



# Highway To A Greener Future

Are **EVs** the only answer to a **sustainable tomorrow?**



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 **Foreword**

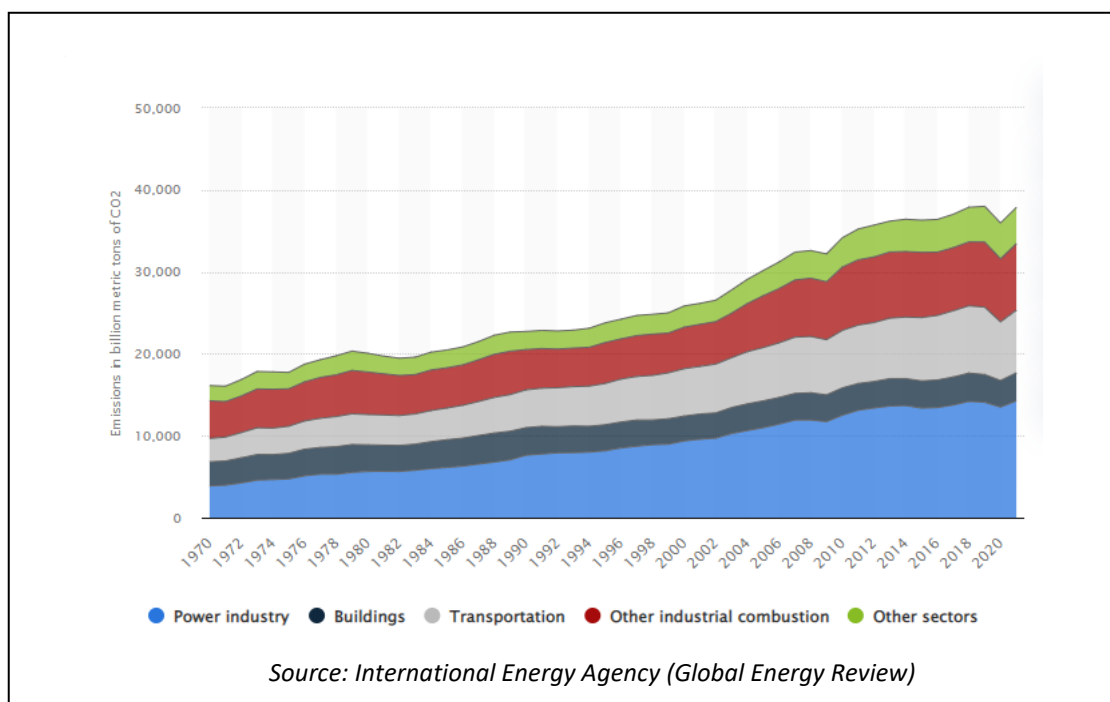
The current market set-up brings to the fore an interesting scenario. In FY22, India's demand for coal, outstripped its production, due to the increase in use of the non-renewable resource in automobiles, households, etc. However, the silver lining is that the growth rate of renewable sources in India has doubled in the last decade, as compared to the growth rate of coal. This indicates that the scenario is slowly shifting from non-renewable sources of energy to green energy and now is the time to ensure that this shift is steady and continuous in nature, for a sustainable future. With this context in mind, the white paper 'Highway to a greener future' aims to shed light on the automobile industry – one of the most prominent users of non-renewable resources. It provides the reader, the current scenario from both Indian as well as global perspective. Further, through various data and case study snippets, the paper gives a holistic picture of where the automobile industry is moving with respect to adapting to greener practices.

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## Introduction

Every passing day our unsustainable actions have a negative impact on our future generation, leaving them with little to no resources. Coal, one of those depleting resources since many generations is the leading component for generating electricity worldwide. Similarly crude oil, a non-renewable natural resource is used to produce petrol and diesel for vehicles to run. Both these processes have huge GHG emissions and affect the environment adversely. On an average burning a pound of coal will emit around 2.07 pounds of CO<sub>2</sub><sup>1</sup> and 1 gallon of gasoline burned will emit around 19.57 pounds of CO<sub>2</sub><sup>2</sup>; is it worth the trade?

The transport sector has always been among the top factor harming the environment. There have been over 2.35 million deaths in India, due to air pollution of all types<sup>3</sup>. According to US environmental protection agency, on an average, a vehicle emits about 4.6 metric tonnes of CO<sub>2</sub> per year<sup>4</sup>. Moreover, globally around 74 percent of the GHG emissions constituted of carbon dioxide in 2016.<sup>5</sup>



<sup>1</sup> United States Environmental Protection Agency, *Frequent Questions: EPA's Greenhouse Gas Equivalencies Calculator*, 15th March, 2023

<sup>2</sup> United States Environmental Protection Agency, *Greenhouse Gases Equivalencies Calculator - Calculations and References*

<sup>3</sup> The Economics Times, *Pollution led to over 23.5 lakh premature deaths in India in 2019, highest in world: Lancet study*, 2023

<sup>4</sup> United States Environmental Protection Agency, *Greenhouse Gas Emissions from a Typical Passenger Vehicle*, March 2018

<sup>5</sup> Ritchie et al., *Greenhouse gas emissions*, 2020

Realizing the difficulties that vehicular emissions cause to the planet, the Indian government has been trying to reduce the same through various initiatives involving alternate fuels. Currently, the government has diversified its focus towards various alternate fuel generation methods such as bio diesel, bio-CNG, bio-LNG, ethanol, hydrogen and electric vehicles (EV). Among these, EV, ethanol and hydrogen fuels are the major focus areas of India.

Contrary to popular belief, EV is not a modern invention – its origins stretch back to the 1800s. However, it has gained popularity in recent times and is touted as the next big revolution in the automobile industry. So, why are EVs threatening to replace the decades-old ICEs or Internal Combustion Engines?

To answer the above question, we need to understand the difference between EVs and ICEs. The latter are vehicles with traditional engines that use non-renewable resources like natural gas, coal and crude oil. This fuel burning inside ICEs emit harmful gases, residuals and particle mass (PM) – all of which have a devastating impact on air quality and human health.

EVs – as the name suggests – work on electricity, with its battery being primarily made of metals like lithium, nickel and cobalt. A major advantage of EVs over ICEs is that the former eliminates toxic tailpipe pollution like CO, NO<sub>x</sub> and NO<sub>2</sub>.

## Types of EVs

The primary types of EVs are the Battery Electric Vehicle (BEV), the Hybrid Electric Vehicle (HEV) and the Fuel Cell Electric Vehicle (FCEV)

- **Battery Electric Vehicle (BEV)**  
Completely powered by electricity and is more efficient compared to Hybrid Electric Vehicles (HEVs)
- **Hybrid Electric Vehicle (HEV)**  
Use both electricity and internal combustion for their running
- **Fuel Cell Electric Vehicle (FCEV)**  
Use electric energy that is produced from hydrogen and does not depend on power plants (like other EVs) where fossil fuels are used to generate electricity



### ***DID YOU KNOW?***

*EV is not a modern invention. Its origin dates back to the 1800s*

## Global stance of EVs

Higher awareness amongst people today, as well as the rise in prices of gasoline is already posing a serious challenge to the sale of ICEs. Major economies around the world are providing a further impetus to the electric vehicle industry through various governmental initiatives. For example, 80% of all new cars sold in Norway<sup>6</sup> in 2022, were electric and this is primarily owed to generous tax incentives and the 50% reduction in ferry fees, road taxes and parking fees offered to EV owners. USA has specific policies in place to provide purchase incentives for EVs – like tax credits, technical and financial assistance to install charging infrastructure, etc.

Sales of electric cars – battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) – nearly doubled year-on-year to 6.6 million in 2021. This brought the total number of electric cars on roads to over 16.5 million. Together, China and Europe accounted for more than 85% of global electric car sales in 2021, followed by the United States (10%), where they more than doubled from 2020 to reach 6,30,000.<sup>7</sup>

Analysts forecast that by 2030, more than 60% of all vehicles sold globally will be EVs.<sup>8</sup> The World Bank expects viability of EVs to further improve between now and 2030 and is actively working with many client countries (like Brazil, Egypt, Senegal, India, etc.) on projects to advance electric mobility.<sup>9</sup> The top global players in the electric automotive sector today are Tesla, BYD and Nissan, thus giving a varied range of commercial or luxury options to the consumer to choose from.



### ***DID YOU KNOW?***

*By 2030, around 60% of all automobiles sold globally are expected to be EVs!*

<sup>6</sup> CBS NEWS, *80% of new cars sold in Norway are now Electric Vehicles*, 2023

<sup>7</sup> Ekta Meena Bibra, Elizabeth Connelly, Shobhan Dhir, *Global EV Outlook 2022-Securing supplies for an electric future*, 2022

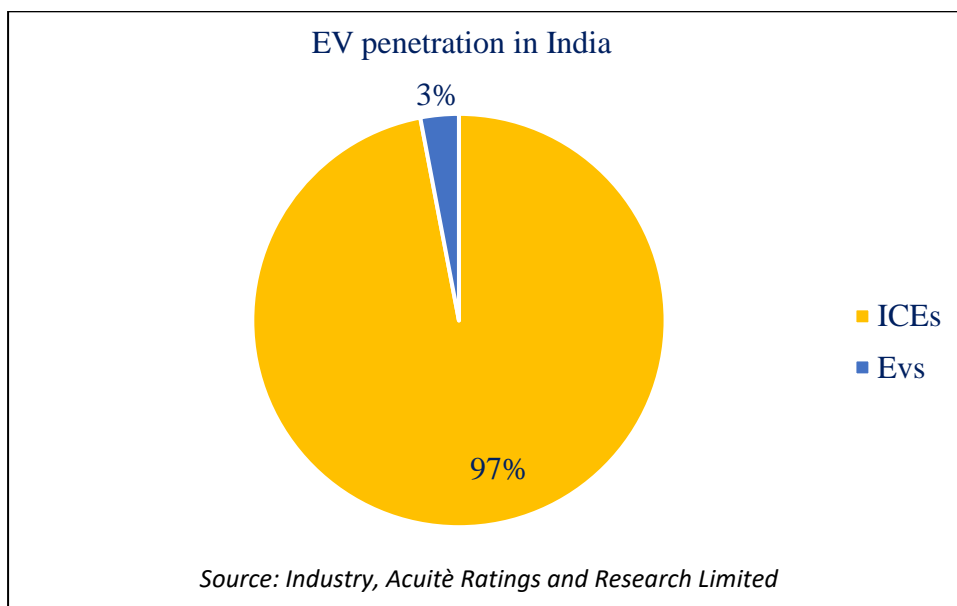
<sup>8</sup> IEA, *By 2030 EVs represent more than 60% of vehicles sold globally*, September 2022

<sup>9</sup> World Bank Group, *New research: Economic viability of electric vehicles is strong and improving in many developing countries*, 2022

## India's highway towards a greener future: EV

India has also jumped on the bandwagon to provide incentives to increase the sales of electric vehicles. The Government has already launched initiatives, such as, Faster Adoption of Manufacturing of Electric Vehicles Scheme – II (FAME – II) and Production Linked Incentive Scheme (PLI) with a budgetary outlay of INR 10,000 crore and INR 25,938 crore respectively.<sup>10</sup> The finance minister also announced policies that help in setting up charging stations at a lower price, waived off customs duty on EV batteries and rev up rural demand for electric vehicles. With 2-wheeler EVs gaining popularity, its ICE counterpart is already facing the heat, with the sales dropping by CAGR 10% from FY19 to FY22.<sup>11</sup> According to Mint, every 20<sup>th</sup> vehicle registered in India in 2022, was an EV.<sup>12</sup> Several organizations have also committed to adopting EVs, such as Zomato, which announced its intention to transition to 100% electric vehicles by 2030<sup>13</sup>.

However, currently the market share of electric vehicles in India is just 3% as compared to ICEs.<sup>14</sup>



<sup>10</sup> Press Information Bureau, *The production linked incentive (PLI) scheme for automobile and auto component successful in attracting investment 15th March, 2022*

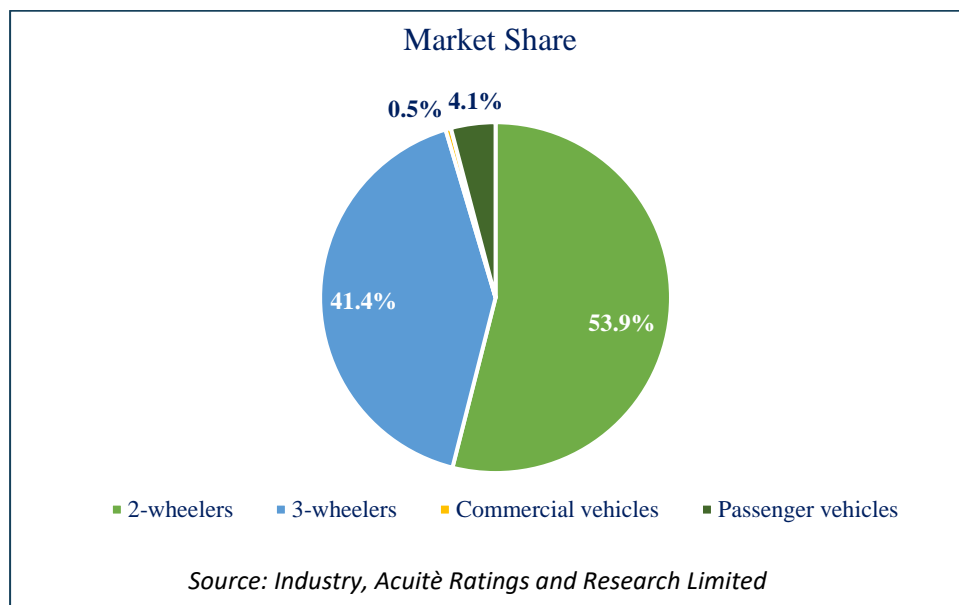
<sup>11</sup> Shangliao Sun, *India: Two-wheeler domestic sales, 2022*

<sup>12</sup> Shuja Asrar, *How EVs in India zipped past 1 million mark in 2022, 2023*

<sup>13</sup> Dwaipayan Bhattacharjee, *Zomato to support Jio-BP's initiative with 100 per cent electric vehicle (EV) fleet by 2030, 2022*

<sup>14</sup> Ajit Dalvi, *EV sales in Q1 already 49% of entire FY2022, 9th June, 2022*

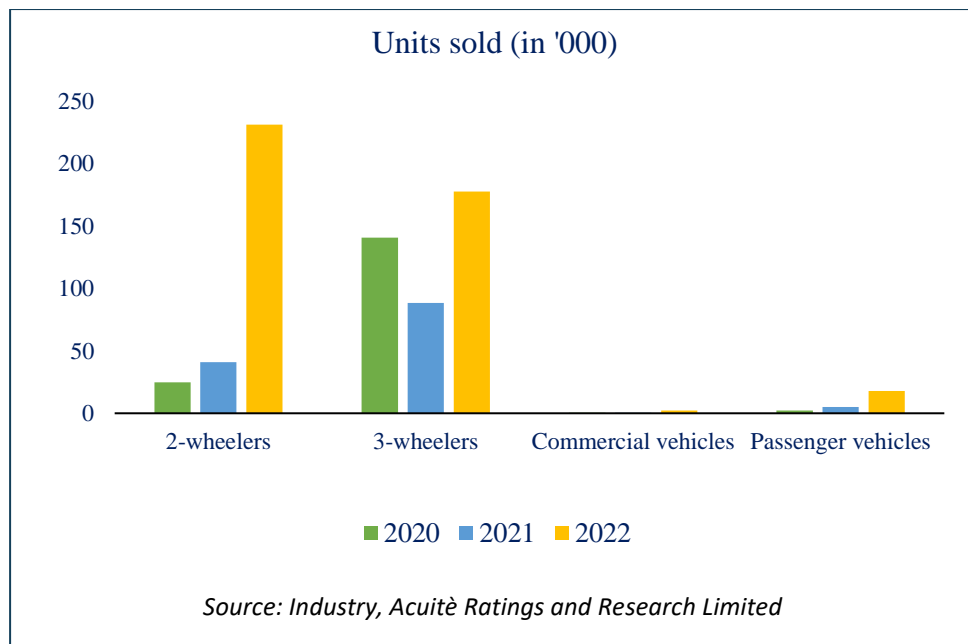
Delving deeper into the EV market, most of the vehicles sold are 2-wheelers and 3-wheelers. Passenger and commercial vehicles have a significantly smaller market share for FY22.



From FY20 to FY21, the y-o-y growth in the number of 2-wheelers EVs sold in India was 65%. This has seen a mammoth jump to 464% in FY22 from FY21. Both three-wheeler and commercial EVs had faced a negative growth rate in FY21 from FY20. This y-o-y growth rate too has jumped up to 101% and 451% respectively, in FY22 from FY21. Passenger electric vehicles had seen a y-o-y growth of 119% in the number of units sold in FY21 from FY20. This increased to 257% y-o-y growth in FY22 from FY21.<sup>15</sup>

<sup>15</sup>Ajit Dalvi, EV sales in Q1 already 49% of entire FY2022, 9th June, 2022





The total y-o-y growth of EVs in FY21 from FY20 was -20%. This has jumped up to 218% in FY22 from FY21.

The top player in the 2-wheeler EV market in India is Hero Electric Vehicles Private Limited with a market share of 28% in FY22. Okinawa Autotech Private Limited comes a close second with a 20% market share. In passenger vehicles, Tata Motors takes the lead with a market share of 85.4% in FY22.<sup>16</sup> With top automobile manufactures like Tata Motors, Mahindra & Mahindra and Hyundai already venturing into manufacturing electric vehicles, the EV market in India is only set to grow further with it already being a profitable destination for big global players like Mercedes-Benz, Audi, BMW, etc<sup>17</sup>.

### Two sides of the same coin: The trickiness of electric vehicles

However, there are still certain challenges that India faces in adopting EVs completely. The country has poor road infrastructure that makes it difficult for EVs to efficiently operate. Additionally, there is a lack of recycling infrastructure for EV batteries which will lead to a higher amount of wastage, thus posing a challenge to sustainability. There are also concerns about the performance of current EV batteries in the extreme temperatures that some parts of

<sup>16</sup> Ajit Dalvi, *EV sales in Q1 already 49% of entire FY2022*, 9th June, 2022

<sup>17</sup> Harshith KN, *Top 5 upcoming luxury electric cars in India* - Times of India, August 17, 2022

India face. Further, there is limited availability of spare parts of electric vehicles in India, thus making it difficult to maintain and repair them. A common barrier in the current EV market is the lack of charging infrastructure. In late 2021, the National Highways Authority of India set an objective to install EV charging stations every 40-60 km along national highways by 2023. Currently, India has an active network of 934 active public charging stations.<sup>18</sup>

Fundamentally, however EVs have an underside to it. Various metals are used in electric car batteries, each with its benefits. The most common metals are lithium, nickel, cobalt, manganese, etc. These metals are important for the battery's performance and lifespan, making them ideal for battery use. The metals that make up EV batteries are rare and mining of the same has negative effects on the environment. The mineral waste from mines pollutes the surrounding rivers and other freshwater water sources and have an adverse effect on crops, animals and humans.

One primary metal used in EV batteries is cobalt and 70% of its total supply comes from the Democratic Republic of Congo (DRC). The country is amongst the poorest in the world and has a prominent social issue of illegal mining also known as artisanal mining. This is wherein workers, including children, are made to dig cobalt in inhumane conditions, often being exposed to toxic pollutants, particulates and fine dust for a prolonged period. There are no safety protocols or labour laws covering artisanal mining which results in the illegal miners suffering from grave injuries, diseases or even death.

Almost 15-30% of the DRC's cobalt supply is extracted from small-scale artisanal mining, thus making it a source of livelihood for a significant share of the population.<sup>19</sup> This is only slated to grow in the near future, given the surge in demand for electric vehicles around the world. The raw cobalt from DRC further moves up the value chain wherein it is refined and used in making the battery for electric vehicles. This processing of cobalt generates tailings which is harmful for the environment, if not treated and stored properly.

Another important metal used in EV battery production is lithium. The current discovery of India's first lithium reserve by the Geological Survey of India in the Reasi district of Jammu and Kashmir will provide a huge impetus to India's EV industry. The 5.9-million-ton reserve of lithium in Reasi, is of the best quality and the extraction of the same will start at the earliest.

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<sup>18</sup> Government of India, Charging map

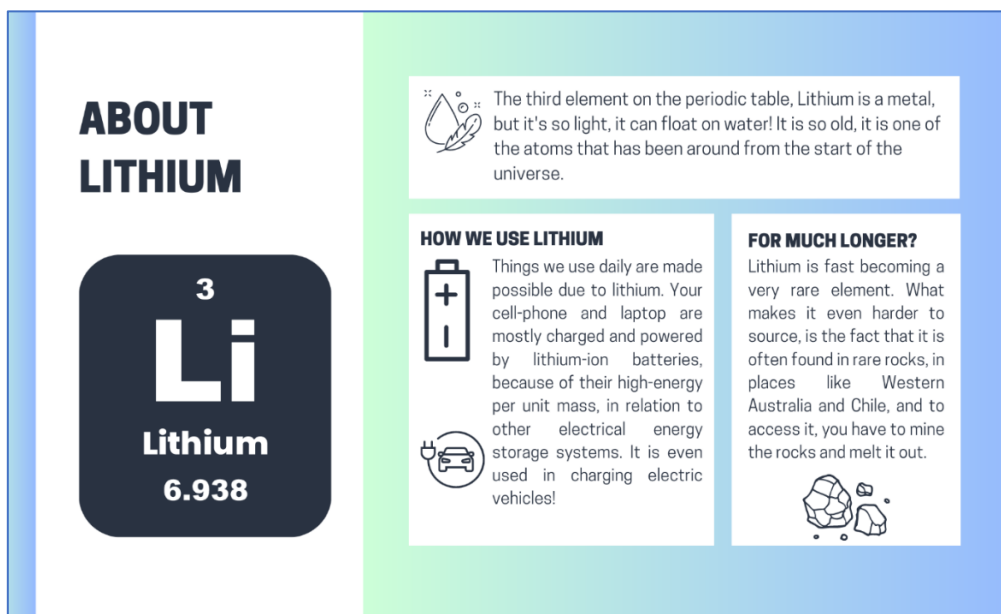
<sup>19</sup> Guest Blogger for John Campbell, *Why cobalt mining in the DRC needs urgent attention*, October 29, 2020.

The mining companies and the Government must ensure that this is done with as less exploitation of the locals and the environment as possible.

### Making Lithium extraction as sustainable as possible – a case study

Another important metal used in EV battery production is lithium. A promising example of how mining can be done in an eco-friendly manner is being portrayed by the Chilean chemical company SQM. It is the second-largest producer of lithium in the world and aims to double its current capacity by 2025. The company has a strong favourable reputation for carrying out manufacturing and other business operations in a sustainable manner.

In 2021, a research team delved into the company's sustainable production process.<sup>20</sup> SQM revealed that it produces lithium through an evaporation process using salt water which is separated from drinking water, by an impermeable clay barrier. Thus, saltwater extraction by the company, in no way affects the scarce potable water in local communities. SQM also has a public website that represents the volumes of saltwater used and contacts the environmental authorities when either salt or potable water levels change. 90% of the company's energy needs are met by renewable sources of energy like solar power. It believes in transparency and regularly updates and justifies its remuneration and governance arrangement to its stakeholders. SQM has set a target to reduce water usage by 50% and become carbon neutral in its largest business lines, by 2030.



The infographic is titled "ABOUT LITHIUM" and is divided into three main sections. On the left, there is a dark blue rounded square containing the atomic number "3", the symbol "Li", the word "Lithium", and the atomic weight "6.938". The top right section, titled "ABOUT LITHIUM", features a water droplet icon and text stating: "The third element on the periodic table, Lithium is a metal, but it's so light, it can float on water! It is so old, it is one of the atoms that has been around from the start of the universe." The bottom left section, titled "HOW WE USE LITHIUM", includes an icon of a battery and a car with a charging plug, with text explaining: "Things we use daily are made possible due to lithium. Your cell-phone and laptop are mostly charged and powered by lithium-ion batteries, because of their high-energy per unit mass, in relation to other electrical energy storage systems. It is even used in charging electric vehicles!" The bottom right section, titled "FOR MUCH LONGER?", shows an icon of a rock being mined and text stating: "Lithium is fast becoming a very rare element. What makes it even harder to source, is the fact that it is often found in rare rocks, in places like Western Australia and Chile, and to access it, you have to mine the rocks and melt it out."

<sup>20</sup> Salima Lamdouar, Patrick O'Connell, *Sustainable investing through the supply chain: Electric vehicles*, October 22, 2021

## **Sustainability beyond EV**

### Hydrogen

Besides EV, ethanol and hydrogen as an alternative fuel is gaining much traction and has undergone extensive research. Fundamentally, hydrogen is a better alternative compared to the conventional petrol and diesel as it is a clean burning, zero carbon emission fuel. FCEVs (fuel cell electric vehicle) use electricity from a fuel cell, which in turn is powered by hydrogen. Although the production of hydrogen may generate harmful emissions depending on the source, an FCEV running on hydrogen emits only water vapor and warm air as exhaust and is considered a zero-emission vehicle. India soon aims to develop cost-effective, clean hydrogen technologies that are free of carbon emissions. Moreover, on the production side green hydrogen is one such alternative which is quite different from grey hydrogen as the former fuel is produced using sustainable sourced electricity. Recently the cabinet has approved the National Green Hydrogen Mission where the government aims to mass produce, utilize domestically and soon export green hydrogen and its derivatives. The ministry of new and renewable energy has received an initial investment of 19,744 crores for the mission and aims at results by 2030.<sup>21</sup> By the end of 2023, the government has planned to launch a hydrogen powered train at the Kalka-Shimla route and other hilly roads subsequently.

### Biodiesel

Biodiesel is a sustainable fuel which is produced from vegetable oils, animal fats or recycled restaurant grease. In India, most manufacturers have approved the use of B5 which is 5 percent biodiesel and 95 percent petroleum diesel. Some vehicles have also approved B20 which has an increased blend of biodiesel, to further reduce emissions. There is further scope for research in the blending mechanism and the effect it has on the engines.

### Compressed biogas or Bio-CNG

Compressed biogas or Bio-CNG is another alternative which is produced using waste or biomass sources. CBG can replace CNG in the future, given the large availability of agricultural residue, cattle dung and other solid waste in India.

### Bio-LNG

Bio-LNG is another biofuel which involves separating methane and CO<sub>2</sub> from biogas which is emitted when processing organic waste flows.

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<sup>21</sup> [https://mnre.gov.in/hydrogen\\_energy\\_government\\_of\\_india#:~:text=The%20Mission%20will%20identify%20and,hubs%20in%20the%20initial%20phase.](https://mnre.gov.in/hydrogen_energy_government_of_india#:~:text=The%20Mission%20will%20identify%20and,hubs%20in%20the%20initial%20phase.)

## Ethanol

Ethanol has been an answer for a more environment friendly fuel since a long time. Many countries around the world aimed to produce ethanol through sustainable methods. The fuel is primarily used in electricity generation and in vehicles. It acts as a substitute for coal and crude oil.

### *How do we produce ethanol?*

Ethanol is generally produced through sustainable methods such as corn, sugar and other residual waste.<sup>22</sup>

There have been studies by the Bamboo people organization where tissue cultured bamboos has have been used to produce ethanol. According to the Union Ministry of Agriculture and Farmer Welfare, India's annual bamboo production is estimated at 3.23 million tonnes. Historically, the use of bamboo has been quite limited with only around 4 percent of the production used for trade and commerce in India.<sup>23</sup> Bamboo was generally used for furniture, rustic decorations and construction.

Such production methods have a positive externality to the environment. Bamboo has one of the highest CO<sub>2</sub> absorbing capacity among other plants. 1 bamboo tree absorbs 450kgs of carbon dioxide every year. It consumes about 35 percent more CO<sub>2</sub> and releases 35 percent more O<sub>2</sub>, compared to other trees.<sup>24</sup> Additionally, land degradation is a major problem confronting India. According to the State of India's Environment 2017, nearly 30 per cent of India's land is degraded. With its unique ability to stitch and repair damaged soils, bamboo is ideal for rehabilitating degraded soil. This process has a double impact where it promotes growing bamboo plants even at barren lands and limits the vehicular emissions to the environment to a greater extent.



### ***DID YOU KNOW?***

*1 bamboo tree  
absorbs 450kgs of  
carbon dioxide  
every year.*

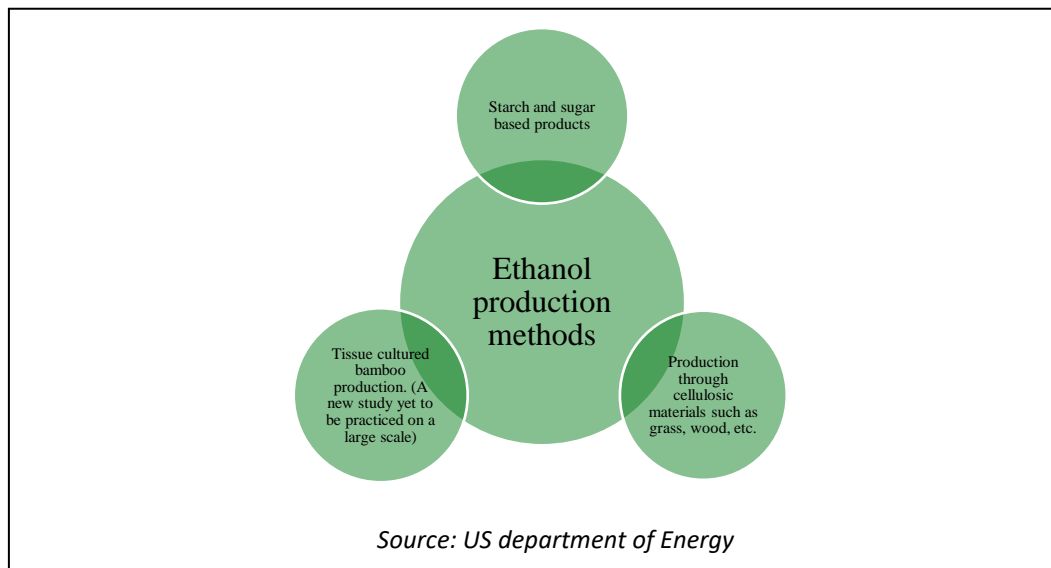
*It consumes about  
35% more CO<sub>2</sub>*

<sup>22</sup> US Department of Energy, *Ethanol production and distribution*

<sup>23</sup> Samar Lahiry, *The story of National Bamboo Mission*, 4 July 2018

<sup>24</sup> Growmore Biotech, *Environmental impact*





### *Initiatives taken by the Government*

Government of India has recently made changes in the percentage of ethanol blending in petrol to 10 percent and aims at increasing it to 20 percent by 2025 in order to decrease vehicular emissions.<sup>25</sup> Several other initiatives such as tax benefits and subsidies has been provided by the Indian government to promote sustainable ethanol production and make India a green nation. The Prime Minister of India has also launched a roadmap for ethanol blending in the country and focuses on increasing production from 700 to 1500 crore litres.

### *Darker side of Ethanol*

Ethanol is less volatile than gasoline which results in more ethanol being used than gasoline to travel the same distance. Additionally, ethanol can cause damage to gasoline-fuelled internal combustion engines, whether in an automobile or a chain saw.

Some more problems with ethanol are:

- It is corrosive when in contact with certain materials in fuel storage, like the zinc and aluminium alloys that are used in carburettors.
- Since it is an alcohol, ethanol dries out the rubber components in a fuel system. This leads to cracking and brittle fuel lines, floats, seals and diaphragms.
- Ethanol is hygroscopic – it likes water. Water enters fuel containers when they are filled up. Once in the gasoline, it forms a chemical mix that causes corrosion of internal parts. As the fuel level in a tank or container drops, water condenses on the cool surfaces of the vessel and runs down into the fuel where the ethanol welcomes it.

<sup>25</sup> Ministry of Petroleum and Natural Gas, *Refining - ethanol blended petrol: Ministry of Petroleum and Natural Gas: Government of India*

- It acts as a solvent in older engines, dissolving the varnish and other deposits in tanks and lines. These then are carried to the carburettor or injection system where they clog the small orifices involved.

### **Ticking the greener box**

Although power generation through other renewable sources such as sunlight, wind, hydro, etc. has already begun, mass production is still an issue as it is contingent on the resource being always available. Electric vehicles are also in the limelight, but the production of the battery of such vehicles is not sustainable as it makes use of non-renewable resource like coal for electricity generation.

Despite central and state government subsidies, EVs are more expensive than a similar petrol or diesel vehicle. Further, the range provided by an EV is limited and the superfast charging facility has negative impacts on its battery life.

Right now, the main question that wanders the minds of government authorities is whether India should divert its resources of time and money to ethanol, EV, both or elsewhere entirely, for a more sustainable tomorrow.

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## About ESGRisk.ai

ESG Risk Assessments & Insights (ESGRisk.ai) is India's first ESG Rating provider and a wholly owned subsidiary of Acuitè Ratings and Research. ESGRisk.ai has developed a detailed methodology and India focused taxonomy and has the largest coverage of ESG ratings on Indian companies. The company provides ESG analysis, ESG ratings and scores on top Indian listed companies via its ESG INDIA 360 Subscription to investors, corporates, educational institutions and government bodies.

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