GREASE NUT 5.0

VERGASER

THANGAL KUNJU MUSALIYAR COLLEGE OF ENGINEERING QUILON

DEPARTMENT OF MECHANICAL ENGINEERING

2025

WHERE PASSION IGNITES
WHERE IDEAS SOAR.

Thangal Kunju Musaliar

VISIONARY AND FOUNDER

VERGASER

Vergaser, meaning carburetor in German, represents the heart of an engineer’s creativity and precision. Just as a carburetor mixes air and fuel in perfect proportion to ignite an engine, an engineer blends knowledge, logic, and imagination to spark innovation. It stands for balance, control, and the power of small mechanisms driving great motion. In an engineer’s life, Vergaser is more than a component—it’s a metaphor for how every detailed adjustment and thoughtful design fuels the world forward.

Message From PRINCIPAL

DR. SADIQ A

I am pleased to present Vergaser magazine of our Mechanical Engineering Department's magazine, the Vergaser magazine, building upon the legacy of its pioneering publication, Grease Nut. This publication reflects the relentless dedication, creativity, and collaborative spirit of our students, who have crafted an excellent platform for sharing knowledge, ideas, and innovations in mechanical engineering. As we strive to connect academic learning with industry advancements, I am confident that the Vergaser magazine will inspire new solutions to the challenges of our times and contribute to shaping a sustainable, forward-thinking future. My heartfelt congratulations to the entire team for their hard work and vision. May the Vergaser magazine continue to inspire and set new benchmarks for the years to come

Message From HOD

DR.MOHAMMED SADIKH

I am so happy to learn that the students of the Mechanical Engineering department are launching a magazine this year, serving as a valuable source of insights, innovations, and developments in our field! The mission behind this initiative is to offer a platform where students can share knowledge, exchange ideas, and stay informed on the latest trends and breakthroughs in mechanical engineering. I am confident that the magazine will explore the captivating world of mechanical systems, covering topics such as robotics, mechatronics, thermodynamics, materials science, and more. It will feature cutting-edge research, real-world applications, and industry best practices. The primary goal is to inspire, educate, and empower the mechanical engineering student community, encouraging them to create innovative solutions, drive technological advancements, and contribute to a brighter future. I am sure that students will find the content both informative and engaging. Wishing you all a rewarding reading experience

EDITORS NOTE

ASWANTH K

The essence of royalty is carried forward through generations by sharing ideas, collaborating, hosting events, fostering teamwork, and offering love and guidance. This magazine is founded on that very spirit to pass down the crown of royalty. I proudly present the Vergaser magazine. To all the professors, students, and staff of the Mechanical Engineering Department, I take great pride and responsibility in carrying forward our flag of honour, royalty, and strength through this publication. I extend my sincere gratitude to the entire team behind this collective effort. Reviving a department magazine after such a long gap was indeed a challenging task it demanded unity, the right mindset, and the collective use of our department's diverse talents. May this edition serve as an inspiration and reference for the countless future volumes that will emerge from our department, motivating the upcoming batches to make us proud. Our true royalty lies in our actions. I feel immensely happy and proud to host this magazine for my department, even after passing out. Presenting to you the Vergaser magazine.

IN THIS ISSUE

TECHNICAL ARTICLES

Pollution Free India: Electric Vehicles as a Solution?

DR RIJO JACOB THOMAS
Asst. Professor

It has been many years since Karl Benz has run his first car in 1885; followed by Gottlieb Wilhelm Daimler in 1886. Both vehicles were powered by gasoline combustion engines. They have made ground-breaking changes in the transportation sector, helping us to conquer the earth, water, and sky. In the process, however, we have polluted all of them. The absence of other 'feasible' and more 'efficient' technologies compelled us to use vehicles powered by combustion engines that used fossil fuels. Combustion of the fuel released the energy required to run the vehicles, but they emitted end products that are harmful to us and the environment. The quantity of these emitted end products or the 'emissions' have now reached their threshold values and has started to have not only local but global effects too. Some of the words that we hear frequently in speeches, talks, and debates, like pollution, global warming, climate change, rise in sea level, and so on, are triggered by these emissions too. Though there are many other sources of pollution, vehicles have polluted our air the most. It is estimated that every year, air pollution kills about seven million people worldwide and that contributes to 11.65% of deaths globally. WHO has reported that about 99% of the world's population is breathing the air that exceeds their guideline limits.[1]

Air Quality Index as a Yardstick for Air Pollution

In addition, air pollution also leads to or triggers many lung and heart related diseases. The condition of our country is much worse than the global average in pollution aspects. How good is the AQI of our country? or, is it better to ask, 'How worse is the air pollution in India?

It was reported in 2019 that 21 out of the 30 most polluted cities in the world are in India. India is pushed to 5th place as a country based on AQI as per the data given by iqair.com [2]. The Air Quality Index (AQI), which is an index for reporting air quality on a daily basis, is a measure of how air pollution affects one's health within a short period.

The purpose of the AQI is to help people know how poor air quality impacts their health. AQI is represented on a normalized scale from 0 to 500; the higher the AQI value, the greater is the level of pollution. An AQI value at and below 100 can be generally considered breathable. However, if the AQI is above 100, air quality is considered to be unhealthy and bad for people at the greatest risk of a health effect. If AQI is greater than 150, then it is really bad for the entire population. It is alarming that three of our four metropolitan cities come under the bracket of cities with an AQI of more than 150. In fact, Delhi is currently one of the most polluted cities in the world with an AQI of 265 [2]. It may be noted that over 2 million Indians lose their life to causes attributed to air pollution. Figure 1 shows the position of Indian cities in the 3D animated air pollution map of the world by IQ Air. [2]

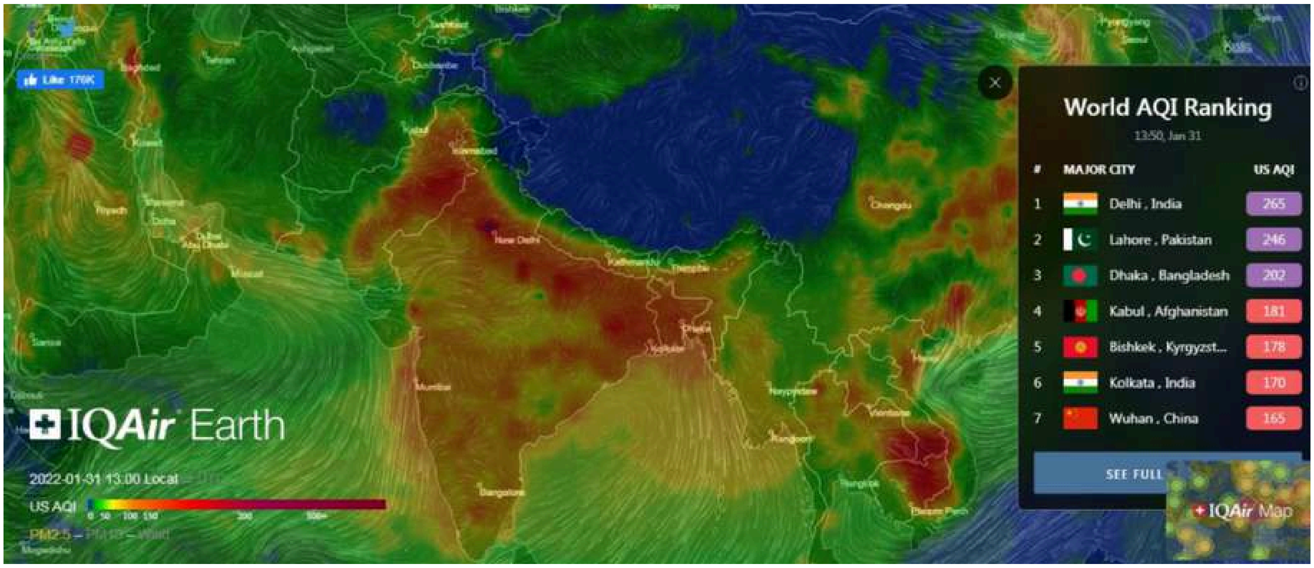


Fig 1. India is depicted in the 3D animated air pollution map of the world by IQ Air [2]

Our country is the world's third greatest producer of greenhouse gases. 50% of India's air pollution is contributed by our industries and 27% is due to our vehicles. The rest is attributed to the burning of the crop, domestic cooking, and miscellaneous causes. Pollution in urban areas is mostly produced by industries and vehicles. In most urban cities of India, vehicular pollution is a major concern. Vehicles contribute to 20% of the total emission of the world. [3] Vehicular emission results in causing many air pollutants; out of which, the ground-level ozone and particulate matter are the most concerning ones. The reaction of UV rays with vehicular exhaust products like volatile organic compounds, nitrous acid, hydrocarbons, nitrogen oxides, etc. may create ground-level ozone. And also results in the formation of toxic smog; thereby damaging the health [4]. Mainly children, elderly people, pregnant women, and persons with a medical history, etc. are vulnerable to the effects of ground-level ozone [5]. The second most concerning air pollutant from vehicular pollution is particulate matter, especially the PM2.5 category particles. PM2.5 is the class of particles that are 2.5 microns or smaller in size. They are dangerous to human health because they can bypass the body's God- given defence mechanisms. Our nose hairs, mucus, etc. try to catch dust particles before they enter the body. But, the PM 2.5 class particles can bypass all these defense mechanisms and get into our bodies. They can enter our lungs and the blood, causing lung diseases and even heart attacks [5].

Good Practices for Reducing Vehicular Air Pollution

Pollution from vehicles is a major cause of concern and needs to be tackled. There is no question that we all need clean air to breathe. It may be difficult to offset all the damages that already have happened to our environment; but, we can definitely do many things to stop further harm to it. We need to do everything we can to reduce the pollutants from the vehicles. No matter who we are, our actions and choices have an impact on the quantity of these emissions. Some of the possible ways in which we can make a difference as individuals are some of the following things:

1. Travel only when it is unavoidable,
2. Walk instead of driving,
3. Ride bicycles for shorter distances,
4. Take public transport systems,
5. Share vehicles (promote shared taxis, carpooling, etc.)
6. Stop racing and drive responsibly,
7. Start early and plan the travel with buffer times,
8. Avoid sudden acceleration and deceleration,
9. Turn off engines when stopped in the traffic,
10. Use alternative fuels and clean energy sources.

Though none of these suggestions work for everyone all the time, they are all definitely good solutions to reduce the emissions from vehicles. Implementing options 1 to 9 listed here requires only our good thinking and strong willpower. But, unfortunately, the majority of us hardly put them into practice.

Electric Vehicles as a Solution to Reduce Air Pollution

The world is eagerly looking into the options like using alternative fuels and clean energy sources. A large amount of money is spent on research to develop technologies and systems in the area. The class of vehicles that uses stored electricity for power, known as battery Electric Vehicles or shortly ‘EVs’, are posed as a good solution to the problem. The world now sees vehicular electrification as a viable solution for reducing emissions. Our country too has rolled out multiple ‘green’ initiatives, plans, and schemes as part of India's commitments to The Paris Climate Agreement. The National Electric Mobility Mission Plan, FAME (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles), GUTS scheme, etc. are some of the examples. Also for those who would like to set up manufacturing facilities, there is a Production Linked Incentive (PLI) scheme. The target government has set for EVs by 2030 are 30% in private cars, 70% in commercial vehicles, and 80% in two- and three-wheelers. When purchasing EVs, the Indian government has given a reduction in GST from 18% to 5%, and also the state governments may decide on reducing the road taxes. The objective is to reduce the pollution by fossil fuel vehicles. Let’s see how it is expected that when switching to EVs, the emissions are being reduced.

1. No Emissions and Zero Air Pollution

The basic operating difference between an EV and a combustion engine based vehicle lies in the way in which the energy is being converted from one form to other forms for the eventual purpose of movement. From its natural source, the stored (potential) energy has to eventually get converted into movement (kinetic energy). In combustion engine based vehicles, the stored energy is in the chemical form and it is released out as heat energy and work through a chemical reaction, combustion, taking place inside the vehicle. Whereas in EVs, electrical energy is stored inside batteries electrochemically and converted back to electrical energy before being converted into movement (kinetic energy). If the production of electrical energy is from the same source as that of combustion engines, i.e. stored chemical energy, then it requires more energy transformations to be used in EVs. The stored chemical energy is converted first to heat energy through chemical reactions (combustion) and then to pressure energy before getting transformed into electrical energy. However, if the sources of electrical energy for EVs are from cleaner sources like nuclear, hydro, solar, or wind power plants, then there would not be any kind of combustion; thereby no emissions and eventually zero air pollution.

2. Decreased Urban Air Pollution and Wide Spread of Air Pollution

All the combustion based vehicles release pollutants into the air through the exhaust tailpipe as long as the engine operates; even when the vehicle is not moving. Also, they pollute all the way they move. Consequently, the exhaust gases are spread throughout and their removal becomes difficult. This is one of the major concerns in urban areas where the population is dense and so is the number of vehicles. The vehicular pollution in urban areas can be considerably reduced by switching to EVs. Irrespective of the base energy source being used to generate their driving electricity, EVs can reduce urban air pollution. With no tailpipe, EVs can give out no emissions when driving. This improves the air quality in towns and cities making them breathable. When charging EVs with electricity from the combustion of fuels, we are moving the pollution from the tailpipes to the power plants. It has another advantage; the removal of harmful exhaust gases is much easier.

Exhaust gases removal and treatment systems can be installed as attachments to the power plants. With the help of strict guidelines and control mechanisms, the government can ensure that no harmful gases are given out by the power plants. Consequently, by transferring the emissions from tailpipes to power plants, EVs can help in reducing not only the quantity of emissions, but also their spread.

3. Drop in the Main Air Pollutants

Adoption of EVs actually would improve overall air quality. A new study by researchers from Northwestern University in the US proves this [6]. They have used emissions remapping algorithms and air quality model simulations to find the differences in air pollution generated from EVs and combustion based vehicles. Their results have showed that EVs will improve air quality considering the whole life cycle even if their source of energy is combustion of fuels. According to them, switching to EVs has the benefit of reducing the two main air pollutants: ground-level ozone and particulate matter. [6] They found that the ground-level ozone levels decreased in the summer. In the winter, however, ozone levels increase slightly but are already much lower compared to summer. This is due to the reduced chemical reaction that occurred because of lesser winter sun (UV) light. The study found that irrespective of the season, the more conventional vehicles are replaced by EVs, the better is the ground-level ozone quality. The second main air pollutant, particulate matter, decreased in the winter and was dependent on location and how the base electrical power was generated. There was an increase in particulate matter during the summer if the electricity is sourced from more coal-fired power plants. However, the use of clean energy sources resulted in drastic reductions in particulate matter.[6]

4. Higher Operating Efficiency

EVs are more efficient than combustion engine based vehicles. EVs can convert about 70 to 80% of the electrical energy supplied from the power grid to kinetic energy at the wheels. Whereas, combustion based vehicles can only convert about 15% to 35 % of the stored chemical energy in fuel to power in the wheels. The better efficiency is also due to the ability of EVs to recharge the batteries during deceleration and thereby recovering immediately “useful” energy otherwise being generally lost in braking.

The efficiency being discussed is called the ‘Well to Vehicle’ efficiency. It takes into consideration all the inefficiencies right from fuel extraction to transportation to supply to charging, discharging, and finally transmitting to wheels as a movement. The ‘Well-to-Wheel’ efficiency, which can be calculated as the product of ‘Well to Vehicle’ and ‘Vehicle to Wheel’ efficiencies, varies from case to case. There is no doubt that the 'Vehicle to Wheel' efficiency of EVs is always higher than that of combustion based vehicles. For instance, in terms of ‘Vehicle to Well’ efficiency, a small electric car is 2.5 times more efficient than a similar petrol car. An electric SUV is 1.8 times more efficient than an equivalent diesel SUV. And an electric scooter is 2 times more efficient than an equivalent petrol scooter. However, whether the ‘Well to Vehicle’ efficiency is better depends on the basic energy source of electricity used.

5. Other Allied Benefits

The efficiency being discussed is called the ‘Well to Vehicle’ efficiency. It takes into consideration all the inefficiencies right from fuel extraction to transportation to supply to charging, discharging, and finally transmitting to wheels as a movement. The ‘Well-to-Wheel’ efficiency, which can be calculated as the product of ‘Well to Vehicle’ and ‘Vehicle to Wheel’ efficiencies, varies from case to case. There is no doubt that the 'Vehicle to Wheel' efficiency of EVs is always higher than that of combustion based vehicles. For instance, in terms of ‘Vehicle to Well’ efficiency, a small electric car is 2.5 times more efficient than a similar petrol car. An electric SUV is 1.8 times more efficient than an equivalent diesel SUV. And an electric scooter is 2 times more efficient than an equivalent petrol scooter. However, whether the ‘Well to Vehicle’ efficiency is better depends on the basic energy source of electricity used.

Other allied advantages of using EVs include the lower running cost, the reduction of noise caused by combustion engines, the lower centre of gravity that makes them more stable and less likely to roll over, the lower risk of fire or explosion since they do not contain flammable fuel, the smoother operation, stronger acceleration, less maintenance, reduction in the import of crude oil and saving of the foreign exchange, the business and employment opportunities related to new EV technologies, setting up of charging stations throughout our country and so on. There is more information about EVs, their advantages, different government promotion schemes, business opportunities, etc. is available on the Niti Aayog website, https://e-amrit.niti.gov.in.[7]

Are Electric Vehicles Really Eco-friendly?

Today, those who are switching over to EVs in India may have a notion that they are not harming the environment at all. Many think that EVs are 'no polluting' vehicles with zero emissions. Are EVs really pollution free? The answer to the question is neither a straightforward nor an easy one. We need to dig deeper to get convinced ourselves. Despite seeing the advantages of EVs, there are various drawbacks too.

a. Carbon Emissions in Production of EVs

Today, those who are switching over to EVs in India may have a notion that they are not harming the environment at all. Many think that EVs are 'no polluting' vehicles with zero emissions. Are EVs really pollution free? The answer to the question is neither a straightforward nor an easy one. We need to dig deeper to get convinced ourselves. Despite seeing the advantages of EVs, there are various drawbacks too.
The production of electric vehicles is typically more energy-intensive than in the case of conventional vehicles. The production process of the basic vehicle is very much the same for both electric and conventional types. Nevertheless, in the end, the production of EVs results in generating more carbon emissions [8]. This happens because the batteries used in EVs are made of metals like Lithium, Nickel, Cobalt, etc., that are not easily available and need to be mined from beneath the Earth.

Depending on the mining and extraction activities of these metals, the battery production process too can be polluting. The emissions for the entire life cycle phases, including the manufacturing and operation stages, for EV and conventional vehicles in terms of carbon dioxide released are compared in the figure. The carbon emissions involved in the vehicle manufacturing of EVs and conventional gasoline vehicles are almost the same. But EVs have another component to be manufactured, i.e. the batteries. Battery manufacturing contributes considerably to the carbon emissions; would be about 30 - 40 % of that of vehicle manufacturing.

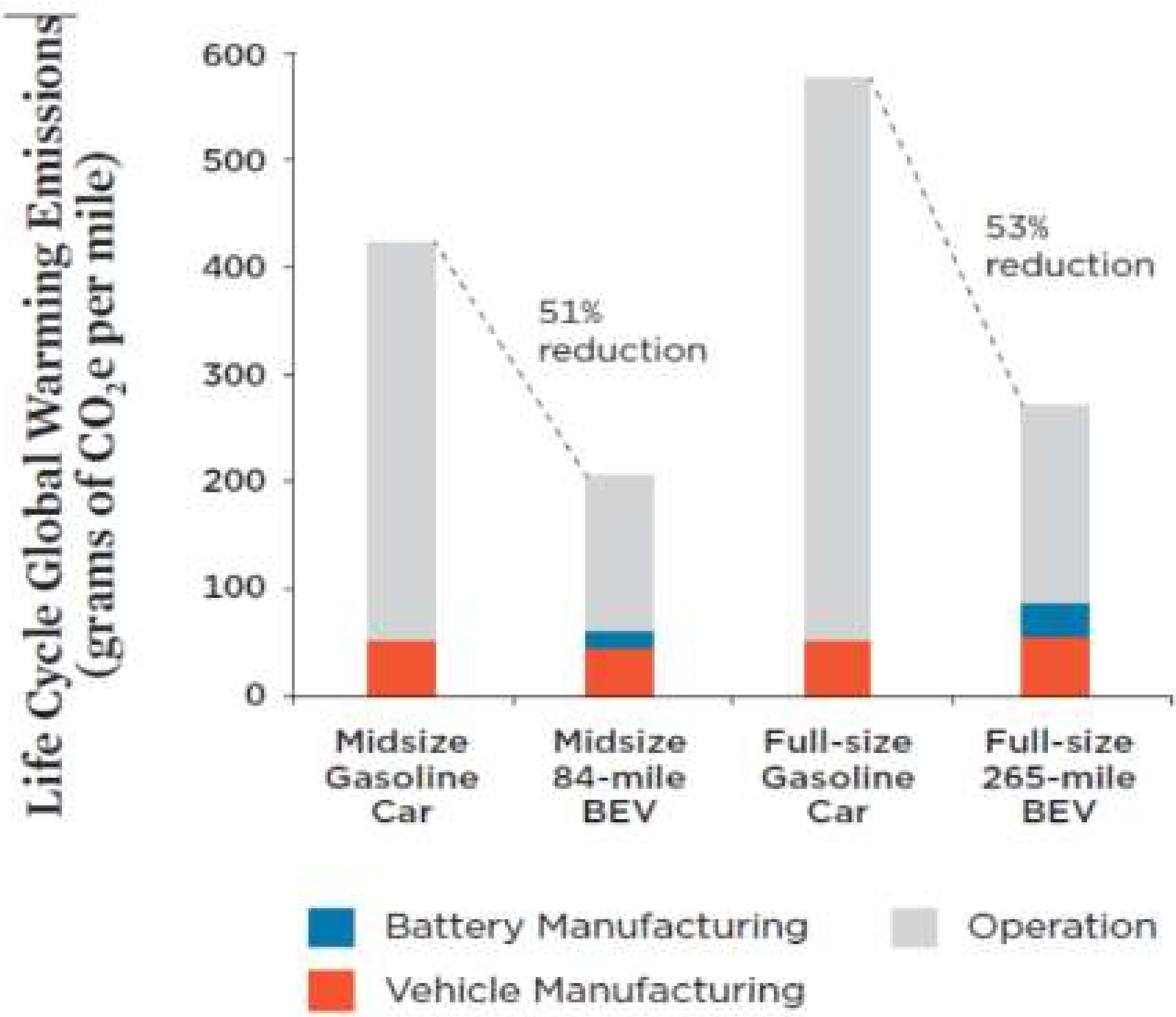


Fig. 2 Comparison of Emissions for the Entire Life Cycle of Battery-Electric Vehicle (BEV) and Conventional Gasoline Powered Vehicles in terms of Carbon Dioxide Released [8]

In addition to this, there are issues with the procurement of the constituent elements of EV batteries. One of the key elements in most EV Batteries is Lithium. It is found in salt flat regions with water paucity and has to be mined out. Generally, all mining processes are associated with various environmental impacts. Also, a huge amount of water, as well as some toxic chemicals, are necessary for the leaching process used in Lithium mining. These things may result in local water scarcity and contamination. Other common elements of EV batteries like Nickel and Cobalt are also to be mined adding to the environmental woes. With the operations phase, the overall carbon emission is expected to be 50% less for EVs as compared to combustion powered vehicles.[8] Unless from clean energy sources, the energy used to produce the batteries themselves is responsible for environmental pollution [8]. Therefore, it is not really easy to say that EVs have a greener production process.

b. Carbon Emissions in Charging of EVs

Unless electricity from clean energy sources is used to recharge them, EVs will only be relocating the air pollution from the place of use of vehicles to the place of power generation. In combustion based vehicles, the fuel is directly used to move the wheels (kinetic energy). In the case of EVs, in the power plants, the stored chemical energy of the fuel is first converted to heat and work to produce electrical energy. Then this electrical energy is electrochemically stored in batteries by the charging process. The discharging process converts this battery-stored energy back to electrical energy before being fed to the motors, where they impart kinetic energy to the wheels. There are more energy conversions and each will result in the degradation of the quality of energy despite its quantity being conserved. Consequently, the energy available at the end for use would be lesser and needs to be compensated for to accomplish the same task.

This is more relevant in the case of a country like India which is majorly dependent on energy from fossil fuels. India generates 67% of its energy from thermal power plants and 88% of our thermal power plants are coal-fired. In a coal based power plant, the electricity required to run an EV for 1 kilometre produces 0.44 g of Nitrogen Oxide and 0.72 g of Sulphur dioxide. The gasoline based vehicles are supposed to produce much less amount of these components. According to the BS-IV standards, vehicles cannot give out more than 0.0 g of Nitrogen Oxide per running kilometre.[9] Also, Sulphur dioxide is not given out by gasoline combustion powered vehicles.

Therefore, an EV charged by electrical energy from a coal power plant would create more Nitrogen Oxide than a conventional vehicle that runs on gasoline and additionally would produce the harmful Sulphur Dioxide too. So the EVs are only as green as their base energy source of electricity.

c. Shortages and Power Imbalance in Charging of EVs

As more and more people switch to electric vehicles, the demand for more electricity may result in insufficient energy supplies. If aggravated, this may in the future, result in increased electricity charges and rationed supplies. Also, it may be difficult to balance the supply and demand needs for charging EVs, especially at peak load times. The sudden increase in demand for electricity as a result of many switching to EVs may make the existing power grids insufficient. For big countries like India with a vast population, it would be hard to keep up with the demand and supply especially when considering the huge infrastructure cost involved. Newer technologies like 'Vehicle-to-Grid Charging' that makes it possible to transfer the energy stored in batteries back to the grid during the peak time; 'Smart Charging' that finds the optimal recharge time when the demand is low; and 'Battery Swapping' where the manufacturer owns the batteries and does the charging so that customers can exchange their battery instantly (like our LPG cylinders) are promising solutions to these problems.

d. Disposal of EV Batteries

EVs can be considered as a good competitor to conventional combustion powered vehicles until their battery ends its life. What can be done with the Lithium-ion batteries that are no longer useful for EVs? The common progression for any battery is reuse, recycle, or finally reject. The first possibility of reuse can be explored. The Lithium-ion battery, at the end of life in an EV, can be given a second life by using them in building electrical grids or for storing energy from wind or solar plants. A prolonged life would help to prolong their environmental impacts. The next option that can be explored is 'recycle'. Most parts of an EV can be recycled similar to any combustion based vehicle, except their Lithium-ion batteries. 99% of batteries used in conventional vehicles that are of the lead-acid type are recycled. However, this is not possible now for the Lithium-ion batteries. They use a combination of many elements in smaller quantities.

Because of this, for instance, the recovery of Lithium by the hydrometallurgical processes is not financially feasible. In 2011, in Europe, only 5% of Lithium was being collected back. The remaining Lithium was either destroyed through incineration or wasted by dumping in landfills.[10] Such actions definitely cannot make EVs ‘green’ at all. The possibility of recycling depends majorly on the design of the battery and the economic and environmental viability of the recycling process. The recycling process requires energy and consequently produces carbon emissions. However, recycling can reduce emissions than mining new materials. In the future, with more batteries that are out there to dispose of, researchers may come out with technologies to recycle or recover Lithium more economically and thereby allowing EVs to become greener. When eventually disposed of in landfills, the disposal toxicity effects of Lithium-ion batteries on air, water, and land need to be assessed.

e. Resource Availability and Monopoly in EV Batteries

The demand for Lithium is day by day increasing. Lithium is not only used in batteries for EVs but also in various electrical and electronic goods including our mobile phones. With increased demands, the mining impacts are also affecting the regions having Lithium resources. Lithium being the lightest metal on earth, huge mining is necessary to obtain the required quantity in terms of mass. The parts of the world where there are Lithium resources are not many and also not in abundance as it is evident from the table given.[10] Earlier the concern of scarcity of Lithium was there in the development of EVs.
Recent studies have quantified the supply and it is found that there would be enough Lithium to meet the world's demand from 2010 to 2100.[11] According to their findings, the projected global lithium availability of 39 Mt (million tonnes) is sufficient enough to meet the expected highest demand of 20 Mt for the period 2010 to 2100.[11] Therefore, it is now believed that a quick and larger switch to EVs may not pose any threats at least till the end of this century in terms of Lithium availability. EVs batteries, along with Lithium, also require Cobalt, Nickel, and other metals. Most of them are mined from only certain parts of the world. Because of this and their relatively high price, these metals are recycled. Recycling will eventually reduce the price and also the quantity of the mined materials, thereby lowering the risk of resource scarcity.[12] Because of these factors, the monopoly of certain countries in terms of EV battery production and also in the supply of the constituent elements of batteries is much evident.

COUNTRY	MILLION TONNES
Bolivia	9
Chile	7.5
China	5.4
United states	4
Argentina	2.6
Australia	1.8
Brasil	1
Congo (Kinshasa)	1
Serbia	1
Canada	0.36

Fig 3: Identified Lithium resources worldwide [10]

Currently, the biggest supplier of EV batteries is China's Contemporary Amperex Technology (CATL). Companies like CATL, have helped China to be the leader of the global EV battery industry. Currently, there is no other country or company that can come even near to their technical and economic efficiencies. It was because of CATL that Tesla, the company that makes the world’s bestselling electric car, has been able to roll out many EVs across the world. Tesla, China (Shanghai) now produces more cars than their factory in California, US.[13]

These monopolies can be controlled by cooperation of countries to start battery manufacturing units utilizing technologies to reuse and recycle existing batteries as well as their constituent elements. There is also a need for international agreements, MoUs, laws, etc. to share technology, facilities, and resources to build a universe free of pollution than specific countries.

f. EVs are Costlier

Another important fact that is observed is that EVs are not very economically competitive in terms of their purchase cost. EVs come almost at double the price of conventional combustion based vehicles. The price of an EV is decided by the components that go inside it. The priciest component is its battery contributing to half of the cost of an EV. The average battery cost for a typical EV comes to about Rs. 6,00,000/- and the average pack price would be about Rs 12,000 per kilowatt hour. In the past, the prices of batteries were very high; but they are still very expensive. Most EVs utilize the same Lithium-ion batteries that are being used in laptops and mobile phones; but, in EVs, they are much bigger, packed, and more intricate with subsystems. Inside the battery, the costlier part is the cathode as it requires expensive metals like Lithium, Cobalt, Nickel, Manganese, and so on to produce it.

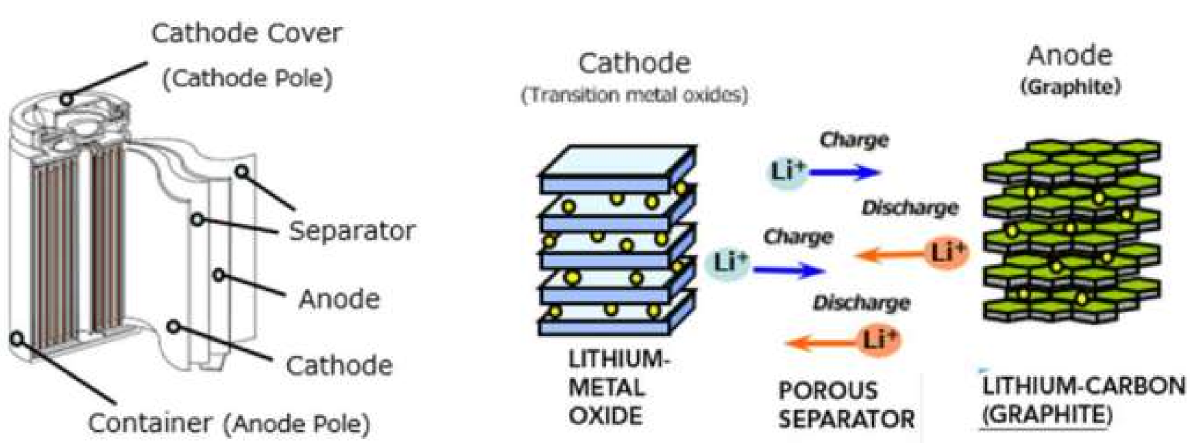


Fig. 4: Parts of a Lithium-ion Battery [15]

The battery prices may not be falling as quickly as they are expected. Battery manufacturers across the world are involved in intense research and development to improve battery technology so that the costs of EVs can be reduced by 30 - 40 %. One of the solutions is to replace the costly Cobalt with Nickel. In doing so, Nickel being cheaper, the price can be reduced, and also the size can be decreased as Nickel can hold more energy. The advantage of Cobalt is that it will not get overheated and catch fire easily.

Therefore, with Nickel, there need to be additional safety arrangements and cooling systems in the battery. Panasonic Corp. in Japan plans to commercialize a cobalt-free version of a high-energy battery in 2 or 3 years. The battery used in the Tesla's Model 3 in 2017 was the "2170" Lithium-ion cells, with more Nickel, i.e., the Nickel-Cobalt- Aluminium (NCA) cathode manufactured by Panasonic. This battery is considered to have the highest energy density, i.e. at above 0.7 kilowatt hour per litre.[14] The CATL is already supplying Tesla with no Cobalt,low-cost Batteries, using Lithium Iron Phosphate (LFP).[14] For high performance, battery manufacturers use more energy-dense materials, like Lithium-Nickel-Manganese-Cobalt oxide or Lithium-Nickel-Cobalt-Aluminum oxide.

There are also attempts to improve other performance parameters like the distance that can be travelled before recharging, charging speed, battery life, etc. However, the fire accidents reported have highlighted the need for more fire-resistant and safer battery designs for EVs. Design of simplified and compact battery packs with heat mitigating arrangements of individual cells is essential. Batteries need to be manufactured in standard sizes rather than tailor-made batteries for each vehicle.[16] This would make batteries more economically viable in terms of maintenance, life, etc., and also enable methods like battery swapping to minimise the recharging time. It is expected that at about Rs 8000 per kilowatt hour, the cost of an EV would be at par with that of combustion powered vehicles. There can be further cost reduction in the EV manufacturing process. Accommodating the battery system within the chassis of the vehicle could reduce the cost and weight of materials. The electric motor is an important component in EVs where further cost reduction is attempted. The cost of the electric motor(s) would be about a tenth of the EV cost. Improvements can also be expected in the electronics that interconnect the battery, motor, and wheels of the EV.

In the case of two-wheeler EVs, the premises are slightly different. For rural India, two-wheelers are the commonest mode of travel. They are the only affordable means for mobility for the multitude of Indians. In the absence of public transport, two-wheelers are the only available and environmentally efficient means of transport. The fuel required per passenger and per kilometre is much less for two-wheelers. When the BS-IV norms are being implemented, the environmental effect per two-wheeler would be much less.[17]

However, the two-wheeler form of EVs is costly and also not very lucrative in terms of offsetting the emissions. Therefore, the transition of rural India to two-wheeler EVs would be much slower. In addition to the environmental aspects, EVs have certain other drawbacks too. The distance they can travel without a recharge is a concern. EVs have a shorter driving range compared to conventional vehicles and the fuel station network. It may vary from 150 to 400 kilometres depending on the type and size of the battery being used. The specified range is again dependent on how the EVs are driven. Driving with more acceleration and speed, the batteries may discharge at a faster rate and get exhausted in a distance much shorter than the specified range. Another limitation of EVs is the time taken to fully recharge the battery. Depending on the type, size, and age, the charging time can vary from 3 to 12 hours. This may be unacceptable to many especially when considering the time taken to fill up the fuel tank. Even the fast
charging to 80% of battery capacity can take 30 to 45 minutes. Therefore, a 'long drive' without stoppages may not be possible using present-day EVs. In addition to this, though the EV batteries are designed for extended use, their practical life depends on many factors like charging cycles, rates, voltage, current, temperature, time, period, levels, and so on. EV batteries may last for 10 to 15 years in a variety of climates and cycles. However, if they fail, the replacement of these batteries may be costly. Other factors of concern in batteries may be their degradation with cycles, climate, operating conditions, issues with their power and thermal management systems, careless usage, and the accident chances.

Conclusion

Therefore, there are many trade-offs while switching to EVs. After seeing the various aspects, in the Indian context, we can conclude the following;

i. No EVs are 100% green or cannot be called zero polluting vehicles owing to the present energy scenario in India. EVs do not pollute while driving, but they may do that in their manufacturing, electricity production, and end-of-life stages.

ii. EVs if they are powered with clean electricity are definitely more eco-friendly than conventional vehicles. EVs powered by fossil fuel based electricity would be more polluting than their conventional combustion powered counterparts.

iii. EVs will decrease urban air pollution. This is very significant because according to the forecast by United Nations, 68% of the world population will be living in urban areas by 2050.

iv. As a country, we can try many other options before encouraging all to switch to EVs. First, we need to encourage people to live sustainably, avoid unnecessary travels, ride bicycles, use public transportation, share vehicles, etc. Incentives and promotions from the Government would help people embrace it as part of their life. These are unquestionably better options to reduce emissions than our current exodus to EVs.

v. Replacing diesel powered engines with alternative fuels like Hydrogen or Methane would help to lower the emissions without throwing away the current vehicles to the environment. The fuel cell technology that can provide continuous electricity is a highly durable and cheaper method for zero-emission mobility than battery EVs.

Therefore, today what India has to discuss is not on EVs but about how to produce electricity more cleanly. With energy from renewable sources mixed with that from our traditional power plants, the power grids are expected to improve the air pollution situation of many of our cities. We definitely need more wind, nuclear, and solar power plants to offset the effects of pollution while switching to EVs. Also according to the Paris Agreement, India has committed to increasing the amount of clean energy to 40% by 2030. The charging of EVs has to rely more on solar energy. People may be encouraged with subsidies to set up small solar based EV charging stations. Large-scale chains of solar charging stations can be installed like fuelling stations by the Government, big companies, investors, etc. in the country. The International Solar Alliance established by India, involving 120 tropical countries, is an excellent move in creating a powerful and large solar power grid of 1,000 GW capacity and by mitigating emissions to the tune of 1,000 million tonnes of CO2 every year. Indian Engineers and scientists can utilize the immense job, research, and innovation opportunities worldwide in terms of clean power, EV manufacturing, electronics, battery technologies, batteries recycling, and recovery, green and fast charging techniques, battery swapping, power grid management, and so on. India can be one of the top countries in the future to rely upon for sustainable solutions for a clean and healthy world.

Cold Spray Additive Manufacturing: Engineering at the Speed of Sound

AHAMMED BILAL A
Asst.Professor

A New Frontier in Additive Manufacturing

Additive manufacturing has reshaped how engineers think about production — from 3D-printed prototypes to metal parts used in aircraft and medical implants. But while most additive processes rely on melting materials with lasers or heat, one method is rewriting the rulebook: Cold Spray Additive Manufacturing (CSAM). In cold spray, metal powders are accelerated to supersonic speeds and deposited onto a substrate — not melted, but mechanically bonded. This solid-state process enables engineers to build dense, high-strength metallic components without the heat-related problems found in traditional additive manufacturing.

How Cold Spray Works

A carrier gas — often nitrogen or helium — is heated and expanded through a converging-diverging nozzle, similar to those used in rocket engines. Fine metal powder particles are injected into this high-velocity gas stream, accelerating to supersonic speeds. When these particles strike the substrate, the kinetic energy from impact causes severe plastic deformation. Instead of melting and solidifying, the particles mechanically interlock and bond to the surface. Because the process never reaches the melting point of the material, it avoids problems such as oxidation, residual stresses, and phase transformations. The result: high-strength, thermally stable deposits that can rival or exceed wrought material properties.

From Coatings to Full Components

Originally, cold spray was developed as a repair and coating technology — ideal for restoring worn surfaces, applying corrosion-resistant layers, and repairing damaged parts. However, advances in robotics, nozzle design, and process control have turned it into a true additive manufacturing process. Today, Cold Spray Additive Manufacturing (CSAM) is used to produce and repair complex components made from aluminum, copper, titanium, nickel, and high-performance alloys like Inconel.

Why “Cold” is Better: Key Advantages

1. No Melting, No Weakness — Cold spray avoids melting, eliminating porosity and cracking, ideal for heat-sensitive materials.
2. High Deposition Rates — Material can be built at over 10 kg/hour, making CSAM one of the fastest additive processes.
3. Superior Mechanical Properties — Strong, dense deposits with minimal residual stress.
4. Environmentally Friendly — No toxic binders or furnaces.
5. Versatile — Works with metals, alloys, and composites.

Challenges in Cold Spray Additive Manufacturing

Despite its promise, CSAM faces challenges: achieving consistent adhesion, preparing surfaces, managing geometry limitations, and controlling cost. Research is ongoing to improve nozzle designs, particle velocity control, and computational modeling for optimization.

The Science Behind the Bond

When a particle strikes at supersonic speed, adiabatic shear instability occurs — localized plastic flow that enables atomic-level bonding. without melting This “solid-state welding” produces dense, uniform deposits with refined grains and high hardness.

The Future of CSAM

Future research includes hybrid manufacturing (combining cold spray with machining), robotic automation, novel powder materials, and even in-space repair applications. NASA has explored CSAM for satellite maintenance since it works without high temperatures.

Conclusion: A Cool Revolution

Cold Spray Additive Manufacturing merges speed, precision, and sustainability. For mechanical engineers, it represents the next frontier — where aerodynamics, materials science, and thermomechanics unite. In a world seeking sustainable and repairable solutions, cold spray proves that sometimes, the coolest innovations are literally the ones that stay cold.

Innovative Pedagogical Tool: Python-Based Problem Solving and Analysis of Principal Stresses Using Generative AI

SYED MUHAMMED FAHD
ASSOCIATE PROFESSOR

Reimagining the Way We Learn Mechanics

Understanding the three-dimensional state of stress and the concept of principal stresses lies at the heart of the Mechanics of Deformable Solids course. For decades, this topic has been taught through mathematical formulations eigenvalue problems and Mohr's circles that,
while powerful, often appear abstract and detached from practical engineering to many students.

As an educator, I have always believed that the essence of teaching lies not merely in transferring knowledge but in transforming how knowledge is perceived and applied. With that conviction, I designed an innovative pedagogical activity that integrates Python programming and Generative AI into the study of principal stresses blending analytical mechanics with modern computation.

Merging Classical Mechanics with Modern Computation

The activity invited students to solve a three-dimensional stress problem using Python and AI-assisted tools. They computed the principal stresses, directions, and maximum shear stress by evaluating the eigenvalues and eigenvectors of the stress tensor effectively connecting mathematical formulation to computational execution. The goal was not only to teach them "how to calculate" but to help them see how theory transforms into results through programming logic. By constructing the stress tensor themselves, debugging code, and observing outputs, students internalized concepts that might otherwise remain abstract.
To support this, I prepared a video tutorial demonstrating the logic of generating Python code for stress analysis. This blended-learning approach allowed students to learn asynchronously and explore at their own pace. Working in groups of three further encouraged collaborative problem-solving, enabling peer discussion, experimentation, and critical reflection.

Pedagogical Intent and Learning Outcomes

This assignment was designed with deliberate educational depth not as a coding task, but as a concept-reinforcement experience. It nurtured four interconnected domains of learning:

Learning Domain	Outcome
Cognitive (Understanding)	Students understood how a 3D stress tensor is constructed and represented.
Analytical (Application)	They applied eigenvalue principles to determine principal stresses and their directions.
Collaborative (Soft Skills)	They developed teamwork, communication, and problem-solving abilities.
Skill (Modern Tool Usage)	They learned Python-based computation and gained exposure to Generative AI for code creation and debugging.

The activity directly aligns with the Course Outcome (CO1) "Determine the principal stresses using tensorial and graphical approach" and maps with PO1 (Engineering Knowledge), PO2 (Problem Analysis), PO5 (Modern Tool Usage), and PO9 (Teamwork).

Reflections on the Learning Experience

The outcomes were deeply encouraging. Students not only demonstrated accurate computational results but also exhibited a stronger conceptual grasp of the underlying mechanics. What struck me most was their growing curiosity questions shifted from "How do we solve this?" to "Why does this happen?" and "What if we change the input conditions?" This shift, in my view, is the true hallmark of active learning when students begin to think
like engineers, experimenting with logic rather than memorizing procedures. Generative AI also played an interesting role, serving as a co-learner assisting students in debugging, refining code, and visualizing their results efficiently.

Looking Ahead: The Future of Smart Learning

Encouraged by the positive response, future iterations of this activity will incorporate 3D visualization of principal planes using Python libraries such as Matplotlib and Plotly. Such visual tools will allow students to see how stress orientations behave in three-dimensional space creating an even more immersive and interactive learning experience. The initiative also aligns with the National Education Policy (NEP) 2020, which emphasizes experiential and skill-based learning. It demonstrates how mechanical engineering a discipline deeply rooted in physical laws can evolve to embrace digital technologies without losing its analytical rigor.

Conclusion

Through this activity, I aimed to make learning Mechanics of Deformable Solids an engaging, thought-provoking, and modern experience. Integrating Python programming and Generative AI transformed a complex theoretical topic into an exploratory, hands-on learning journey. For our students, this experience was more than a computation exercise it was a gateway to a new way of thinking about engineering problems. And for me as an educator, it reaffirmed that when we merge the precision of mechanics with the power of computation, we prepare our students not just to understand engineering but to innovate within it.

Sustainable Transportation: The Road to a Greener Future

DR FIROZ N
Asst. Professor

Transportation plays an essential role in shaping modern society, influencing the environment, economy, and the quality of life of people across the world. It is not merely a means of moving people and goods but a fundamental enabler of development, trade, and connectivity. However, as the world faces the challenges of climate change, pollution, urban congestion, and energy scarcity, the sustainability of our transport systems has emerged as one of the most pressing global concerns. The need to make transportation more sustainable is not a matter of choice but of necessity, as it directly affects the future of our planet and the well-being of generations to come.
Sustainable transportation refers to mobility systems that meet present needs without compromising the ability of future generations to meet theirs. It aims to reduce environmental harm while improving accessibility and efficiency. By promoting cleaner fuels, electric vehicles, shared mobility, and well-planned public transport, societies can reduce their dependence on fossil fuels and cut greenhouse gas emissions significantly. Beyond its environmental benefits, sustainable transport is also a matter of social equity. Affordable, safe, and reliable transportation ensures that all sections of society—especially rural populations and low-income groups—have access to opportunities for education, healthcare, and employment. Thus, sustainability in transportation goes hand in hand with inclusiveness and social justice

Globally, transportation is closely linked with several United Nations Sustainable Development Goals (SDGs). It directly contributes to SDG 7, which focuses on affordable and clean energy, by encouraging the shift from fossil fuels to renewable energy sources through electric mobility and biofuels. It supports SDG 9, promoting resilient and innovative infrastructure, and SDG 11, which envisions sustainable cities and communities through improved public transport and non-motorised mobility options such as walking and cycling. Transportation also plays a vital role in SDG 13, which calls for urgent action to combat climate change, as well as SDG 3, which promotes good health and well-being by reducing air pollution and traffic-related stress. Efficient transport systems, in turn, enhance productivity and support SDG 8, which advocates for decent work and economic growth. In essence, a well-planned and sustainable transport sector acts as a bridge connecting multiple goals, accelerating progress toward a balanced and equitable future.

In India, several government initiatives have been launched to drive the country towards cleaner and more efficient mobility. The Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme provides incentives to promote the use of electric vehicles and the development of charging infrastructure. The PM-eBus Sewa scheme aims to introduce electric buses in major cities, providing an affordable and eco-friendly alternative to diesel-based public transport. The National Clean Air Programme (NCAP) focuses on reducing air pollution across 131 Indian cities through measures such as promoting low-emission zones and encouraging public transport. The National Logistics Policy (NLP) of 2022 is another major step, aiming to create an efficient, resilient, and sustainable logistics network by integrating road, rail, and waterway transport. Urban development missions such as the Smart Cities Mission and AMRUT have also emphasised sustainable mobility by developing pedestrian-friendly infrastructure, cycling lanes, and improved public transportation systems. Even rural schemes like the Pradhan Mantri Gram Sadak Yojana (PMGSY), though primarily aimed at connectivity, indirectly support sustainability by improving access and reducing travel inefficiencies.

Despite these encouraging developments, the road to sustainable mobility is filled with challenges. Rapid urbanisation and the continuous rise in private vehicle ownership have led to higher fuel consumption, congestion, and pollution. Public transport systems in many cities remain inadequate, and rural connectivity still faces infrastructural and financial limitations. The availability of charging infrastructure for electric vehicles is limited, and the cost of adoption remains high for many users. Moreover, the preference for private over public transport continues to dominate urban lifestyles, creating behavioural barriers to sustainability. Urban planning practices often fail to integrate land use and mobility, leading to urban sprawl and longer travel distances. Financing sustainable transport projects is another major obstacle, requiring innovative funding mechanisms such as public–private partnerships and green bonds.

To overcome these challenges, an integrated and inclusive approach is essential. The transition to sustainable transportation must prioritise public and non-motorised transport systems to reduce congestion and pollution. Electrification of vehicles, powered by renewable energy, should be accelerated through the creation of widespread and accessible charging networks. Urban development must be guided by the principles of compact, mixed-use planning and transit-oriented development so that workplaces, schools, and services are easily reachable by public transport. Freight and logistics systems must be redesigned to promote multimodal transport and energy-efficient operations. Equally important is the need to influence behavioural change among citizens through awareness campaigns, incentives, and improvements in comfort and safety. Sustainable mobility should also ensure equity, providing safe and convenient access for women, children, the elderly, and persons with disabilities.

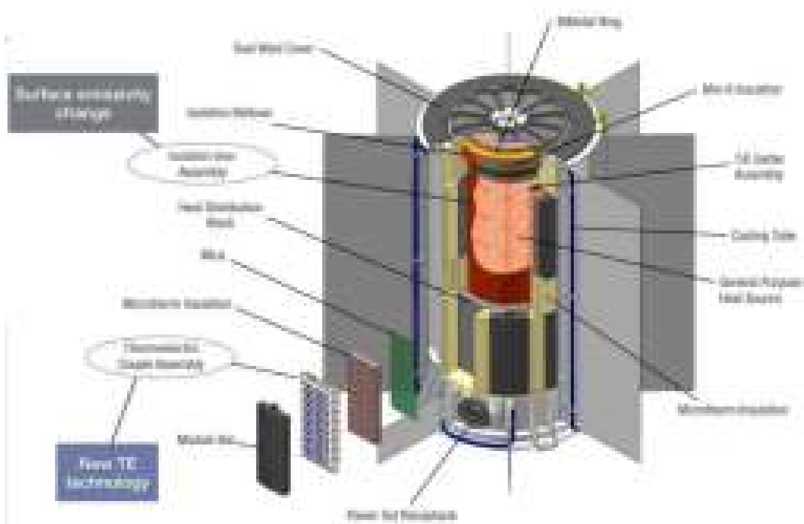
Transportation thus stands at the intersection of environmental protection, economic growth, and social progress. Moving towards sustainable mobility offers benefits far beyond reduced emissions—it strengthens energy security, enhances public health, and creates more liveable cities. India's policies and programmes have laid a strong foundation, but achieving a truly sustainable transport system requires coordination among government agencies, industries, researchers, and citizens. It is a collective journey that demands consistent effort, technological innovation, and behavioural transformation.

Sustainable transportation is not merely an environmental agenda but a pathway to a better quality of life and a more equitable society. The choices made today in planning, technology, and governance will determine the future of mobility for decades to come. The vision of a cleaner, smarter, and more inclusive transport system is well within reach if nations commit to long-term thinking and collective action. The road ahead may be long, but the destination —a sustainable and net-zero transportation future—is one that humanity cannot afford to miss.

THERMOELECTRIC GENERATORS FOR SPACE EXPLORATION

Revolutionising Power Systems Beyond Earth

The evolution of thermoelectric generators (TEGs) and radioisotope thermoelectric generators (RTGs) has transformed the energy landscape of deep-space exploration. From powering the Voyager spacecraft to enabling long-duration missions like Curiosity and Perseverance, advancements in thermoelectric materials have redefined how humanity explores the cosmos.



Advancements from RTG to eMMRTG

The Physics Behind Thermoelectricity

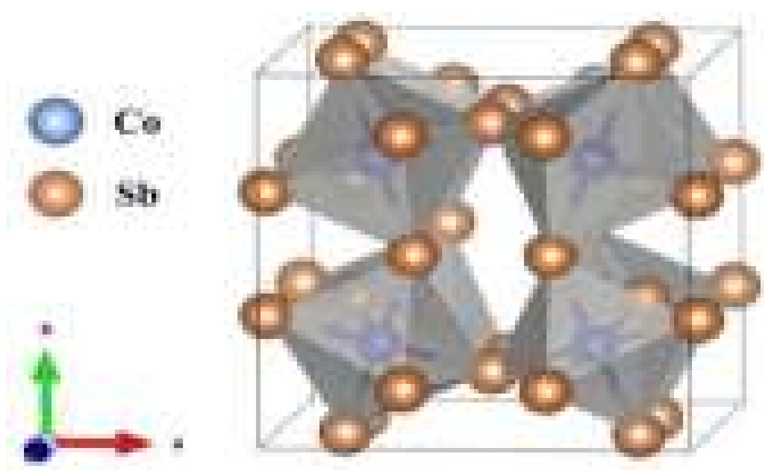
TEGs work on the Seebeck effect, where a temperature difference across two dissimilar materials generates an electric voltage. This principle enables the direct conversion of waste heat, especially from radioactive decay, into usable electricity, making it invaluable for space missions where sunlight is limited.

From RTG to MMRTG: The Evolution

RTGs used silicon-germanium (SiGe) alloys, but modern Multi-Mission RTGs (MMRTGs) incorporate improved thermoelectric materials, such as PbTe/TAGS compounds. These advancements increase efficiency, reliability, and mission lifespan.

eMMRTG: The Future of Deep Space Power

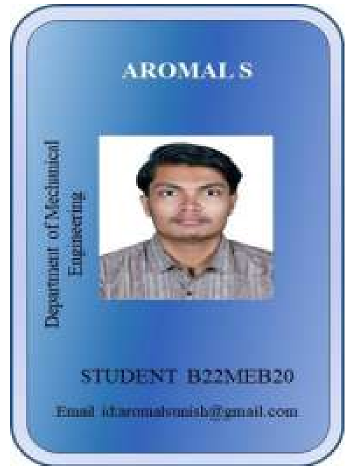
The Enhanced Multi-Mission RTG (eMMRTG) introduces skutterudite-based (SKD) thermoelectric materials that exhibit phonon-glass electron-crystal (PGEC) behaviour, a unique property where the material conducts electricity like a crystal but blocks heat flow like a glass. This minimises thermal conductivity while maintaining high electrical conductivity, resulting in a significantly improved figure of merit (ZT) and up to 25% higher conversion efficiency. The eMMRTG's optimised thermal management and material stability make it ideal for powering future deep-space missions such as Dragonfly.



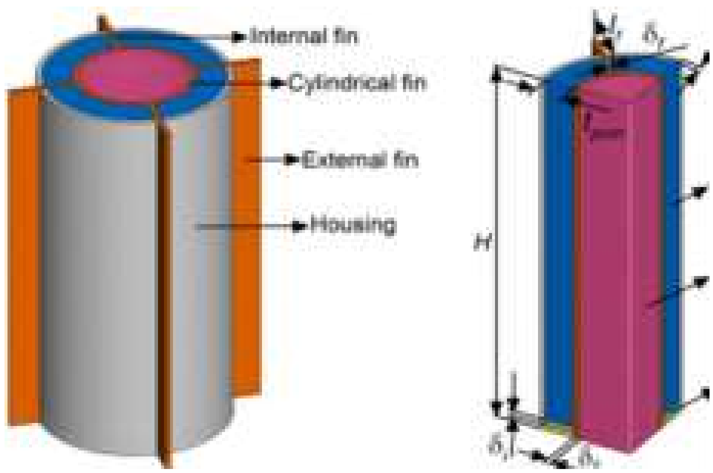
crystal structure of the CoSb3-based SKD alloy

HYBRID COOLING FOR EV BATTERIES: INTEGRATION OF FINNED STRUCTURES WITH PCMS

Cooling the Future: The Hybrid Revolution in EV batteries



Electric vehicles demand advanced cooling technologies to ensure battery safety and longevity. By merging Phase Change Materials with high-conductivity metal fins, engineers have developed hybrid systems that manage heat passively yet efficiently eliminating pumps and fans while maintaining optimal temperature balance through intelligent material design and innovative thermal engineering.



Smart Thermal Design for the Electric Era

When Metal Meets Melt: The Science Behind Stable Power

Within the PCM matrix, aluminium or copper fins act as high-speed heat pathways, transferring warmth from active battery cells to cooler regions. This metal–material interaction enhances heat spreading, prevents dangerous hotspots, and creates a uniform temperature field, transforming passive materials into active protectors that extend battery life and stability. These advancements increase efficiency, reliability, and mission lifespan.

Hybrid PCM-fin cooling systems represent a breakthrough in sustainable EV design. Through improved fin geometry, nanocomposite PCMs, and compact structural layouts, these systems enable efficient heat dissipation without consuming power. The result is safer, longer-lasting batteries that support greener mobility and redefine performance standards for next-generation electric vehicles.

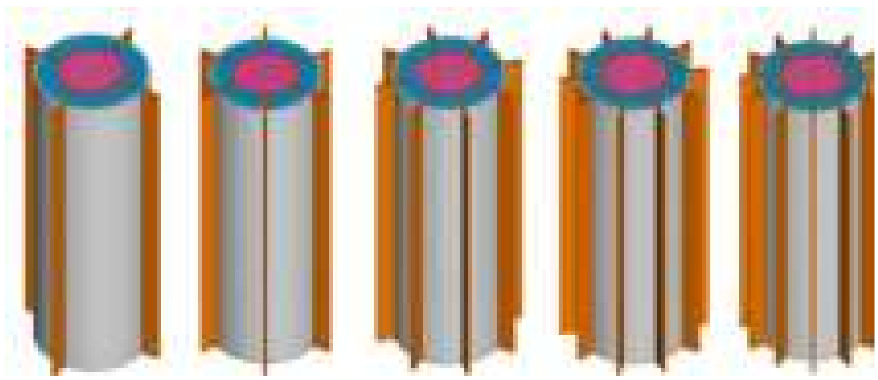


Figure. Different hybrid models around a cell of battery

TKMCE

Clubs

SAE TKMCE

ENGINEERING REDEFINED

THANGAL KUNJU MUSALIAR COLLEGE OF ENGINEERING • QUILON •

"Innovation Ignited. Futures Engineered."


*XLR8FST

SAE TKMCE

SOCIETY OF AUTOMOTIVE ENGINEERS TKMCE CHAPTER

The Society of Automotive Engineers(SAE TKMCE) is a vibrant student organisation dedicated to fostering the growth and development of aspiring engineers. Our mission is to provide a platform for students to gain a deeper understanding of the engineering profession, bridging the gap between academia and industry, by hosting meetings with practising engineers, organising field trips to research and engineering establishments, sponsoring student projects of engineering interest, and participating in SAEINDIA Section activities. Open to all TKM College of Engineering students who are SAEINDIA student members or SAEINDIA members, our organisation welcomes individuals passionate about engineering and innovation.

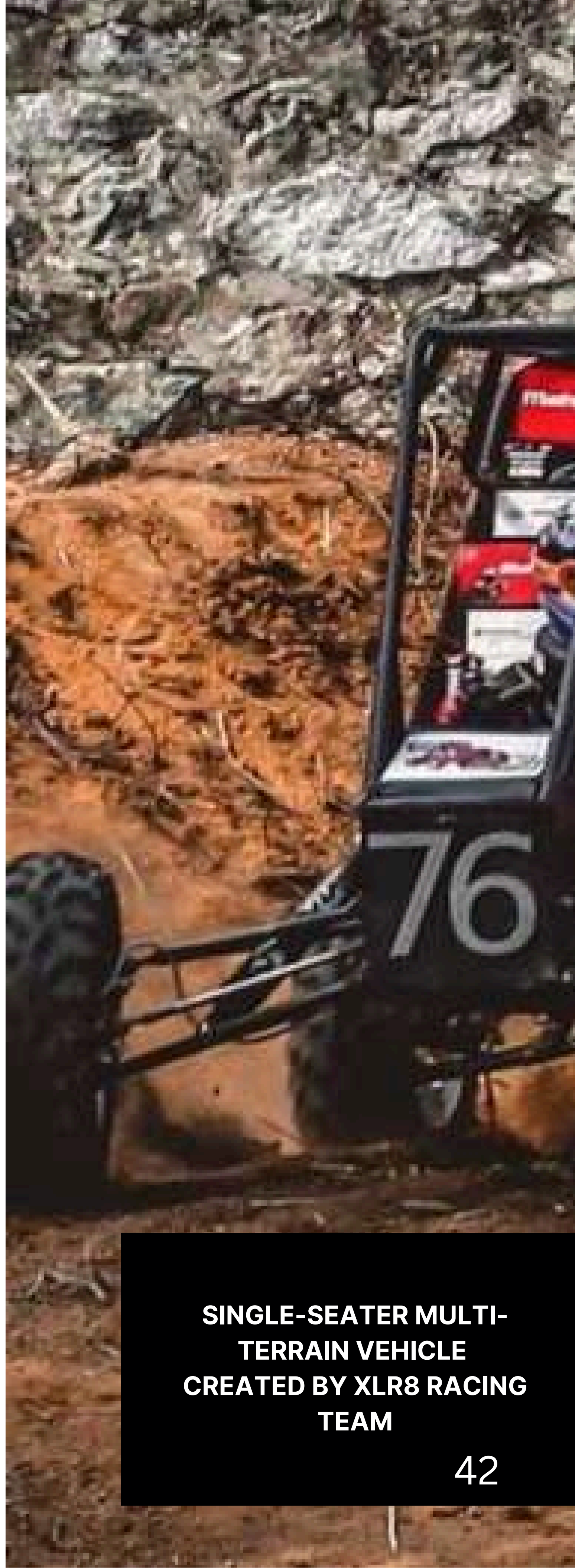
Our Teams

1.BAJA

BAJA, launched in 2007, is a premier engineering event organised by SAE India, where students design, build, and race all-terrain vehicles. With over 400 participating colleges, BAJA India fosters innovation and practical skills, backed by leading OEMs like Mahindra and Ansys. TKM College's XLR8 racing team has excelled in this competition, achieving notable successes in both the mBAJA (conventional) and eBAJA (electric vehicle) categories.

M BAJA

The XLR8 racing team was formed in 2016 with a novice team of 23 students. Despite initial setbacks, they developed a single-seater multi-terrain vehicle and participated in BAJA events.The team overcame challenges, achieving notable rankings, including AIR 45, AIR 5, and AIR 61, and secured top positions in Kerala. They adapted to virtual events during the pandemic and participated in the Mega ATV Championship. With each iteration, the team improved, showcasing resilience and determination. Despite mechanical errors and unexpected failures, XLR8 continues to innovate and push boundaries in the world of automotive engineering.



SINGLE-SEATER MULTI-TERRAIN VEHICLE CREATED BY XLR8 RACING TEAM

E BAJA

SAEINDIA introduced eBAJA in 2014, an electric engine-driven BAJA event, to promote greener mobility, as advised by former Indian President APJ Abdul Kalam. This category features electric-powered ATVs with 48V traction motors, fully automatic transmission, and 110 Ah battery packs. Although eBAJA competitions began recently, our XLR8 team has not participated until now. Instead, we attended an online workshop in 2022 to thoroughly study the project. We are currently building a car for eBAJA 2024, which promises to be exceptional due to our meticulous planning and in-depth study of its design, covering both theoretical and practical aspects.

BAJA ACHIEVEMENTS

- 2016-17
  - Virtuals: 1st place in Kerala, 32nd position All India
  - Main Event: Participated in Pithampur, Indore
- 2017-18
  - Virtuals: 61st position All India at Chitkara University, Chandigarh
  - Main Event: All India rank of 45, 1st position in Kerala at Pithampur, Indore
- 2018-19
  - Virtuals: 181st position at Chitkara University, Chandigarh
  - Main Event: All India Rank of 5, 1st position in Kerala at IIT Ropar, Punjab
- 2019-20
  - Virtuals: 47th position at Chitkara University, Chandigarh
- 2020-21
  - Virtuals: 60th position in online event
  - Virtual Dynamic Event: All India Rank of 61, 2nd position in Kerala

2. XLR8FST

Formula Bharat was a competition that we were pushed into participation in thanks to an ill-informed early registration, nevertheless the exposure was colossal building on the experience from the previous supra, and were one of the very few first-time teams to incorporate custom springs and pushrods into the design but lack of funding and understanding of the scale of the competition was put on full display as the team of SAE Supra went for the competition and saw the mountain that had to be scaled even though the team cleared a few static rounds they weren’t able to clear the technical inspection.

- AIR 40 in Formula Bharat 2020
- AIR 2 in Formula Bharat 2021
- AIR 16 in Formula Bharat 2022
- AIR 31 in Formula Bharat 2023
- AIR 15 in Formula Imperial 2023
- AIR 19 in Formula Bharat 2024

3. SPOX

SPOX Bicycle Deisgn Team aims to design a manually propelled road bike for a bicycle design competition, to create a vehicle that is ergonomically comfortable, aesthetically appealing, and mechanically strong, capable of carrying an average human being. The design must adhere to applicable Indian Standards for bicycle design. Additionally, the goal is to keep design and manufacturing costs low, targeting a price point of Rs. 7,000 for single-speed and Rs. 10,000 for multi-speed transmission, with an annual sales target of 50,000 units per year.

2024- 25

- All India Rank 1 - Dynamic Performance

2025-26

- Kerala Rank 4, AIR 16 - Overall performance

2024: AIR 1st for best innovative design category.

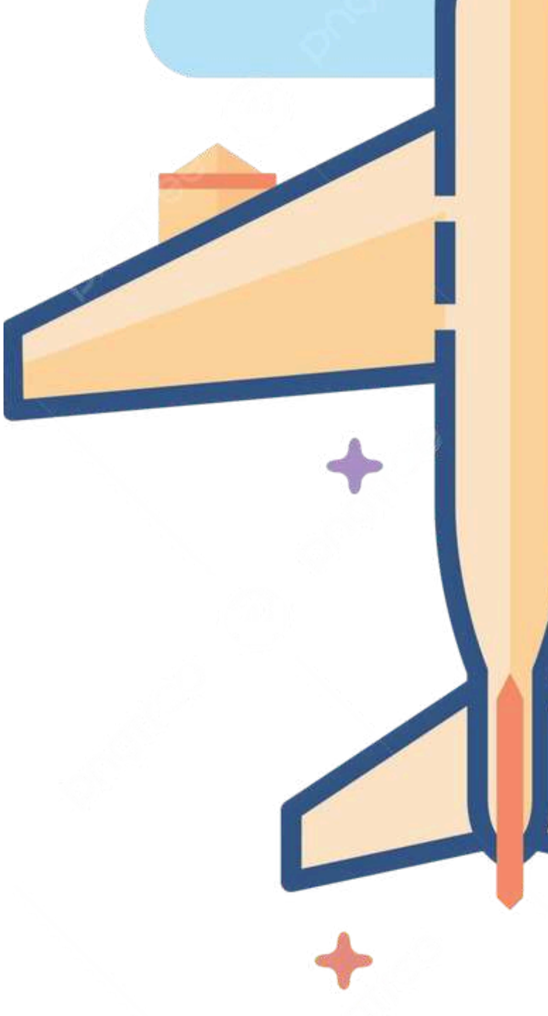
4. VEGHA

The SAE Electric Two Wheeler Design Competition 2019, tasks the students to think, analyse, design, develop, build, test, and present in a series of events. First of its kind in India, the Competition ensures that Students get a realistic 360-degree workplace experience. The objective of ETWDC 2019 is to design, engineer, prototype, and demonstrate an Electric two-wheeler to carry one person, with a price tag of ₹60000, based on an annual sale of 25000 units per year.

- Secured All India Rank (AIR) 3 for technical presentation in the 2018-19 season.
- Team Vegha secured Third Place in the competition for innovative approaches to innovation and 3D modelling in 2023-24.

5. DRONA

The Drone Development Challenge (DDC), formerly Aero Design Challenge, aims to build students' capabilities in understanding technical concepts and applying them to design and test real aircraft. The competition evaluates teams based on design report, analysis model, flight, and maximum payload achieved. The team consists of 10 members from different engineering branches, who have attended workshops like Envision-3D Modeling & Printing, ANSYS Fluent Fundamentals, and DDC Hands-on-Workshop, and utilized software like SOLIDWORKS, Fusion 360, ANSYS, and XFLR5. The competition is held in phases, including design report submission, fabrication, final inspection, and participation, with technical inspection to ensure dimensional accuracy.



6. AERO

SAE Aero Design is a competition where teams design, build, and test radio-controlled aircraft to meet mission requirements, simulating real-life engineering challenges. It has two classes: Regular (max payload) and Micro (balance payload and weight). In 2019, the Autobots team from TKMCE participated in the Aero Design Challenge, showcasing determination despite a crash ending their competition. In 2020, two teams, SPIT FIRE and FALCON, demonstrated engineering skills and creativity in designing and flying aircraft, with a focus on payload limits, stability, and structure. The pandemic necessitated online presentations, which enhanced team members' skills in Solidworks and Ansys. The teams, including SPIT FIRE, FALCON, AREX, and Zeus, demonstrated excellence in aircraft design, presentation, and disaster management.

Year in review 2024-25

ACADEMIC YEAR HIGHLIGHTS

VEGHA TEAM

SAE TKMCE has had an exceptional year in 2024-2025, marked by significant achievements and milestones. The journey began with the formation of our Executive Committee on August 12, 2023, followed by the creation of the Documentation & Media Team in November, tasked with crafting engaging content and managing our media presence. November also saw a warm welcome to our first-year students during the Orientation held on November 6, 2023.

Our recruitment efforts were vigorous, with a Membership Drive from December 26, 2023, to January 10, 2024, and additional drives for the Aerex, Electric Two-Wheeler Design Competition, and Formula Design Competition. The year was a tapestry of notable achievements: from excelling in the CFD Competition and Spox Bicycle Design Competition to making strides in Electric Two-Wheeler Design and the XLR8 Student Formula Team.

Year in review 2024-25

ACADEMIC YEAR HIGHLIGHTS

SPOX TEAM

The SPOX Bicycle Design Team of TKM College of Engineering achieved a remarkable milestone this year with the design and fabrication of a single-speed city bicycle under ₹7000. The model was developed with a focus on ergonomic comfort, structural stability, and visual appeal, ensuring both performance and affordability. Designed to support the average rider, the bicycle features an optimized frame geometry for improved posture, handling, and ride efficiency.

Despite encountering several technical and logistical challenges during the design and manufacturing phases, the team's persistence and problem-solving approach led to the creation of a high-performing prototype. Their innovation and engineering excellence were nationally recognized when SPOX secured the All India Rank 1 for Best Dynamic Performance. This achievement highlights the team's technical capability, design innovation, and commitment to developing efficient, sustainable mobility solutions.

Year in review 2024-25

ACADEMIC YEAR HIGHLIGHTS

TEAM XLR8 FST

The XLR8 Formula Student Team, renowned for its focus on performance and speed, designed and built single-seater race cars for prestigious events like Curiosumtech Formula Bharat, ISIE Formula Imperial, and SAE Supra. Also secured AIR 15 in Formula Imperial and AIR 19 in Formula Bharath.

Our organisation also orchestrated major events like the EUREKA Ideation Program and a series of technical competitions and workshops. "Tesseract II," our technical journal, showcased cutting-edge advancements in automotive engineering, reflecting our unwavering commitment to innovation and excellence.

ACADEMIC YEAR HIGHLIGHTS

TEAM TRAX

Team TRAX from TKM College of Engineering achieved a historic All India Rank 3 in FMAE MotoStudent India Season 4, held from October 11 to 15, 2025. Formed in November 2024, they were the first team from TKMCE to participate in this competition, designing and building a motorcycle from scratch. Competing in Asia's largest vehicle manufacturing contest, the team showcased remarkable engineering skills. Under the guidance of Mr. Ahammed Bilal A and led by Captain Madhav Manu, they built a MOTOGP-style race machine and excelled in various segments: 1st in Autocross, 2nd in Acceleration and Endurance, and 3rd overall in India. Their success resulted from team dedication and support from OK CLUB, TKMCE alumni sponsors. Team TRAX exemplifies how passion and teamwork can lead to success.

TKMCE

Clubs

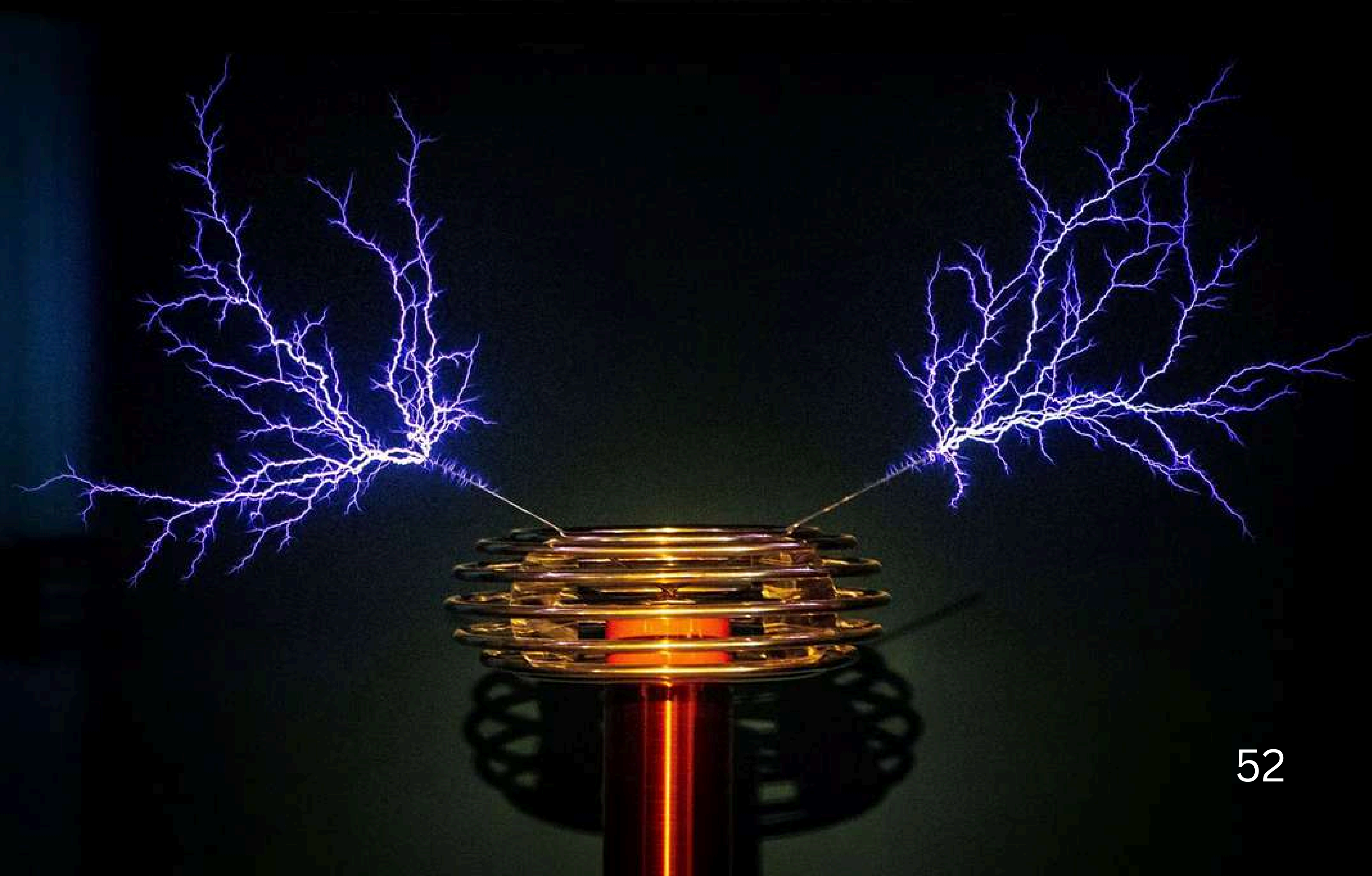
ASME

REPORT

ASME

SETTING THE STANDARD

TKMCE STUDENT SECTION



*DISTINGUISHED STUDENT SECTION AWARD

ASME TKMCE

AMERICAN SOCIETY OF MECHANICAL ENGINEERS TKMCE CHAPTER

The American Society of Mechanical Engineers (ASME) is an American professional association that, in its own words, "promotes the art, science, and practice of multidisciplinary engineering and allied sciences around the globe" via "continuing education, training and professional development, codes and standards, research, conferences and publications, government relations, and other forms of outreach."
ASME TKMCE was established in November 2018 under the guidance and leadership of Dr. Rijo Jacob Thomas, Assistant Professor, Department of Mechanical Engineering, Mr. Goutham B Raj (Mechanical Batch 2016-2020 batch) and Mr. Adilsha Kizhuvedath (both students of Mechanical Batch 2016-2020 batch).

EVENTS

Conducted by ASME

1. STUDENT ORIENTATION PROGRAMME

The ASME student orientation program served as a gateway for aspiring mechanical engineers, providing invaluable networking opportunities, industry insights, and guidance for academic and professional success. Through interactive sessions and mentorship, participants gained a deeper understanding of mechanical engineering principles and cultivated the skills necessary to excel in their studies and future careers, enriching their journey within the field of engineering.

2.CAREER E-FEST 2023

TKM College of Engineering excelled at the ASME Career E-Fest 2023, with over 100 students participating online. Their remarkable engagement earned them the prestigious title and a $500 award for the highest participation rate. This achievement reflects ASME TKMCE's commitment to fostering active involvement and excellence in mechanical engineering education.

3. ONE-DAY INDUSTRIAL SKILL DEVELOPMENT PROGRAM

The one-day skill development program, organized by ASME TKMCE, was conducted at NIT Trichy, drawing enthusiastic participation from students of TKMCE. Through hands-on workshops and interactive sessions, attendees honed their technical competencies, fostering a culture of innovation and excellence. The collaboration between institutions facilitated knowledge exchange, empowering students to thrive in the dynamic landscape of engineering and technology.

4. TALK SESSION

ASME TKMCE organized a compelling talk session exploring the "Scope and Challenges of Metallic Biomaterial for Implants and Prostheses," drawing a diverse audience of engaged students. Experts delved into the intricate world of biomedical engineering, discussing emerging trends, technological advancements, and the ethical considerations surrounding the development and application of metallic biomaterials. Attendees gained valuable insights into this critical field, sparking thought-provoking discussions and fostering a deeper appreciation for the intersection of engineering and healthcare.

ACHIEVEMENTS

of ASME

1. Highest attendance award at EFEST Careers

ASME TKMCE secured the highest attendance award at E-Fest Careers for the second consecutive year with a $500 cash prize (2022,2023).
This achievement reflects dedication and professionalism, inviting members to explore more opportunities for academic and professional growth.

2. Distinguished Student Section Award

ASME TKMCE has been honoured with the Distinguished Student Section Award for the year 2023-24.
The memento and a cash prize of 10k was handed over to Dr. Shafi K A , HOD of Mechanical dept by Dr. Sajeeb R , Principal of TKM College of Engineering.
This award is a symbol of excellence, hardwork and dedication and the ASME TEAM has delivered it once again!

TKMCE

Clubs

ISHRAE

REPORT

THANGAL KUNJU MUSALIAR COLLEGE OF ENGINEERING • QUILON •

STUDENTS IN ISHRAE

TKMCE STUDENTS CHAPTER

*INDUSTRIAL VISIT TO TRIVANDRUM INTERNATIONAL AIRPORT HVAC SYSTEM

ISHRAE TKMCE

INDIAN SOCIETY OF HEATING, REFRIGERATING, AND AIR CONDITIONING ENGINEERS TKMCE CHAPTER

ISHRAE, the Indian Society of Heating, Refrigerating, and Air Conditioning Engineers, established in 1981, plays a vital role in advancing the HVAC&R industry in India by promoting knowledge sharing and best practices among professionals, engineers, and industry stakeholders. It actively organises seminars, and conferences, and publishes research to drive innovation, sustainability, and energy efficiency in the sector. Through its educational programs and initiatives, ISHRAE helps nurture future talent while ensuring that the HVAC&R industry contributes meaningfully to the development of sustainable infrastructure and the overall improvement of India's built environment.

UNITING STUDENTS *for HVAC&R Excellence*

The ISHRAE TKMCE chapter is a vibrant, student-led organisation at TKM College of Engineering, dedicated to advancing knowledge and skills in HVAC&R technology. Through a diverse array of workshops, seminars, industrial excursions, and technical competitions, it provides students with hands-on experience and practical insights into heating, ventilation, air conditioning, and refrigeration. The chapter plays a crucial role in bridging the gap between academic theory and industry practice, empowering students with the expertise and innovative mindset required for successful careers in HVAC&R. By fostering a culture of ingenuity and sustainability, ISHRAE TKMCE not only prepares future professionals but also contributes significantly to the evolution of India’s HVAC&R landscape.

CHAPTER REINSTALLATION AND ORIENTATION CEREMONY

The ISHRAE Chapter convened for its Reinstallation and Orientation Ceremony on October 4, 2023, marking a pivotal milestone in its ongoing journey. This significant event featured the induction of new members into the Executive Committee (Execom), with Mr. Godwin Francis formally inaugurated as President of the Student Chapter.

The ceremony commenced with a Welcome Speech by Prof. Rizwan Rasheed, the Coordinator of the ISHRAE Student Chapter at TKMCE, followed by the official inauguration by Er. Shafi R, Assistant Manager at L&T Infrastructure. The event also included an insightful presentation of the activity report by Godwin Francis, a Technical Talk Session led by Mohammed Sajin, and contributions from Shahudheen, President of the Kollam Sub-chapter, which collectively enriched the attendees’ understanding and engagement with the HVAC&R field.

Further enhancing the event, Dr. Rijo Jacob Thomas, Coordinator of the ISHRAE Student Chapter at TKMCE, delivered a heartfelt felicitation speech, underscoring the significance of the occasion in advancing the chapter's mission. Gokul GS, Program Head of the ISHRAE Student Chapter, addressed the gathering, elaborating on the chapter’s objectives and future aspirations. The ceremony concluded with a Vote of Thanks by Faheem Ameen, Secretary of the ISHRAE Student Chapter, who expressed sincere gratitude to all participants for their invaluable contributions and support. The event not only celebrated the chapter’s past achievements but also set a promising trajectory for its continued dedication to fostering knowledge and opportunities in the HVAC&R field.

Executive Committee Members 2024-25

President: Aswin Sasidharan
President-Elect: Satvik G
Secretary: Faheem Ameen
Treasurer: Akshay Ashok
Documentation Heads: Sarath S S, Gautham Sen
Program Heads: Gokul G, Hemanth PM, Farhan Dileep
Technical Heads: Aravind R, Subin Suresh, Devadath RS
Media Heads: Thomas M Kolethu, Akshay Ashok
Design Heads: Stervin G Solomon, Rahul Samjith

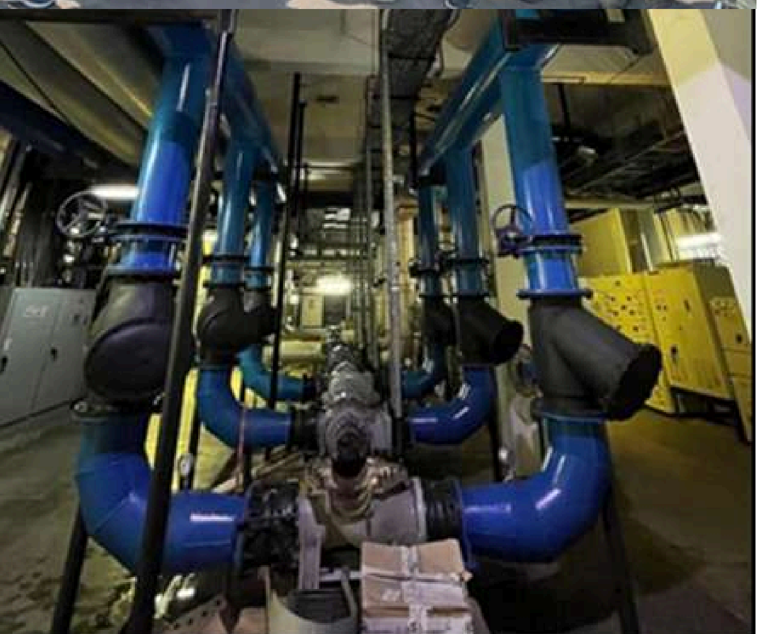
REFCOLD INDIA 2023 Exhibition

The representatives from ISHRAE TKMCE, Faheem Ameen and Farhan Dileep, both third-year Mechanical Engineering students, showcased impressive enthusiasm and commitment during their participation in the esteemed REFCOLD INDIA 2023 exhibition, held in Chennai on October 12th and 13th. The exhibition served as a significant platform for knowledge exchange and industry collaboration, where Faheem and Farhan immersed themselves in the dynamic environment of HVAC&R advancements. They navigated through the event's vibrant interactions and engaging discussions, seizing opportunities to connect with industry experts and delve into the latest innovations. Their active participation and profound engagements at REFCOLD INDIA 2023 not only enhanced their understanding but also expanded their horizons within the HVAC&R sector.Our representatives' participation in REFCOLD INDIA 2023 highlighted their proactive approach and strategic vision for fostering industry collaborations. Their efforts extended beyond the exhibition floor, as they actively sought out potential partners and explored future avenues for collaboration, setting the stage for impactful industry relationships.

REFCOLD INDIA 2023 Exhibition

Their engagement not only showcased their dedication to advancing their professional expertise but also reflected ISHRAE TKMCE's commitment to staying at the forefront of HVAC&R innovations. By immersing themselves in this high-profile platform, Faheem and Farhan emerged as key contributors to the sector's growth, embodying the spirit of innovation and excellence that propels ISHRAE TKMCE forward.

Faheem Ameen and Farhan Dileep’s experience at REFCOLD INDIA 2023 exemplified the profound impact of experiential learning. Their active interactions and engagements at the exhibition went beyond mere knowledge acquisition, deeply influencing their perspectives and shaping their future ambitions. Their participation underscored ISHRAE TKMCE's mission to equip its members with essential tools, insights, and connections for success in a rapidly evolving industry. Returning from the event, Faheem and Farhan are not only carrying forward valuable experiences but also a reinvigorated sense of purpose and dedication to fostering positive advancements in the HVAC&R sector.



INDUSTRIAL VISIT TO TRIVANDRUM INTERNATIONAL AIRPORT HVAC SYSTEM

The Industrial Visit to Trivandrum International Airport was organized by ISHRAE TKMCE for the students to gain exposure to HVAC (Heating, Ventilation, and Air Conditioning) systems implemented at the airport. The visit aimed to provide practical insights into the functioning, maintenance, and challenges faced in managing HVAC systems in a large-scale facility such as an international airport. The visit aimed to bridge the gap between classroom learning and practical industry applications, focusing specifically on the challenges and innovations within HVAC systems at a bustling international airport.

Participants:
The visit saw enthusiastic participation from 47 students pursuing BTech in Mechanical Engineering from TKM College of Engineering, Kollam, accompanied by the following faculty members

1. Dr. Rijo Jacob Thomas (ISHRAE-TKMCE Faculty Coordinator)
2. Prof Resmi S L
3. Prof Ajimshad A

and representatives from ISHRAE TKMCE.

ACTIVITIES AND OBSERVATIONS

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’VENTURE INTO VENTILATION’ TALK SESSION

On November 23, 2023, the "Venture into Ventilation" talk session provided a comprehensive and enlightening exploration of the HVAC industry, offering attendees invaluable insights into this dynamic field. The session featured Mohammad Sajin, President of the ISHRAE Kollam Chapter, whose extensive expertise and deep knowledge illuminated the various career prospects within HVAC. Sajin's engaging presentation not only highlighted the current trends and landscape of the industry but also guided aspiring professionals through the intricate pathways that could lead to successful careers in this rapidly evolving sector. Adding depth to the discussion, Dr. Rijo Jacob Thomas, an esteemed Assistant Professor in the Mechanical Engineering Department, offered an in-depth analysis of the fundamental concepts underpinning HVAC systems. Dr. Thomas's scholarly approach and passion for the subject enriched the session, providing a thorough understanding of core principles, mechanisms, and technological advancements. The session effectively combined theoretical knowledge with practical insights, delivering a panoramic view of HVAC’s significance across industries and its myriad career opportunities.

TECHNICAL SESSIONS

The airport HVAC system visit offered an in-depth look at the complex infrastructure that ensures passenger comfort and safety. Key highlights included the robust power supply system, managed by a synchronised network of four generators controlled by a centralised PLC, which guarantees uninterrupted operation. The hydro-pneumatic pump system, also PLC-controlled, maintains consistent water pressure throughout the airport. Safety features include Air Circuit Breakers (ACBs) for fault isolation, Y strainers, rubber bellows, and precision valves for water filtration and flow control. The cooling system utilises an efficient shell and tube heat exchanger with an insulated evaporator and a non-insulated condenser for optimal performance. The visit also covered critical fire safety measures, such as the jockey pump for maintaining sprinkler system pressure and a diesel-generated backup pump for emergencies. Additionally, the cooling tower operates through natural convection to reject heat. Overall, the visit highlighted the sophisticated, well-coordinated systems that contribute to a safe and comfortable airport environment.

ISHRAE PREMIER LEAGUE (IPL)

The ISHRAE Premier League (IPL) 2024 Cricket Championship, held on April 27 at The Oval Turf in Kazhakkoottam, Thiruvananthapuram, was a vibrant event that brought together cricket enthusiasts from various backgrounds. The ISHRAE TKMCE chapter delivered a spirited performance, advancing to the semifinals and earning recognition for their dedication and skill.
The championship not only provided an exhilarating cricket experience but also offered valuable networking opportunities, fostering camaraderie and collaboration among ISHRAE chapters.

CONCLUSION

The engagement of ISHRAE TKMCE has undeniably enriched the understanding of students in HVAC (Heating, Ventilation, and Air Conditioning) related topics, contributing significantly to their academic and practical knowledge. Building on this success, the commitment to further nurture students' learning continues unabated, with plans for the organization to host a series of events in the upcoming year. Through these endeavors, ISHRAE TKMCE remains dedicated to fostering a culture of continuous learning and professional development among students, ensuring they are well-equipped to excel in the field of HVAC engineering.

TECHNICAL ACHIEVEMENTS

Congratulations

Dr. Baiju A

Invited as Expert Speaker at the Indo-German Bilateral Workshop on "Leveraging Radiative Cooling Potential of Surfaces: Stepping towards Net-zero Emissions (RaCoPBuS: NET)" held at IIT Roorkee.

SPORTS ACHIEVEMENTS

Congratulations

Godson Shaji

SECOND PRIZE
Kabaddi B-zone

Milan Santhosh

SECOND PRIZE
Tennis interzone

Shyam Krishna

SECOND PRIZE
kabaddi zone

ABUBAKAR SIDDIQUE

CHESS INTERZONE CHAMPION

Congratulations

MUHAMMED BASITH N

CHESS INTERZONE CHAMPION

Joyal M S

CHESS INTERZONE CHAMPION

Aman vijayan

kho-kho interzone 3rd prize

HARIKRISHNAN K U

Hand Ball interzone 1st prize

TOP PLACEMENTS

Congratulations

Abaan Palli

James George

Thasnim NS

Akshay Ashokh

Congratulations

Akshay Anil

Ravi Sreelal

Sreehari A

Reeba C Manoj

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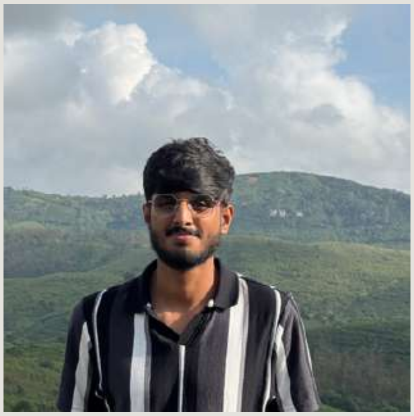

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