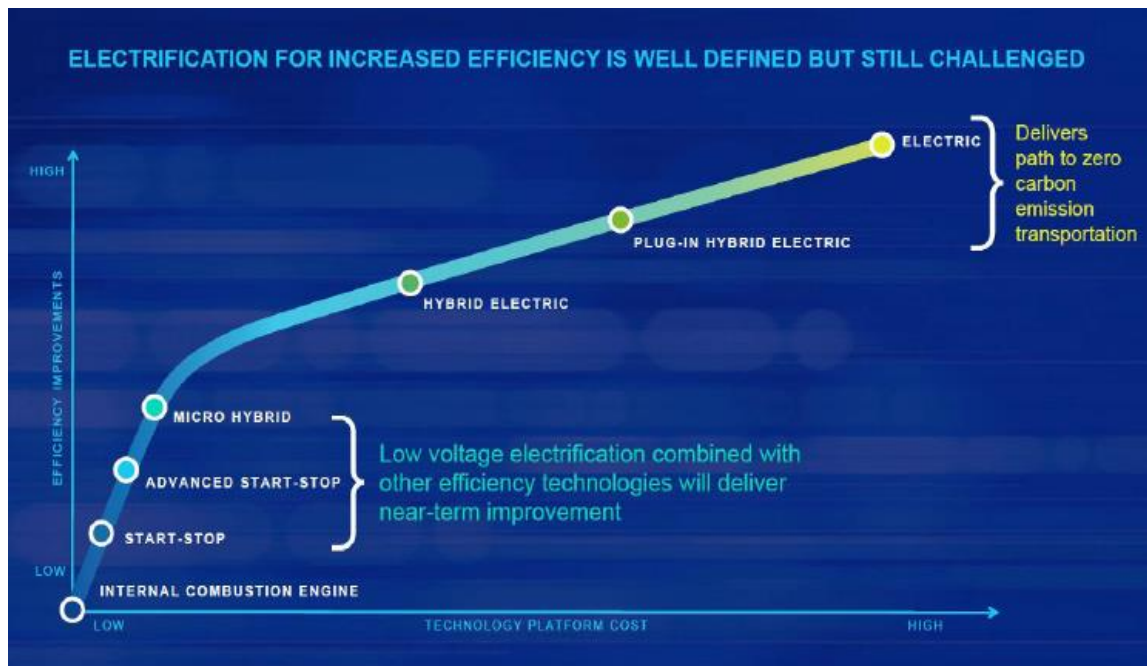


Mr. Douglas Patton, President, SAE International delivering the presentation on 'Is IC Engine Dead or Not Yet'.

Key points shared by Mr. Patton in his presentation are as follows:

- As far as the history of IC engine goes, the IC Engine took centuries to take its today's form and has survived many challengers in the past, such as steam and electric in the early 1900's, and the gas turbine thereafter. Still in 2017, more than 90 million IC engines were built for various applications.
- However, in recent past, with concerns of growing emissions, transformation to electric vehicles has taken centre stage globally. China in its new energy policy plans to ban fossil fuel vehicles and shift to electric vehicles. UK, France and Germany are in the process of banning IC engine vehicles from cities. Every major OEM has a full electric vehicle, extending to entire vehicle lines. Charge times are being reduced and range of EVs is moving from 200 miles to 300 miles. Hence, the electric vehicles are here to stay.
- The push for E-mobility doesn't mean that it will be the end of IC engines. IC engines and electric vehicle will coexist along with plugin hybrids. For achieving the greater objective of reducing carbon di oxide emissions, plugin hybrids can play a key role, as they do not have the typical issues of electric vehicles such as range anxiety and charging time.
- Globally various agencies are projecting very different scenarios for IC Engine and electric vehicles. Worst case scenario projects 18 million new IC engine vehicles in 2050, while the best case scenario projects 120 million IC engine vehicles in 2050. Bloomberg estimates 85 million new electric vehicles in 2040.
- Mr. Patton stressed on the fact that electrification is definitely happening in transport segment but it is not going to be all electric. The transformation is going to be gradual from IC engines to micro hybrids to hybrid electric to plug in hybrid electric and then fully electric.

Technology cost significantly increases with electrification



Source: SAE International

- He further quoted Toyota's powertrain executive program manager Ben Schlimme, who at a seminar, presented a vision of the future for automobiles that includes a broad portfolio of hybrid-electric vehicles, plug-ins and fuel-cell cars and trucks going out to 2050. He goes on further to say "Electrification will play a significant role in the future, but that doesn't mean the death of the IC engine and going ahead there is no one single solution for the automobile market." It is going to be a mix of different powertrains including ICs, EVs, hybrid vehicles and hydrogen fuel cell cars.
- There are many possible ways of electrification and there is no single solution, but they all require IC engines. Today's IC engines are very complex. The new IC engines being developed, such as Skyactive – X Mazda Engine have increased torque of 10 – 30 percent, super lean burn and engine efficiency up to 20 - 30 percent over the current models. Next generation, Infiniti Variable compression engines, are offering significantly higher mileage and provide great opportunities for carbon di oxide emission reductions.
- Diesel trucks will continue to stay in the future, off road applications for IC engines such as construction vehicles, agriculture and heavy equipment machineries etc. will continue to run on IC engines.
- Mr. Patton summarised his presentation by stating that:
 - Passenger car applications for electrified vehicles will increase but with limited Battery Electric Vehicles. Plugin Hybrid Electric Vehicles will play a major role in electrification
 - On highways, light, medium and heavy duty applications will remain primarily on diesel
 - Agriculture and construction equipment will remain on diesel
 - IC Engines will continue to survive

The program was concluded by closing remarks from Mr. C V Raman, Senior Executive Director (Engineering) - Maruti Suzuki India Limited & Chairman SAE NIS, who in his closing remarks stated that it is essential to have a long term plan which should be well thought for any disruption. The vision of the country for controlling emissions and transitioning to e-mobility is commendable but it will require a clear cut plan with enablers and policy push in the right direction. Various technologies should be looked at for achieving the ultimate objective of carbon di oxide reduction. Mr. Raman thanked the organizers, presenters and panellists for the insightful program and the discussions that emerged during the session.