HYBRID AUTOMOBILE AND ELECTRIC VEHICLES

MCL241 TERM PAPER

APRIL 1, 2022

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"We wanted to use the hybrid technology to boost performances, like in F1, rather than use it just to reduce fuel consumption and emissions"

Roberto Fedeli, Ferrari's technical director

Introduction

It may be seen that when an avenger in 2030 falls from space, it lands on a car, bus or train. Interestingly even the directors are well aware of the fact that autos are expanding quicker than humans nowadays. So to be on the same page, it is vital to know more about some futuristic vehicle to understand marvels more deeper.

The over-a-century-old automotive business is preparing for change. The rise in the price of fossil fuels and the environmental effect of their emissions has prompted a shift in individual mobility habits. The industry is shifting away from internal combustion engines and electric automobiles (EVs).

Hybrid Automobiles

Introduction

The term "Hybrid Century" might be appropriate for the twenty-first century. We are along with development are using hybrid plants that we gzrow, hybrid animals that we breed, hybrid material and vehicles that we manufacture, mostly important and new hybrid education online teaching and offline exams.

The term "transportation" refers to the movement of commodities and people between locations. In the past, humans relied on horses and other animals to do this, but as hybrids become trendy, these creatures are being replaced with a confusing mass of metals that is made to be understood below.

"A car with more than one propulsion system is generally known as a hybrid car, and it consists of a combination of petrol or diesel engine with an electric motor" (1)The biggest advantage of hybrid vehicles is its big scope in economy and efficiency, not "TRENDY".

History

These automobiles were well-made in the 1910s since they were a new and powerful technology, but they were poorly marketed and lost their momentum because their price was greater and their power was less than other cars at the time. It is still common practise to utilise submarines powered by diesel at the surface and by batteries below.

To combat the effects of climate change and rising pollution levels, the government has promoted the use of electric and hybrid cars. More than 25 years of research and development has resulted in billions of dollars invested by manufacturers. General Motors and Toyota only created a small number of new technology other from these. For the first time, Toyota's 1997 introduction of the Prius in Japan signified a significant milestone. The Honda Insight became the first mass-produced hybrid electric car later that year, in 1999. For although Insight may have been the first hybrid vehicle, it wasn't enough to build a foothold in the market without Toyota's Prius. The Prius has become associated with the term "hybrid" in the years since it was initially launched. Carmakers around globe use it as a platform for a broad range of other hybrid cars, and it's been the most popular hybrid vehicle ever made by a major automaker.

The Prius may face stiff competition in an era of increased environmental awareness. In 2010, Honda announced the second-generation Insight while Chevrolet unveiled the Volt. Hybrid vehicles will have a stronger presence in the global automotive market in the future as their technology develops. It doesn't matter what the future holds, hybrid vehicle research and development will continue as it has for the previous many decades.

Working

Engine Management

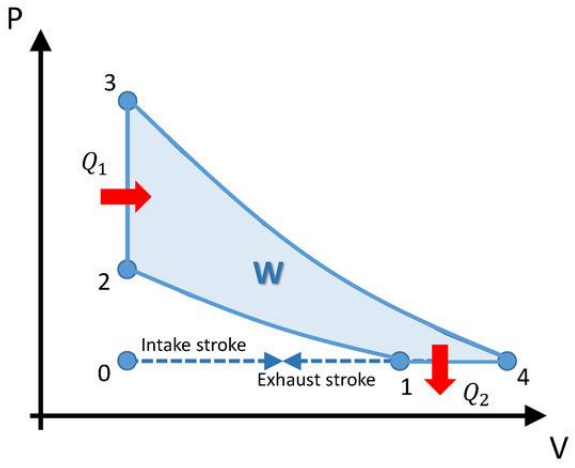
A hybrid car combines a petrol / diesel engine and an electric, with the two systems working in tandem to push the vehicle forward. There are times when the electric motor is the only source of power, and other times when the gas engine is the predominant source, which is managed by the hybrid vehicle's engine management system. As a result, less gasoline is required, resulting in better fuel economy.

The sophisticated system design of HV captures the energy wasted by ordinary automobiles when braking, which is commonly referred to as regenerative braking. In some circumstances, increasing power may actually increase performance.

Thermodynamic cycles

1. **Atkinson Cycle**

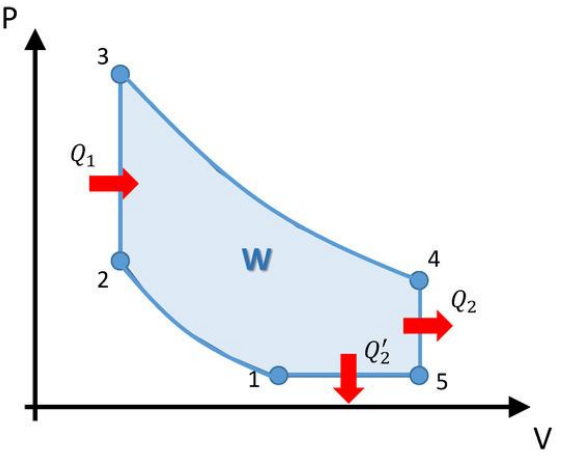
Most hybrid electric cars employ the Atkinson Cycle as their primary internal combustion engine. This cycle, that has a lengthier expansion stroke than compression, is responsible for most of the injected fuel's energy. As a result, the mixture has more time to expand in the combustion chamber, increasing the amount of work it can do. With this cycle, the internal combustion engine may be efficient in thermal energy at the cost of low power, making it ideal for hybrid vehicles.



$$\eta^{Atkinson} = 1 - K\frac{TR \cdot PR^{\frac{1}{K}-K} - 1}{TR - \left(\frac{TR}{PR}\right)^{1-K}}$$

2. **Miller Cycle**

To compensate for the lack of torque from the engine, hybrid vehicles often use a type of engine called a Miller cycle. Typically, a bigger cylinder is employed in the Miller cycle. A compression stroke is shortened by pushing load out of normally closed valves when the piston goes upward in compression stroke ,this occurs in conjunction with an expansion stroke.



$$\eta^{Miller} = 1 - \frac{PR \cdot CR^{1-K} + (K-1)CR - K\left(\frac{PR}{TR}\right)}{PR - \left(\frac{PR}{TR}\right)^{K}}$$

Continuously variable transmission

Contrasts with transitional cars, which only offer a fixed range of gear ratios, this automatic transmission is capable of smoothly shifting gears. It is possible to function at a constant RPM while cars are traveling at varied speeds thanks to a strong tool such as the CVT.

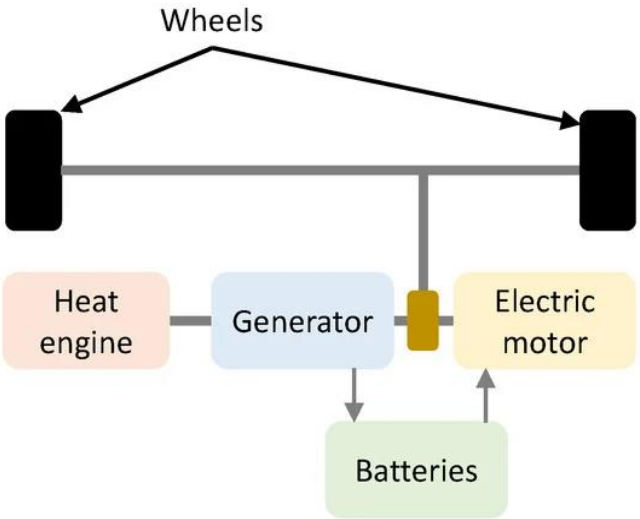
Types of Hybrid Vehicles

Classification by Vehicle Hybridization Level

This distribution determines how much is the share of electric and combustion systems in the HEV's. The more the vehicle is electric the more it will be called hybrid.

1. **Full hybrid**

These HV can independently run on combustion i.e diesel or petrol, electric engine or in combination. The battery of Full hybrid is not recharged by plugging in, it is recharged by running the combustion engine. The electric engine is ideal for journeys that demand a lot of starting and stopping, and the combustion engine shows its dominance when the acceleration is required by the system.

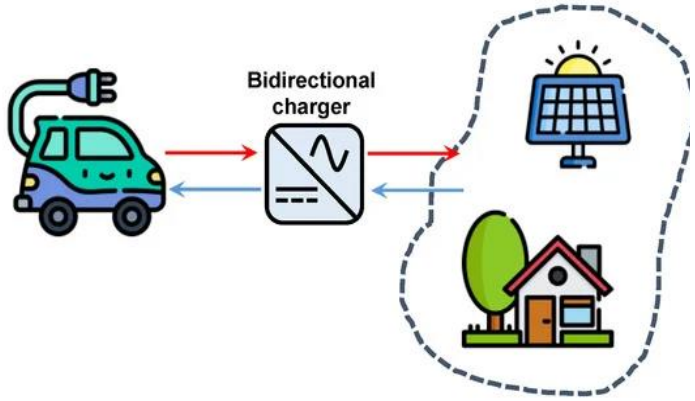


2. **Mild hybrid**

These HVs are always powered by a hybrid of electric and combustible engines. The engines are continuously running in parallel. In contrast to the combustion engine supremacy in complete hybrids during acceleration, an electric engine is required even during

acceleration. The vehicle's propulsion is dominated by an electric powertrain.

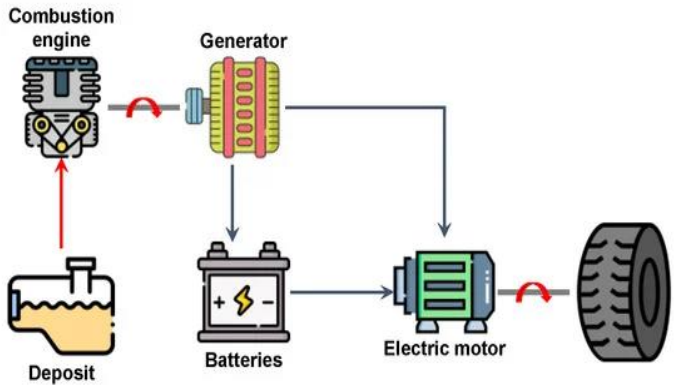
3. **Plug-in hybrid**
   To fully recharge the battery, it must be plugged into an electrical outlet, as the name implies. PHEVs are capable of running solely on electricity. The on-board storage system can be used for grid support chores, which is an intriguing characteristic of this type of vehicle.



Classification by Architecture

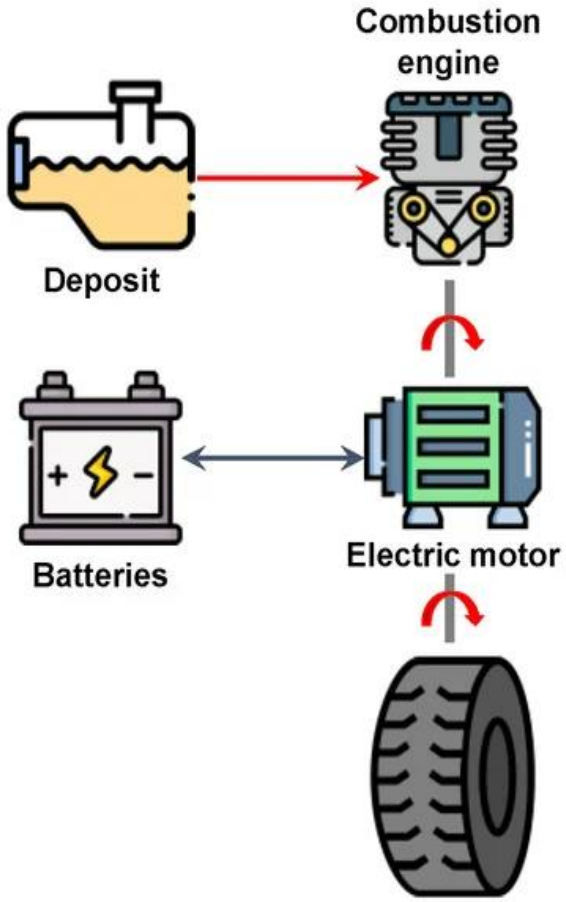
This classification slices on the bread on the size of system layout, enabling energy path and components and interconnections.

1. **Series Configuration**
   In this configuration, the gasoline engine is there only to replenish the batteries, Electric motors supply all the push in this configuration, and there is no physical mechanical connection between the engine and the wheels in this way.

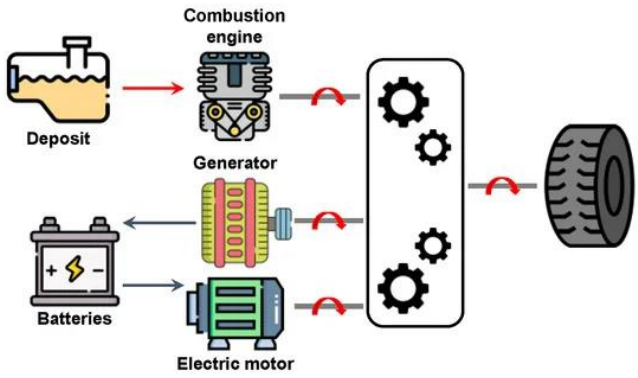


2. **Parallel configuration**

Using a shared gearbox, the electric motor or multiple motors and gasoline engine combine their power. There are many different ways to set this up. Transmission options include automatic, manual, and CVT (continuously variable) (CVT). As a result of this design, the series architecture will be much easier to implement because you no longer require an electric generator. It's possible that the electric motor can work in reverse, converting kinetic energy from the transmission system into electricity that can be stored in batteries.



3. **Mixed configuration**
   This architecture merges the preceding two designs into one. In this instance, the ICE, the electric motor, or both systems might be used to propel the vehicle. Using a differential set, which connects the electric and heat systems mechanically, the heat engine is mechanically tied to the transmission system.



Advantage of HV's

Start and Stop

Having an electric engine gives a lot of benefits over regular vehicles as the electric engine can be ignited and watered instantaneously. HV saves fuel to a greater extent by switching off the engine when the vehicle is idly standing. Electric engines also help while starting the vehicles as they ignite fast and provide a good amount of torque.

Cleaner energy

Along with working on electric motors, hybrid vehicles are also fuel efficient. Fast start and stop feature filters more pollution out of it. Energy required for charging batteries may be confusing for saying eco-friendly as somewhere coal may be used to produce that energy but it got its tag because the pollution produced for charging can be controlled and managed.

Regenerative Braking

In conventional vehicles friction is generated to stop the vehicles but HV does not lose energy of the momentum of the vehicle, its engine works in reverse mode to charge the batteries.

Future of HV's

Although HVs provide numerous advantages, we must also contend with a few drawbacks. As a result of the high cost of HV's, the conventional mode of transportation remains dominant. Although we are digging deeper and deeper for it as public awareness of pollution is growing and the prospect of a bright future ahead of us, The Prius and the Honda Insight are excellent examples of hybrid vehicles.

Submarines are also hybrid vehicles -- some are nuclear-electric and some are diesel-electric

Electric Vehicles

Introduction

Only chemical energy stored in rechargeable battery packs is used to propel a battery electric vehicle (BEV). There is no additional source of propulsion for a battery electric vehicle (BEV). Instead of internal combustion engines, BEVs use electric motors and motor controls or internal combustion engines. They do not have an internal combustion engine since they are powered only by battery packs (CI or SI engines).

Motorcycles, boats, bicycles, skateboards, railcars, forklifts, buses, and lorries might all be equipped with electric motors and hence comes under the category of battery electric vehicles.

History

Gustave Trouvé, a French inventor, enhanced the efficiency of a tiny electric motor in 1880. Fitting a newly invented rechargeable battery to an English James Starley tricycle, he created the world's first electric vehicle. He quickly transformed his battery-powered motor into a maritime propulsion system. On May 26, 1881, the 5-metre Trouvé boat prototype known as Le Téléphone attained a speed of 3.6 km/h upstream and 9.0 km/h downstream.

The demand for motor cars skyrocketed in the late nineteenth century. In 1897, electric battery-powered taxis were introduced in London. They were dubbed "Hummingbirds" because of their characteristic humming sound.

In comparison to other early 1900s cars, electric vehicles offered major benefits. They lacked the vibration, odour, and noise common with gasoline vehicles. In addition, unlike other gasoline vehicles, they do not require a gear shift. Although steam engine vehicles were likewise gearless, they took longer to start, especially in cold weather.

Electric vehicles were preferred since they did not require a human effort to start the engine, whereas gasoline vehicles required a hand crank to start it up.

Because of the advent of the gasoline-powered automotive industry, electric automobiles had begun to lose appeal. People began to choose automobiles with higher power and a longer range as road infrastructure developed and travel times became shorter.

By the 1910s, the majority of businesses had ceased manufacture of electric cars. Furthermore, at the time, the majority of the world's battery-powered vehicles were golf carts and British milk floats. Electric automobiles have all but vanished from the market.

People began looking forward to renewable fuel sources as battery technology advanced and the commencement of global warming in the coming 20-30 years. Tesla Motors, based in California, began research on the Tesla Roadster in 2004, and it was first made available in 2008. The Roadster was the first highway-legal serial production all-electric automobile to employ lithium-ion battery cells, as well as the first manufacturing all-electric car to go more than 320 kilometres on a single charge. As more firms began to

produce electric cars, battery-electric vehicles gained a new market position.

Working of EVs

The electric car is propelled by an electric motor (EV). The motor is also powered by rechargeable battery packs. From the outside, it's difficult to tell if an automobile is electric or gasoline-powered. Often, the fact that the car is almost silent is the sole indication that it is electric. (7)

When compared to gasoline vehicles, electric vehicles have less moving components.

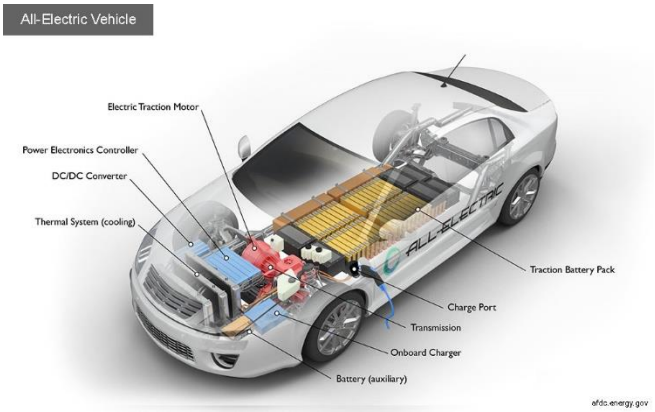
- Electric Engine/Motor –It gives the wheels power to rotate. It might be of the DC/AC kind depending upon the manufacturer.
- Inverter - It is a device that is employed to change the waveform of the current, ie. It converts the direct current (DC) electric current into alternating current (AC) or vice versa
- Drivetrain - It transmits the power of the engine to the wheels.
- Batteries- are being used to hold the electricity required to operate an electric vehicle. The bigger the kW rating of the battery, the longer the range.
- Charging - Because the battery drains with usage, charging stations are set up to replenish it.
- Thermal system (cooling): This system keeps electric motor, power electronics, and other components within a safe operating temperature range.

In this article, we will demonstrate the operation of a Tesla electric automobile. (8)

Motor

To begin, the Tesla induction motor is separated into stator and rotor. The rotor is nothing more than a collection of transmitting rods connected by end rings. The stator receives a three-phase alternating current power output. The three-phase alternating current in the coils generates a magnetic field. This spinning magnetic field causes a current to flow through the rotor bars, causing them to revolve.

The incredible thing regarding induction motors is that their rotation speed is determined by the frequency of the alternating current power source. This implies that the speed at which the wheel revolves may be changed simply by changing the frequency of the source of power. This characteristic makes Tesla speed control simple and dependable.



Battery

The battery is the electric vehicle's fuel. Lithium-ion batteries are used in the majority of current electric cars. These cells are coupled in parallel or series combinations to generate the necessary power for the car's operation.

A great quantity of heat is created as a result of continuous discharge, which is cooled using a glycol coolant. This is one of the principles that distinguishes Tesla from other electric vehicle manufacturers.

The use of numerous tiny cells rather than a few large cells ensures essential cooling. This decreases thermal hot spots, resulting in equal temperature distribution throughout the various cells, resulting in longer battery pack life. All of these cells are placed in detachable

modules, resulting in around 16 of these modules, each containing approximately 7000 cells.

Ranges of some tesla EV cars:-

Tesla model S	Range 610 KM
Tesla model 3	Range 560 KM
Tesla model X	Range 514 KM
Tesla model Y	Range 540 KM
Tesla Roadster	Range 998 KM

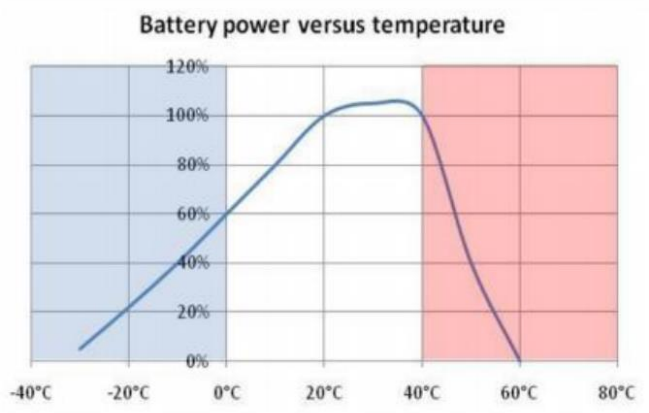
Battery thermal management system

The performance of a lithium-ion cell is affected by both temperature and operating voltage. Lithium-Ion cells perform effectively when voltage and temperature are restricted. Otherwise, irreversible harm will be done to the cells.

As a result, a battery cooling system is required for the system to function properly.

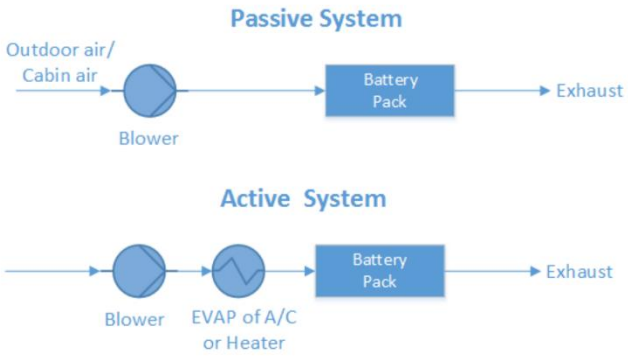
Cooling: Because of inefficiency, battery cells create both power and heat. This heat should be discarded from the battery pack as soon as the battery temperature reaches the optimal level, if possible. It may damages the battery. As a result, a refrigeration function is essential.

Heating: In cold climates, the temperature of the battery pack is likely to fall below the lower thermal limit. As a result, a heating feature is required to raise the temperature of the battery system to a optimum temperature range quickly. (LI and ZHU)

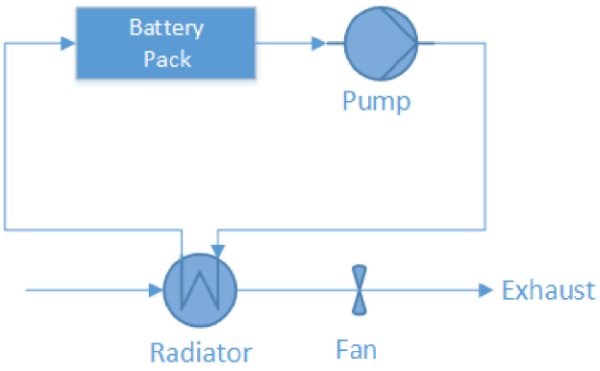


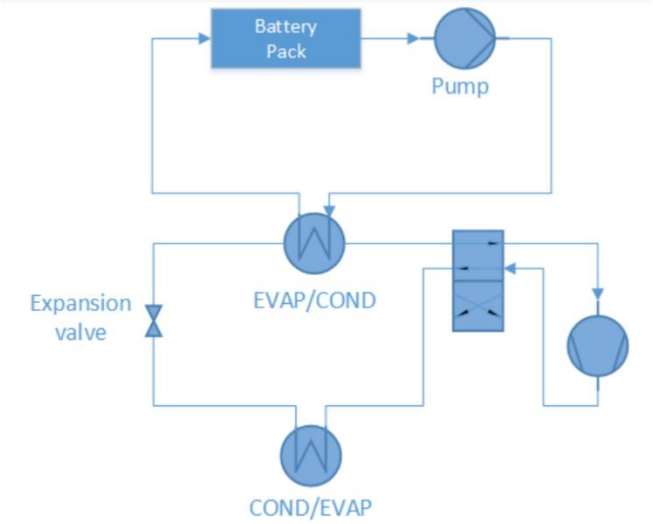
Types of BTMS:

1. **Cooling and Heating by air:**
   Air is used as the thermal medium in air systems. The intake air might be direct from the environment or from the cabin, or it could be conditioned air from an air conditioner heater.

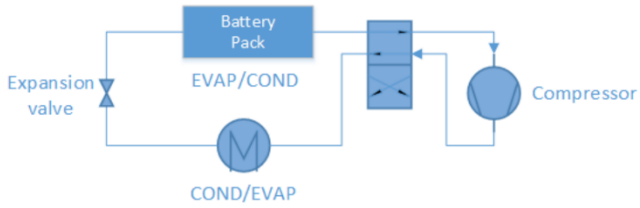


2. **Liquid Cooling and Heating**
   Another type of heat transmission fluid is liquid. There are different variety of liquids used in heat management systems. Mineral oil, for example, is a dielectric liquid that may come into direct touch with the battery cells. The other type is conducting liquid. It is a type of liquid that can indirectly meet or touch the battery cells, such as a combination of water and ethylene glycol.





3. **Direct Refrigerant Cooling and Heating**
   A direct refrigerant system (DRS) is similar to an A/C loop, except the refrigerant is used directly as a heat transfer fluid cycling through the battery pack.



Advantages of EVs

Reduce reliance on fossil fuels

Because electric automobiles are totally powered by electricity, gasoline use will fall in the future years. Furthermore, driving a gasoline-powered vehicle may be a burden on your pocket as fuel costs climb on a daily basis.

Convenience

Electric vehicles are simple to recharge. There is no need to visit gas stations to refuel. Even regular home plugs may be used to charge electric cars.

Cost-effective

When compared to gasoline vehicles, the cost of recharging an electric vehicle is insignificant. Furthermore, there are several government incentives/subsidies available for purchasing non-polluting automobiles.

Green

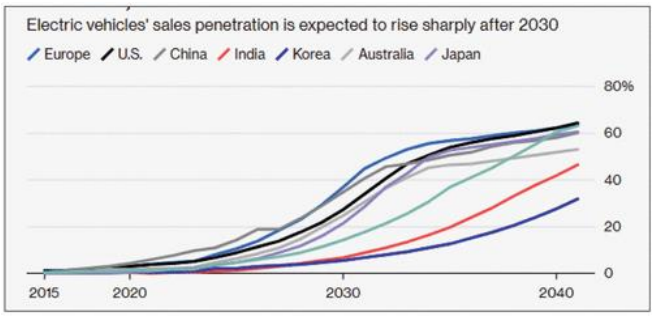
Electric vehicles are completely eco-friendly. Because it is fuelled by a clean energy source, it does not release any harmful fumes or smoke into the environment. They do really produce less pollution than hybrid cars, which run on gas and hence produce pollution.

Low maintenance

Because electric vehicles have fewer moving components, there is less wear and tear, and vehicles have a longer lifespan, lowering maintenance expenses.

Conclusion and Future of EVs

In a number of on-road applications, electric automobiles have a lot of potential to displace vehicles powered by internal combustion engines. Reduce dependence on petroleum, improve local air quality, and enhance the driving experience are just some of the benefits of electric vehicles. Urban micro-mobility and automation, as well as other forms of urban automation, go hand in hand with greater trends toward electrification and decarbonization. (9)



Several studies predict that electric vehicles will play significant roles in the future, which is shown in substantial investment in car research and marketing, charging infrastructure, and continued technological advancement, particularly in batteries and related supply networks. Consumer acceptance and adoption and technological advancement constitute a virtuous self-reinforcing loop of technology component upgrades and cost reductions that might enable broad implementation. Predicting the future, including technological adoption, is still a complex undertaking. Nonetheless, this in-depth examination provides a bright picture of the future of EVs.

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