EV Vehicle the challenges, the future existence to Gasoline Vehicle. How the Petroleum Industry transforms with the Emerging EV vehicle Industry

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SUMMARY

This Paper is presented to educate the Energy Researchers, energy Educationalist, and Utility and Energy generation, distribution, and transmission companies both on traditional turbo engine and EV Vehicle Battery and understand Pros and Cons, limitless innovation, and ideations, and how Gasoline Turbo Engine compete the EV battery world, Gasoline cars do have longer life and with true innovations happening around Gasoline Turbo Engines.

The focus of this paper is around technicality of energy density and carbon reduction, and how would EV world can achieve the energy density as compared to a gallon of gas stored in milk can, which today need approximately 75-90 bricks stacked next to each other to get the same energy density value stored in gallon of gas in a milk can. This increases tremendous weight to the car with battery cells stacked at the bottom of the car. References (1)

This paper will also focus heavily on pros and cons emerging because of the lack of innovations in developing compact battery, reduce weight of the battery, and impact of car price for EV vehicle.

KEYWORDS

Energy Density, EV, KwH/I, Turbo Engine, AFR, EGR, EFS, MX EVCE Portal

About the Paper

The Paper Titled "**EV Vehicle the challenges, the future existence to Gasoline Vehicle. How the Petroleum Industry transforms with the Emerging EV vehicle Industry**" was selected by the author for the CIGRE 2021 conference as the author thinks many energy researchers, EV car manufacturers, Gasoline car manufacturers, energy and distribution companies supplying power to charge the car batteries can come together reducing carbon foot print. This will bring a new innovation in transportation industry where people can buy cars that emits less carbon, reduce cost over gas, however cost over vehicle a one time investment could be very expensive based on the car model purchased as EV cars are getting expensive day by day for long range EV cars, reduced price on short range EV does not make sense as it leads to too many times charging the car and wait for the charge time make no sense, this is more explained in the pros and cons in this white paper.

This paper brings the statement highlighted below from car manufactures like Mazda, Tesla, and other brands into life and educates the energy and distribution companies on what could be the possible growth market for EV vehicles and be prepared to address the load coming in from EV market. Mazda has just released its electric version of the car to challenge themselves with their turbo engine innovation that removes 10% of carbon from the total carbon emitted with their first gasoline engine innovation Sky active-G.

Mazda Mission Statement (**Gasoline Win over EV. Is It possible to make a gasoline engine so efficient that it would emit less Carbon dioxide per mile than is created by generating electricity to run an electric car over that same mile ?** Small Japanese carmaker Mazda says yes, in an interview published last week with the British magazine Autocar, Mazda claimed that its next generation of SkyActive G engines will be so fuel-efficient that they'll be cleaner to run than electric cars.) [2]

Top EV producers [3]

Here are the Following top EV Producer who are challenging themselves to make

- Number 15 **Kia Soul EV**
- Number 14 **Volkswagen e-Up**
- Number 13 **Peugeot e-208**
- Number 12 **Jaguar I-Pace**
- **Number 11** Renault Zoe
- **Number 10** Audi e-tron
- **Number 9** Volkswagen ID.3
- **Number 8** Mini Electric
- **Number 7** Tesla Model S
- **Number 6** BMW i3
- **Number 5** Hyundai Kona Electric
- **Number 4** Polestar 2
- **Number 3** Honda e
- **Number 2** Tesla Model 3
- **Number 1** Porsche Taycan

1. Jaguar I-Pace
2. Hyundai Kona Electric
3. Kia e-Niro
4. Mercedes EQC
5. BMW i3
6. Tesla Model 3
7. Volkswagen e-Golf
8. Audi E-Tron Quattro
9. Renault Zoe
10. Tesla Model X
11. Nissan Leaf
12. Hyundai Ionic
13. Volkswagen e-up
14. Porsche Taycan
15. Honda e
16. Vauxhall Corsa-e
17. MINI Electric
18. Peugeot e-208

smallest Batteries with less weight and have Driving range up to 1000 Kilometer on a full charge of a Battery with a Battery capacity of 32KwH- 150KwH range, several experiments are going around the world on how to achieve higher capacity Battery and will be a challenging task to achieve higher Energy Density and making the Battery size smaller and smaller there by reducing the weight of the Battery.

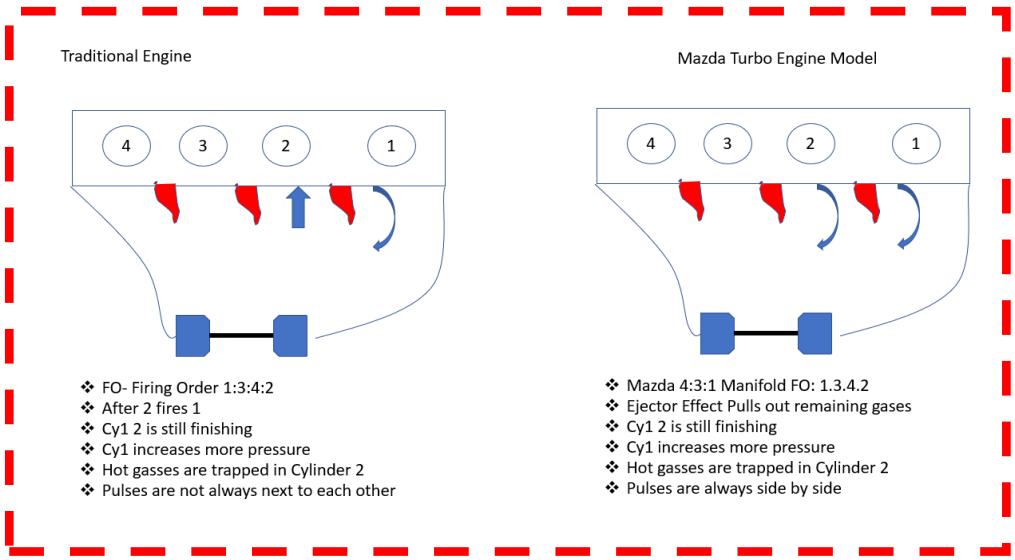
Problem Statement

The Problem Statement on the competition between EV car makers and Gasoline Tourbo Engine car makers. How do I achieve higher energy density? this is a very pressing and challenging questions to EV Car manufacturers. There are other critical questions like, how do I build electric farm to charge cars in volume? and most importantly, how do I reduce the charge time where consumer need to wait anywhere from 30min to 6 hours on a super charger to load the full capacity of the EV vehicle battery?

Today EV car makers and Gasoline car makers are focusing on two technical reasons and 4 Environment and Consumer Benefit reasons, and when looked closely at the new automotive world. The two technical reasons need deep engineering knowledge, and the 4 Environment and Consumer Benefit reasons would focus on sustainability and green energy initiatives and help consumer use the vehicles for personnel and business use keeping environment and cost in mind.

They are the below two technical reasons,

1. AFR and EGR- Air Fuel Ratio, Exhaust Gas Recirculation- Achieve Performance and Efficiency from a Turbo Engine Car
2. ED- Energy Density- How much energy you can put into certain space and innovate smaller battery with higher energy density.



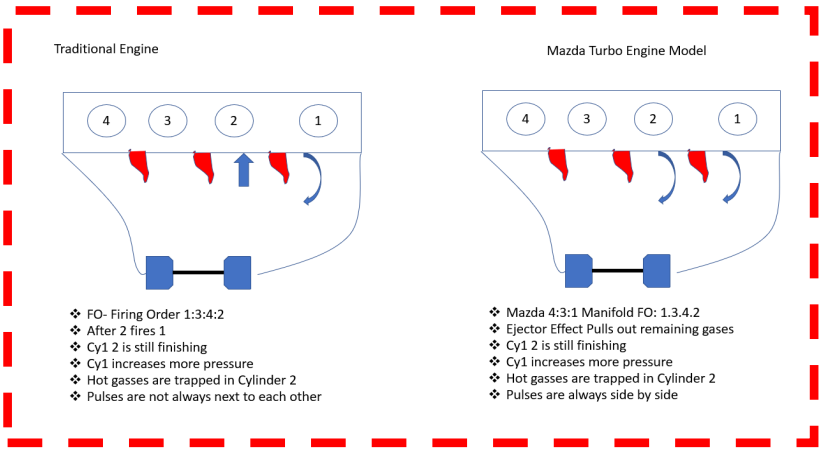
Why the combustion Engine still as a long life ahead? How combustion engine achieves power and efficiency?

Power and Efficiency are met through Small dell size server engine called Sky Active G from Mazda. Mazda engineering the engine can be explained through above diagrams that has enough growth to compete the EV battery market. Turbo Charge engine takes Air from intake point and circulates that would have good Air Fuel mix and maintains AFR ratio of 14:7:1. The two key process that Mazda Turbo Engine follows are,

- Exhaust Gas Scavenging

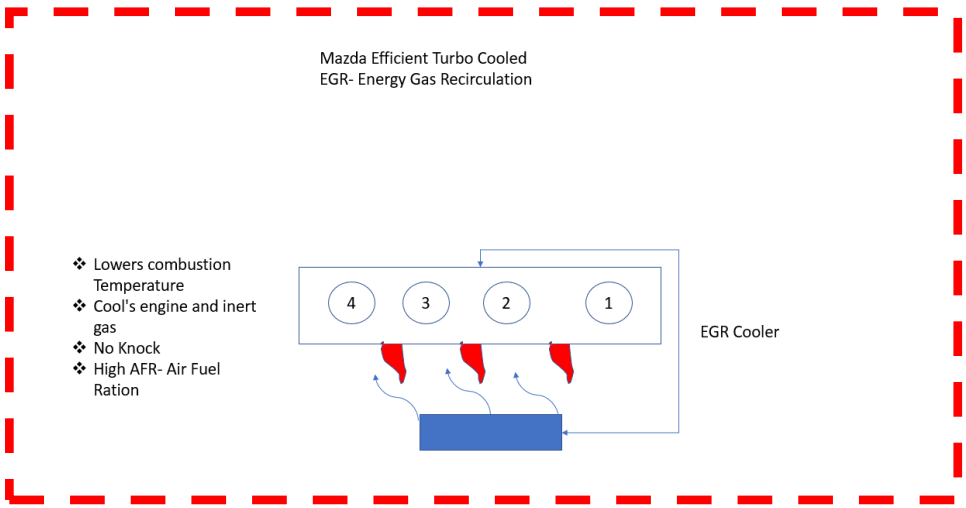
This is a process of firing exhaust gas through the engine pulses, and which are next to each other through which the exhaust gas escapes. The firing order is critical, the traditional engine have firing order in such a way that the exhaust gasses are trapped in the pulses which heats up the engine hitting the efficiency and performance of the car. Most of the traditional engine uses 1:3:4:2 ratio and Mazda turbo engine uses 4:3:1 as explained in the above diagram.

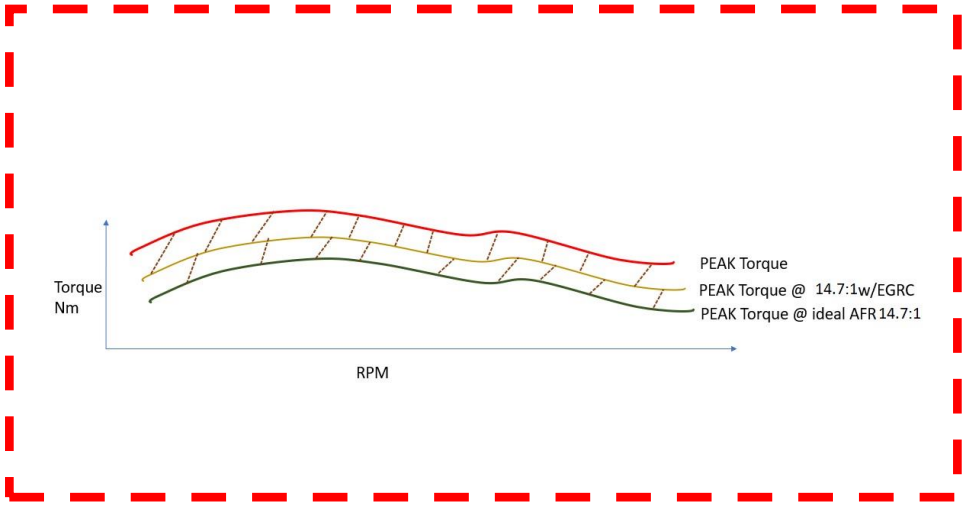
Let us look at the combustion Engine closely and what makes it to keep the engine cool and make sure exhaust gas are not trapped making engine over heated.



- Exhaust Gas Recirculation- Cool EGR or EGR cooler

EGR cooler will allow less oxygen and not tapping the hot gas in the exhaust vents, creates more Torque and that is how few cars like Mazda CX-9 could produce as much as 310nm of Torque and 250 Horsepower when a 93 Grade Premium gas is filled in the gas tank of the car, the main function of EGR is to regulate combustion temperature and to keep it as much low as possible. Cool EGR will improve AFR ratio to be around 14.7:1. Below diagram shows EGR, AFR, and Torque graph.

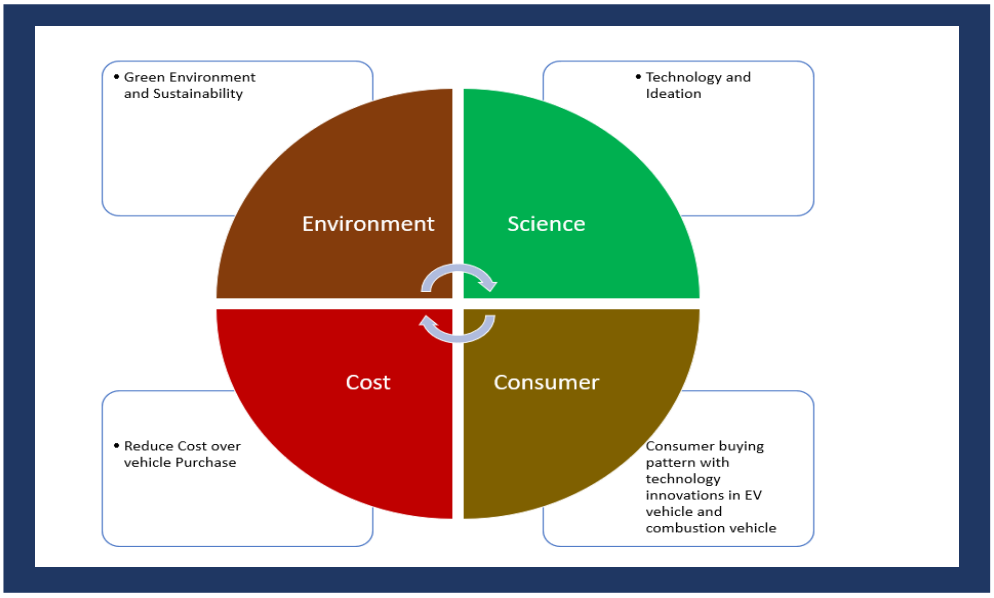




AFR stands for air to fuel ratio. Fuel doesn't burn on its own. It has to be mixed with air. AFR tells you how many parts of air are mixed with each part of fuel. For example, a 14.7:1 **AFR** (or just 14.7) means the mixture is 14.7 parts air to one part fuel

Four Environment and Consumer Benefit Reasons

1. Science
2. Environment
3. Cost
4. Consumer



In the above diagrams what you learn is the advanced research that car manufacturing companies are doing to make combustion engine behave almost like the benefits one would get buying an electric car. It is an effort by gasoline car manufacturers to stop consumers paying the premium which is around 12000$ as per the market research while the Government rebate are not always approved for all cars. For example, Tesla Government rebates are lesser to Hyundai and GM Bolt where the consumer get full 7500$ tax credit.

The Science-

What is Energy Density? And why it is so important.

Energy Density- How much Energy can be occupied in certain space?

Most importantly Space is going to be a question? a larger space the battery occupies to store the energy when compared to same energy of gas stored in a gallon of Milk box. A Gallon of Milk Can filled with Gasoline and weighs roughly around 6 pounds and has approximately 33.7Kwh/Liter of energy density per gallon of gasoline in the milk can. At the same time, an average EV car Battery weighs about 600 pounds to store the same energy density? And occupies the space as many as 100 full bricks stacked next to each other. It makes sense to innovate the science here and produce smaller size Battery with higher Energy Density.

Scientist have researched about 8 different types of lithium-ion battery and came with a conclusion that the smallest lithium-Ion Battery about the size of an AA battery can store up to 684Kwh/Liter as compared to a Gallon of Milk can filled with Gasoline. This is only an assumption to the possibility but need to explore the real possibility of making a battery with this high energy density value.

The Environment

The Environment challenge for the combustion is how to increase AFR and make sure much of the carbon does not sits in the car and creating polluted environment. Today according to the true facts from Mazda, its sky active G engine can reduce carbon by 10% and it aims to make the turbo engine 100% carbon free through improved EGR and AFR.

The Cost

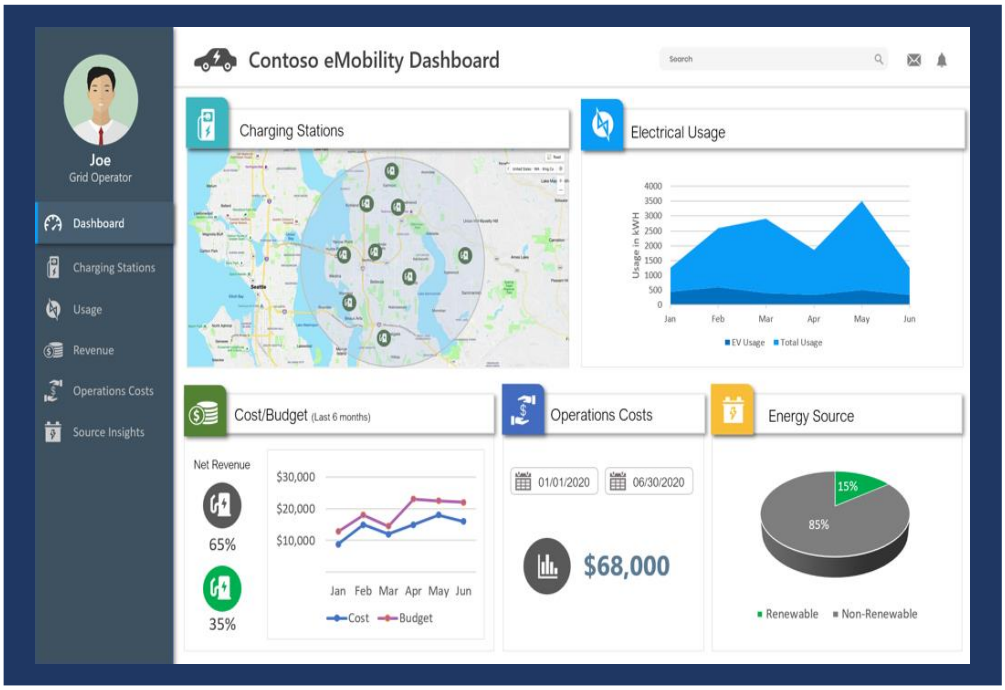
Cost has always been challenging to car manufacturers more than to consumers, according to Alex Partners a leading research firm a good EV car with all the latest technology of Auto Pilot and improved battery with a range of 280-320 Miles per charge will not come less than 45000 USD because of the cost in making the car. Also, according to Manufacturing Magazine by SAP and other technology firms have found that it takes manufacturing companies of electric car to be profitable if the price of the car is kept around 48000 USD. There is a 12000$ purchase cost penalty when compared to traditional gasoline vehicle for the customers to enjoy the gains of electricity driven cars.

The Consumer

Looking at the Consumer side and consumer buying points and keeping environment in mind - Scott Bailey CEO Tula technology [4] says approximately 2 billion combustion engine cars will be sold by 2045 “The march to an electrified future absolutely has to include clean, efficient, ideally cost central combustion engines- simply because now we have to start combining technologies to get the maximum environment benefits. There is going to be roughly 2 Billion more internal combustion engines produced between now and 2045. It is a big obligation to make them as efficient as possible. However, adding to Scott comments, not only efficient and how do we make it efficient cost effectively to the consumer is a big question. This paper is the right beginning to these questions.

Terawe MX- EVCE Portal

Consumer today can go to MX EVCE portal developed by Terawe Automotive Group using Microsoft Azure and select different EV and Combustion engine models to see the cost benefit analysis, this portal can also be customized by various top manufacturing companies like Toyota, Hyundai, Tesla etc., and have all three car models i.e., traditional, combustion, and EV cars available here. The portal give access to public and internal employees to select options and calculate consumer benefit as well for internal employees to maintain all their blueprint and engineering design of the of EV and Turbo Engine models. The MX EVCE portal can also be used by Energy Distribution Companies, third party charge providers like charge points, and car manufacturers of EV Vehicle to see the available charge points and talk to Utility companies to have more capacity planning to meet the growing demand of charge stations. Here is a snapshot of the portal how to visualize the charge points and how one could do distributed resource planning from usage, cost/budget, operation cost, and energy source.



What it means to Power Generation and Distribution Companies?

Let us say the EV manufactures have achieved and solved the problem to energy density, Today Electric Vehicles Market Share is Projected to Reach USD 700 Billion with 22% CAGR by 2026: Facts & Factors [5]

- How are Energy Generation and Distribution companies are going to plan the capacity?
- How are third party charge stations like ChargePoint are going to collaborate with energy companies to meet the demands?
- How are some of the private car manufacturers like Tesla who have their own charge station will do capacity planning and create Electric Farm Stations?
- What are the tariff and subsidy of having a charge station at residential and commercial places by individual resident owners and business owners?
- What are different rebate programs?
- What are the secured payments at the charge stations to avoid fraud with Payments?

There could be many more questions like this which energy and utility companies need to have their DRP team discuss and plan the capacity planning for the new charge station projects. There could be a possibility that large Electric Farm Stations will be seen very soon as more and more success on energy density is achieved by the EV manufacturers.

Comparison EV vs Combustion Engine Vehicles

EV	Combustion Engine
Longer wait times to charge and frequently charging leads to reduce battery life creating dead cells in the battery.	Quick to fuel the tank and run.
Limited charge stations lead to premium charge rates for over booking parking lots	Cost effective to own.
Limited Charge Station leads to volume traffic at the Electric Farmland and delayed wait times.	Manufactures make more margin in Combustion cars than traditional and EV cars with combustion cars as it meets both demands.
Have many possibilities of explosion if the electrical wiring is not done properly and if the battery is defective- Premium quality check required before manufacturer release the car to market- We have seen Auto Pilot Tesla getting crashed and Hyundai Kona getting fire for European models.	There is a scope in the growth of engineering the turbo engine to make 100% carbon free.
Pay Premium Penalty over 12000$ to own the car.	Make combustion engine a hybrid combustion engine will give a new dimension of using both electric and gas source.
Up to 6500$ expensive than traditional cars for average features in the car.	Longer range depends on fuel tank capacity, but the good part is, there is no wait time at the gas station within the city and freeway limits.
Need to work closely with charging providers and energy companies and need to have tight collaboration to bring charging rebate programs to consumers.	Higher Torque and Horsepower can be enjoyed always, it is possible to achieve this in EV vehicle, but the cost will be very high to achieve this as we all known Porsche Tycan is priced over 150000 USD for a 64Kwh battery and higher torque and Horsepower.
Solar and Wind charging is still at cradle level, this will grow eventually, and this will allow energy companies to have any additional charge coming from the solar panel into battery supply back to grid and pay consumers for those KwH.	Recall is mostly around air bags and we have seen very less recalls for fuel tank or Explosion recalls, we have seen two fixable recalls for Hyundai Kona EV and one permanent recall for Hyundai Kona EV **Hyundai will replace 75,680 Kona EV batteries over potential fire risks (msn.com)**
Battery replacement is expensive	Cost of maintenance is cheaper as there is no electric component in it such as heavy battery connected to electrical system.

Conclusion

The Author concludes that this paper will help Utility and Energy Organizations, Battery and Turbo engine research organisations, Car Manufacturing company, both EV and Turbo Engine car manufacturer, Third party charging stations an Opportunity to understand the holistique view of EV and Turbo Engine Market. Also, learn the pros and cons of each industry and how they are challenging to achieve Energy Density.

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