Technoarete Transactions on Electrical Vehicles and Automotive systems

Volume No. 3

Issue No. 1

January - April 2024

ENRICHED PUBLICATIONS PVT.LTD

JE - 18,Gupta Colony, Khirki Extn,
Malviya Nagar, New Delhi - 110017.
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Technoarete Transactions on Electrical Vehicles and Automotive systems

Aim & Scope

Technoarete Transactions on Advances in Electric Vehicles and Automotive Systems (TTAEVAS) is a double-blinded Peer-reviewed open access International Journal published by Technoarete Publishing. This journal aims to cover research studies pertaining to electric cars, hydrogen fluid cells, in-vehicle production of electricity, electronics for electric vehicles, automatic components, electrical machine for automatic propulsion, "zero-emission" range vehicles, electromagnetic research issue of electric vehicles, energy management technique and strategies, super capacitors, electric motors, control system design for electric vehicles, charging mechanisms of electric vehicles, electric trains, electric ships, electric aircrafts, electrification of heavy- duty vehicles, hybrid electric vehicles, electrification of off-road vehicles, sustainable energy systems, intelligent transportation system for vehicle, environmental impact of electric vehicles, fuel cell vehicles, heavy duty buses, battery management system, electric air conditioner mechanism for electric vehicles, sensor and propulsion system, stability analysis and vehicle Motion Control heating system for electric vehicles power semiconductor devices, wide bandgap devices, seasons for electric motors and converters wireless power transfer mechanism for electric vehicles.

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(Volume No. 3, Issue No. 1, January - April 2024)

Contents

Comprehensive Analysis of Electric Train Energy Consumption Modeling to Ensure Environmental Sustainability

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ABSTRACT

The energy consumption of electric trains is considering the efficiency of regenerative braking for the support of the system of rail simulation. Furthermore, the energy recovery reduces the overall consumption of power, and the railway department is trying to capture the energy consumption that is totally associated with the operational parameters, train routes and several trains. The railway department is transiting the overall backbone of transportation systems that are sustainable in nature that can be necessary for limiting the effects of global warming. The railways' department is also trying to establish the renewable resources such as solar panels, electric power plants and many more. The methods of energy consumption within the railway transportation are compared to other systems for the cost and the precisions. Therefore, the main use of the energy consumption is totally associated with the department of the railway for maintaining the overall sustainability-related with eco-friendly environment.

Keywords—Solar panels, electric power plants, eco-friendly environment, sustainability

Introduction

Environment sustainability is aiming at enhancing the quality of people's life without providing unnecessary strain upon the supporting ecosystems of earth. It can be considered as the creation of equilibrium among consumerist culture of people along with the living world. Environmental sustainability provides several advantages to the globe, and it also diminishes energy-oriented prices, attracts the latest consumers, and enhances sales rate, boost innovations including that it also puts greater impact in society. Utilizing and consumption of electric trains can be considered as environment friendly rather than diesel powered trains. In this research paper, in case consumption of electric train energy is effectively providing environmental sustainability or not, this will be critically discussed.

Advantages of electric train energy consumption

Electric trains have the ability to diminish carbon emissions in comparison to diesel powering trains, though only in case power generation mixture is not dependable upon fuels with higher carbon content, basically that is known as coal. This overall research paper is trying to develop an electric train-oriented energy consumption modeling structure in consideration of instant regeneration decelerating efficiency in terms of supporting a railing stimulation system (Wang and Rakha, 2017). The transportation sectors have become the main customer of energy along with that developer of **GHG emissions**. More specifically, transportation-oriented energy utilization has estimated for **27% of the overall globe basic energy consumption** including that generated 34% of greenhouse gas that is CO2. The increasing attention in terms of environmental sustainability regarding transportation systems created significant opportunities to investigate the chances of energy optimization more in these sectors particularly characterized through an already **higher level of sustainability**, more particularly in railway stations.

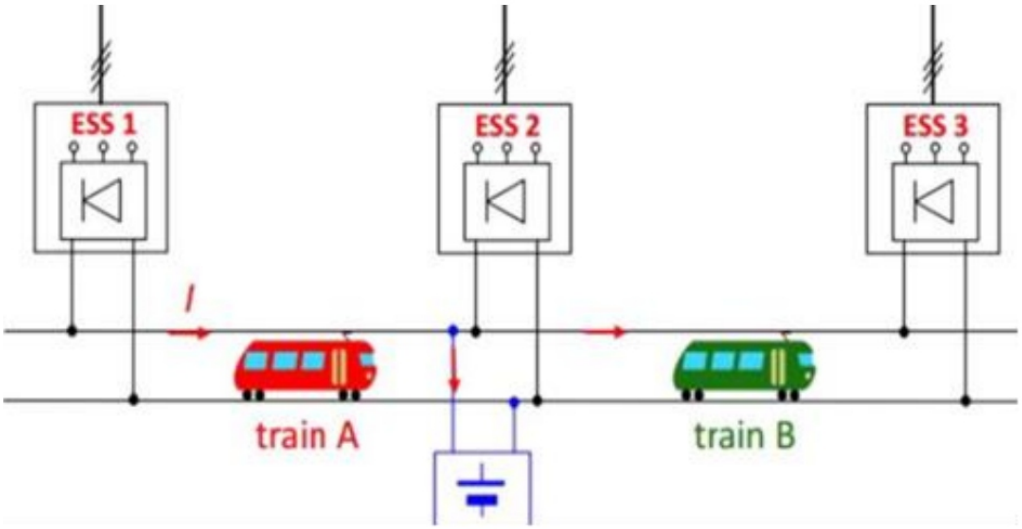

Figure 1: Model of electric train
(Source: Wang and Rakha, 2017)

Electric power trains are having a great estimation of benefits over those diesel engines. Electric trains provide more environmental sustainability, quicker acceleration, ***generate less CO2 emissions*** including that they are lighter, and lower fuel prices as it explains that it generates less wear upon tracks. As including several of electric conveyances, there are several important cuts in the ***CO2 emissions*** at the time of utilizing electric trains systems as opposed to that diesel **or else steam driving trains pollution** through the trains itself is mainly zero (Al-Thawadiet al. 2019).
Moreover, electric trains' consumption would be beneficial as it has less energy efficiency including lower maintenance prices that in turn might lead to less expensive train tickets (Shinde et al. 2018). Consumption of electric trains can be beneficial as electric trains naturally emit **20 to 35% lower carbon** than other diesel trains and an electric train is more environment friendly, basically electric trains that are powered through **renewable energy** including that it offers **free carbon journey**.

Challenges faced by railway department in maintaining sustainability

In the current scenario, the railway system is playing an important role in the transportation system of India. In addition, there are advanced and interesting developments in the railway departments. It is much more justified because the railway ministry is trying to develop the transportation system by using battery or hydrogen trains and start the main art of digitalisation. The transport planners and decision-makers can be the more effective craft for the strategic decision and several priorities that provide sustainability to railway departments (Shinde et al. 2018). For the upcoming future, technology is becoming a significant part of sustainable and better railway systems.
Furthermore, the most significant role of the railway system in rural, suburban, and urban passenger transport is the overallsustainability of the total transport system. Apart from that, as the greenest and cleanest high-volume transport, the railway system is playing a vital role in creating economies and sustainable lifestyles. Sustainable development is the most important factor for the economic growth of the railway ministry and this ministry should take employment opportunities and best initiatives for maintaining sustainability (Ramya and Devadas, 2019).
The main challenges that are faced by the railway department such as the operation and construction of the railway department have degraded, destroyed, and fragmented the overall ecosystems. In addition, it

also destroyed the habitat; land degradation occurred and increased soil erosion during construction.
It also affects the wildlife movement, water bodies and many more. The railway department is having a sustainability management-based life cycle for the turnout system of railways and they are trying to maintain the effectiveness and efficiency for improving the overall sustainability (Kaewunruen and Lian, 2019). Therefore, the department of railways to sustainability is it provides several efficient services, transfer the traffic from the roadways and offer the real alternatives for fewer modes of sustainable transport.

Advantages and impacts of electric train energy on environment sustainability

The system of the railway is dynamic and complex, and they are part of the broader and larger transportation system. The environmental impact of the railway transportation system is always compared with the roadway and also with air transport. Inaddition, the main environmental impact of several trains is totally compared by summarising the analysis of life cycle. On average, the railroads are much more fuel efficient than the roadways vehicles such as trucks. The most important technology of railway systems comes from the recovery of braking energy and the braking energy of the railway system is then recovered within the storage systems for maintaining sustainability (Ceraolo et al. 2018). The movement of freight by the railways instead of the trucks can lower the emissions of greenhouse gas and that is also up to 75%. The railway transportation is an environmentally friendly transportation system as it is easier to travel from one place to another. Furthermore, for this, the emissions of greenhouse gases per kilometre on the railway transport are about 80% less than the roadways transportation.
Sustainable development can be increased in the railway department by planting more and more trees, nurturing the biodiversity on the rail land, reducing several wastes within the supply chains of railway networks. In addition, developing the long-term strategies for improving the resilience of the railway network within the face of the climate change and by this, the department is trying to maximise the overall contribution of the railway passengers. The environmental impacts are much higher for the fuel technology and for that the powertrain technology is used to reduce the emissions of greenhouse gases (Sharma and Strezov, 2017). The economic cost of the electric vehicles is much higher while the technology of the powertrain cost is lower as they are eco-friendly.

Materials and methods

The energy consumption of electric trains can be done by establishing sustainable energy resources such as solar panels, by establishing electric power plants on the trains. Furthermore, the electric locomotives that are having higher efficiency from the electric motors are helping in the consumption of energy resources. In addition, the power might also come from renewable and clean resources such as geothermal energy, solar power, hydroelectric power and many more. The comparative analysis is done for the environmental impact that is affecting the eco-friendly environment and a recovery period is taken to improve the overall impact (Gao et al. 2019). The trains are using steam power, electric and diesel fuel and the electric power is mainly utilised for maintaining the sustainable development. The trains that have the electric propulsion usually consume the energythat is being produced as several kinds of electric power plants. For determining the overall pollution through the air, the production of electric power and the overall energy consumption is done and by this, the production of electric power is muchmore decisive in nature.

Result and discussions

In this overall research process, major benefits and impact of utilizing electric train energy consumption

modeling and in case it is providing environmental sustainability or not is a major part of discussion. Ultimately, through the overall research discussion it can be stated that electric train consumption is more beneficial than using diesel trains. Environment sustainability is the major concern of people and consumers are more concerned about the transportation that is environment friendly (Ceraolo et al. 2018). Throughout Indian railway transport, it can be recognized that electric trains are more environmentally friendly forms of transport. In addition, GHG emissions per traveler kilometer for railway transport are normally up to five consecutive times less than that of car conveyances. Deduction in fossil fuel-oriented dependency has been continuously an issue globally for numerous years (Balali and Stegen, 2021). On the other hand, results naturally show that railways have a significantly less energy footprint than passenger cars along with trucks. Passenger railway is basically three times greater efficient rather than a car upon a passenger mile basis at recent occupancy levels.

The less energy consumption of electric trains is leading towards a less greenhouse gas emissions. In the year of 2017, numerous measures have been taken in terms of becoming more sustainable, environment friendly and efficient. Utilization of solar powered oriented diesel electric trains would be beneficial in terms of becoming more environmentally sustainable. Few years ago, railway departments launched a solar powering diesel electric train, through the Safdarjung station that is situated in Delhi (Vujanovićet al. 2021). Railway sectors have utilized 16 solar panels, separate of them generated 300Wp and this is included in the portion of planning of the Indian railways in terms of promoting renewable and clean energy. This overall process supported the Indian railway to save the Indian railways up to 5.25 lakh liters of diesel per each train in later 25 years including those three crores each train in the equal time frame. Consumption of this is equally environmentally sustainable as it supports the reduction of 1,350 CO2 emissions from each train in the next 25 years. In Indian railway electric train consumption rate is high as it generates low carbon emissions.

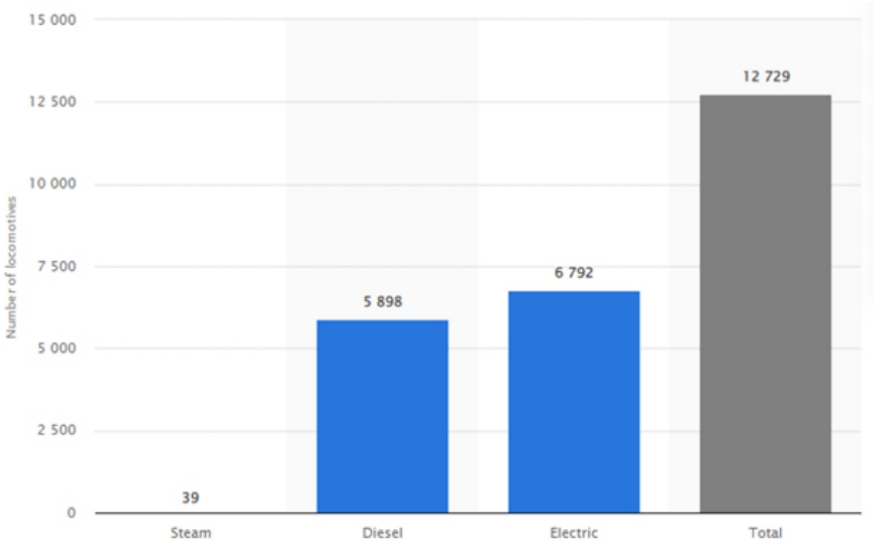

Figure 2: Electric train in India
(Source: Sun, 2021)

Future scope

The Indian Government needs to take numerous measures in terms of making electric trains more sustainable. Consumption of Solar power facilities would be beneficial in terms of making electric train more sustainable. In order to make electric trains more sustainable it is necessary to adopt practices of energy conserving and installing new forms of green technology can help in making the environment

more sustainable (Liu et al. 2018). The Indian Government needs to provide more money and take measures in terms of reducing carbon emissions. The Indian railway minister is primarily planning to have 1000MW solar powering procedures by 20250 and 2021. This move would support Indian railways in sourcing nearly 10% of electrical energy through renewable sources. Indian railways are continuously trying to take green initiative and the Minister is trying to provide 71.19MW of solar plants that have already been installed (Nag, 2019).

Conclusion

Environment sustainability is the major concern of every passenger along with that the Indian Government is continuously trying to take better effective measures in order to make electric trains more sustainable. The Indian government has also taken several measures such as electric power plants and solar panels in terms of making electric trains more sustainable. Electrictrains generate lower CO2 emissions than diesel trains and it also produces less pollution therefore, it can be stated that electric train consumption would be beneficial for environmental sustainability.

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Critical Analysis on Usage of Hybrid Power in Assuring Vehicle Stability Through Converting Electric Energy to Mechanical Energy

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A B S T R A C T

The increase of utilization and recovery of efficient energy of regenerative braking is done in hybrid vehicles for distribution strategy and energy transformation through storage systems of hybrid energy with ultra-capacitor and battery. The system of regenerative braking in the hydraulic system of braking has several advantages of recovering kinetic energy and quicker responses that can improve the utilisation of efficient energy of the overall vehicle. The converted energy is stored in the devices of energy storage such as ultra-capacitors, batteries, and even in flywheels that are having ultrahigh speed and it extends the overall range of driving up to 10%. Furthermore, electric vehicles are totally equipped with a hybrid system of braking that is regenerative and hydraulic and the system of regenerative braking is insufficient that can offer the same type of deceleration that is available in the conventional vehicles then the system of hydraulic braking is applied there. Therefore, the analysis on the usage of hybrid power is verified on assuring the vehicle stability by converting electrical energy to mechanical energy.

Keywords— Regenerative braking, Hydraulic braking system,electro-hydraulic system, Vehicle stability control

Introduction

The usage of hybrid power in electric vehicles includes the technology of regenerative braking. It can cause the wheel in slowing down and convert from electric energy to mechanical energy and also store it back within the battery. Other than that, it also assists the gasoline engine that provides extra power for climbing up to the hills. Furthermore, it totally shuts off the overall engine when the vehicle comes to a stop and then restarts when the accelerator of the vehicle is pressed. This research includes exploring the significance of the hybrid power in assuring the stability of a vehicle and also illustrates the energy transformation in the electric vehicles by the usage of the hybrid power.

Significance of hybrid power in assuring vehicle stability

The system of hybrid power is still the emerging technology that is used for evolving in future by having lower cost and wider technology. In addition, this system is bringing different storage, consumption of several technologies and generation in a single system by improving total benefits that are compared to other systems in a single source. Furthermore, there are several factors that influence the capability of regenerative braking of electric vehicles at lower speed and simulation is carried out for each of the factors for displacement at a lower speed (Heydari et al. 2019). The regenerative system of braking that consists of the ***electro-hydraulic system*** of composite braking has several advantages for recovering kinetic energy and quick response of the vehicle. It also improves the utilisation of efficient energy of the

overall vehicle. In the current scenario, the component of energy storage for the system of regenerative braking adopts the system of power supply that is composed of pure batteries. It is having the characteristics of low power, characteristics of undesirable temperature and a shorter life cycle.

The lower specific energy is the main shortcomings for having an ultra-capacitor as one of the energy devices for an electric vehicle. It is totally combined with a battery that is having higher energy that forms the storage system of hybrid energy (Zhaoet al. 2019). The ***Vehicle stability control (VSC)*** is the braking control that controls the handling performance of a vehicle. This system improves the handling performance and overall stability of a vehicle and the strategies of VSC are developed for the ***Hybrid electric vehicle (HEVs)***. Furthermore, if a vehicle consists of an anti-braking system and it is also totally designed for having the hybrid powertrain, then the hybrid powertrain will be consisting of several electric motors. It is excluded from thesystem of an active safety control loop.

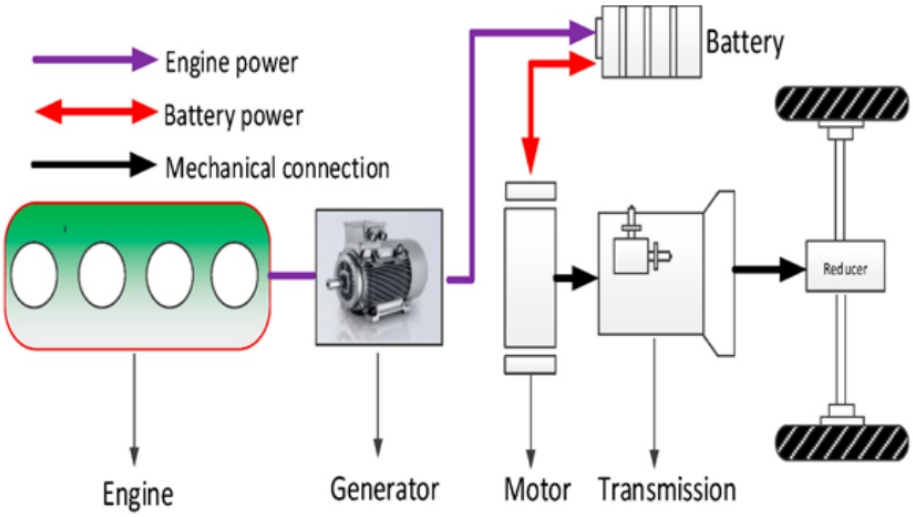

Figure 1: Energy management strategy of hybrid vehicles
(Source: Li et al. 2019)

The technology of HEV is providing the improvement of fuel economy and it also enables the HEV for exhausting fewer emissions that are totally compared to vehicles that consist of conventional combustion engines (Li et al. 2019). On the other hand, the traction and braking capabilities are totally provided by several electrical machines and they are totally disabled at the time of activation of several safety features. The HES is growing the capacity that is from the systems of an off-grid of fewer kilowatts. It is also designed for the low voltage AC and DC for the huge megawatt systems that are expanding to the medium voltage in the grid-connective systems of voltage. The major drawback of a hybrid vehicle is the capability of energy storage and these energy resources are having high specific power and higher energy that reduces the charging time (Jyotheeswara et al. 2018). Electric vehicles based on hybrid technology are totally powered by the engine of internal combustion and the electric motor that uses energy that is stored in batteries. Therefore, the system of HES is a much more promising solution that is sustainable for the power generation of several electric cars.

Energy Transformation in electric vehicles by the usage of hybrid power

The engine of the electric vehicles transforms from the electrical energy to mechanical energy that is through the electromagnetic interactions. The main conductive element that is inside the electric vehicle makes the movement as it entersthe overall magnetic field and it also ends up by receiving electric current. The hybrid electric vehicle are having several advantages such as these are environment

friendly, having several financial benefits, these are less dependent on the fossil fuels, having the system of regenerative system. The hybrid vehicles also have several disadvantages such as having less power, being more expensive, poor handling performance, maintenance costs are higher, replacement of the battery is costly and many more. Furthermore, there are also advantages regarding DC input voltage that is stable around their nominal value and it also enhances the stability of vehicles on the storage system of hybrid energy (Trovão et al. 2017).

HEVs are totally regarded as the critical solutions for enhancing the fuel economy of several automobiles as they might decrease the consumption of fuel and emissions of exhaust. It utilises electrical energy with the advantages of pollution-free and lower costs, while the configuration of the powertrain is the main part of designing the HEVs. The storage system of hybrid energy has a primary energy source that is a Li-ion battery and the secondary source is the Ultra capacitor and these sources deliver the power demand in hybrid vehicles (Itani et al. 2017). On the other hand, the energy transformation is totally analysed in the hybrid vehicles and for that, the configurations of single-mode are totally designed for considering the efficiency of energy. In addition, it also analyses the loss of energy conversion and the transmission of mechanical energy from electrical energy. The main purpose of the hybrid vehicles is to propose the controller of an artificial neural network that is for estimating the yaw moment which is required for the stability of dynamics in electric vehicles. The ordinary HEV undertakes the supply of overall energy and also the battery of the vehicle is also treated as the energy buffer. It can easily adjust the overall output power within the engines with several loads by the proper release of the energy and proper absorption of energy.

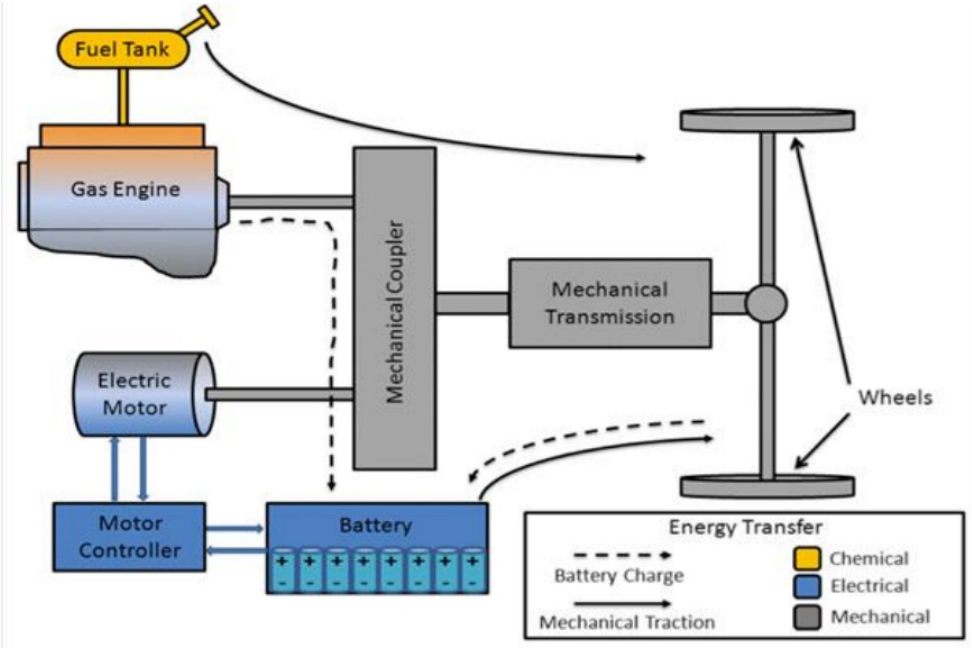

Figure 2: Process of Energy Transformation
(Source: Krithika and Subramani, 2017)

The HEVs are capable of improving the fuel economy, the overall emission for the system of hybrid power and also the control strategies that are much more significant (Krithika and Subramani, 2017). The feedback system of control is also used for regulating the HEV within the fuel cell, super capacitor and batteries while these components are totally implemented with other fuel cells within the hybrid vehicles. The main equivalent relationship between electric energy and fuel is not as constant as the efficient system of HEV is not evaluated after a certain time.

Result and discussion

The important possibilities that are for increasing the energy efficiency regarding the savings of electric vehicles are accumulated within the electric vehicles. It also increases the performance range of the vehicles with the initial resources. The electric and hybrid vehicles ensure the overall improvements in the reduction of emissions and fuel saving. The management of energy for the system of hybrid power consists of battery, ultra capacitor and fuel cell and these are totally dedicated to the electric vehicles (Marzougui et al. 2019). The overall change for focusing on the hybrid technology is done by several automobile manufacturers and there are various configurations of hybrid and electric vehicles. The configurations of hybrid vehicles are the electric batteries that are equipped in electric vehicles are called Battery electric vehicles (BEV), hybrid vehicles that combine the conventional propulsion are based on the ICE engines.

Furthermore, the electric propulsion of vehicle motors is powered by super capacitors or batteries called HEV, the electric vehicles are totally equipped with several fuel cells and they are called battery vehicles of fuel cells. However, the combination of elements of energy storage requires the power electronics that are based on converters that are associated with measurement and control instrumentation, known as the storage system of hybrid energy.

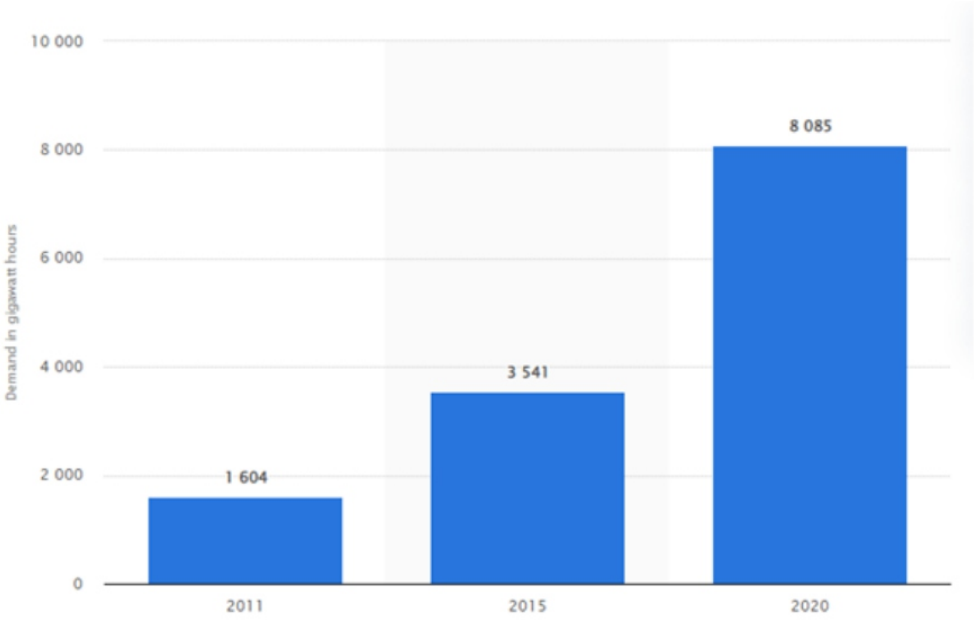

Figure 3: Energy storage demand of Hybrid Electric Vehicles
(Source: Statista, 2021)

The demand for energy storage of the hybrid vehicles was 1604 in the year 2011 and the demand gradually increased day by day with 3541 in the year 2015 (Statista, 2021). In the current scenario, the demand increased up to 8085 in the year 2020. The best thing about hybrid vehicles is this system is having several advantages in both engines that are on internal combustion and in electric vehicles for overcoming the disadvantages. For the enhancement of the performance of hybrid vehicles, the control system is totally utilised for designing the strategies of the power management for hybrid vehicles. The controllers are totally tuned by using the Simulink control for achieving a better balance between the stability of the vehicle and response time.

Based on the high repeatability of the vehicle routing, the strategy of energy management is totally proposed for optimising the hydrogen consumption that ensures the stability within the operation

process. The method of incremental conductance provides appropriate initial values that can be simulated steadily and quickly and also it improves the overall performance, ensures the stability and accuracy of the hybrid vehicle (Lü et al.2019). Electric vehicles that have two energy sources are known as hybrid vehicles and on these vehicles special batteries, main batteries and capacitors are used as the secondary energy sources.

In addition, these sources are totally designed for providing energy and power to the hybrid vehicles. Energy transformations of HEVs form an idea of reducing the energy losses and the design of HEVs method of powertrain configuration is proposed. The hybrid vehicle improves the fuel economy and also reduces the consumption of fuel and it is the major benefit of several HEVs. The hybrid vehicles aim to save the fuel by running on electricity and for full acceleration or if the batteries are totally discharged the hybrid vehicle has to be run long distance. On the other hand, the strategy of energy management plays an important role for the fuel cell of HEVs and it also affects the performance and efficiency of the energy storage in HEVs (Zhou et al. 2017).

Conclusion

Through the overall research, it is concluded that, the vehicle stability of hybrid vehicles is attained by using the driving technique of rear method, regenerative control of braking, and the system of hydraulic braking. Overall performance of controlling vehicle stability is calculated by using Simulink and the results of the Simulink illustrates the regenerative braking and driving performance of hybrid vehicles and they are fully capable of providing stability to the vehicle. Furthermore, the better performance can be only achieved by applying the regenerative method of braking control and driving procedures. HEVs run on both conventional technology of internal combustion engine and an electrical propulsion unit. This energy transformation from electrical energy to mechanical energy within the vehicle is done through electromagnetic interactions and axle electric motors are used in EVs to ensure its stability.

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Research on Vehicle Dynamic Control (VDC) System for Designing Hybrid Electric Vehicles Using Renewable Energy Resources

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ABSTRACT

The study is focused on the concept of a vehicle dynamic control system for promoting hybrid electric vehicles. Along with that, the study is also focused on renewable energy resources and their usage in the making of hybrid electric vehicles. It can be identified that China is a country where the largest number of hybrid electric vehicles can be identified while Sweden is a country where the lowest number of hybrid electric vehicles can be found. Some websites, journals, and articles help to gain knowledge and data about the vehicle dynamic control system and hybrid electric vehicles which are discussed in this research article. Apart from that, a specific theory has been used to understand and describe the concept of the research topic appropriately.

Keywords— Vehicle dynamic control, hybrid electric vehicles, renewable energy resources, environment

1. Introduction

1.1 Introduction

Vehicle dynamic control is a system that refers to the use of several sensors to monitor the inputs of the driver as well as the motion of the vehicle. Afternoon on entering these aspects the system can control the brake pressure as well as engine output which helps the driver to maintain control in the cars. The study is focused on the concept of the vehicle dynamic control system and its uses for designing hybrid electric vehicles by the uses of renewable energy resources. Renewable energy resources refer to the resources that provide energies from renewable aspects such as hydropower, wind, solar, water, and others. The concept of the vehicle dynamic control system and its importance for designing hybrid electric vehicles is discussed in the article. Apart from that, the concept of renewable energy resources and their importance for hybrid vehicles as well as for the environment is disclosed in the research article.

1.2 Rationale

The usage of hybrid electric vehicles in different countries is increasing day by day as the number of people with environmental concerns is also increasing. There are so many countries that produce and use hybrid electric vehicles by usingrenewable energy resources as well as a vehicle dynamic control system to protect the environment and complete their needs. It is identified that China is the country that used the largest number of hybrid electric vehicles, nearly 4710 thousand, in the world and Sweden is the country that used the lowest number of hybrid electric vehicles (Neves et al. 2019). Apart from that, some other countries which promote the usage of hybrid electric vehicles are Europe, the United States, California, Norway, Germany, France, UK, Japan, Netherlands, and others.

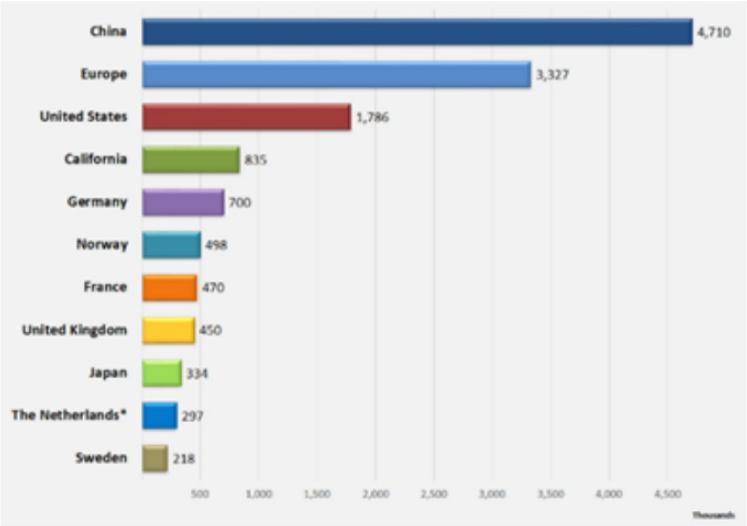

Figure 1: Countries that use hybrid electric vehicles
(Source: Neves et al. 2019)

1.3 Aim and objective

The aim of the research article is to explore the importance of the Vehicle Dynamic Control system for designing hybrid electric vehicles.

Objectives

- To describe the importance of Vehicle Dynamic Control system for the environment
- To understand the usage of renewable energy resources in the Vehicle Dynamic Control system
- To investigate the significance of hybrid electric vehicles for the environment

1.4 Research questions

Research questions of the research article are

- What is the Vehicle Dynamic Control system?
- What are renewable energy sources and how can they be used in the Vehicle Dynamic Control system?
- What is hybrid electric vehicles and how is it important for the environment?

2. Literature review

2.1 Concept of Vehicle Dynamic Control system

Vehicle dynamics control system is the process that leads to the development of vehicle industries. The entire process is focused on different sensors that are focused on the motion of the vehicle and the inputs of the driver. The dynamic control system is beneficial for the drivers as it helps to maintain the controls of the cars (Zhao et al. 2018). ***Nissan*** is one of the most popular car manufacturing companies which use the vehicle dynamic control system for producing their cars. The company uses different types of sensors in cars to enhance security and safety. The sensors are ***front-wheel speed sensors, VDC controller, steering angle sensor, rear-wheel speed sensor***, and others.

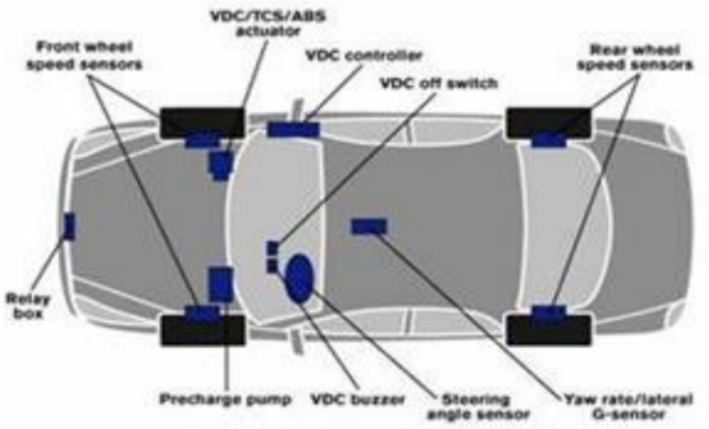

Figure 2: Vehicle Dynamic Control system
(Source: Zhao et al. 2018)

2.2 Idea about renewable energy resources

Renewable energy refers to the energies that are recyclable and come from some specific resources such as geothermal solar hydroelectric power water and others. The sources of renewable energies are mainly the sources of the environment. The use of these energies for completing the daily needs of people is not only beneficial for humans but also beneficial for animals and the environment (Wang et al. 2020). Vehicles are generally based on petrol and diesel which are decreasing day by day. In this situation, the use of renewable energies for using vehicles is the way to save petrol and protect the environment (). The use of renewable energy resources for designing hybrid electric vehicles is discussed below in the article.

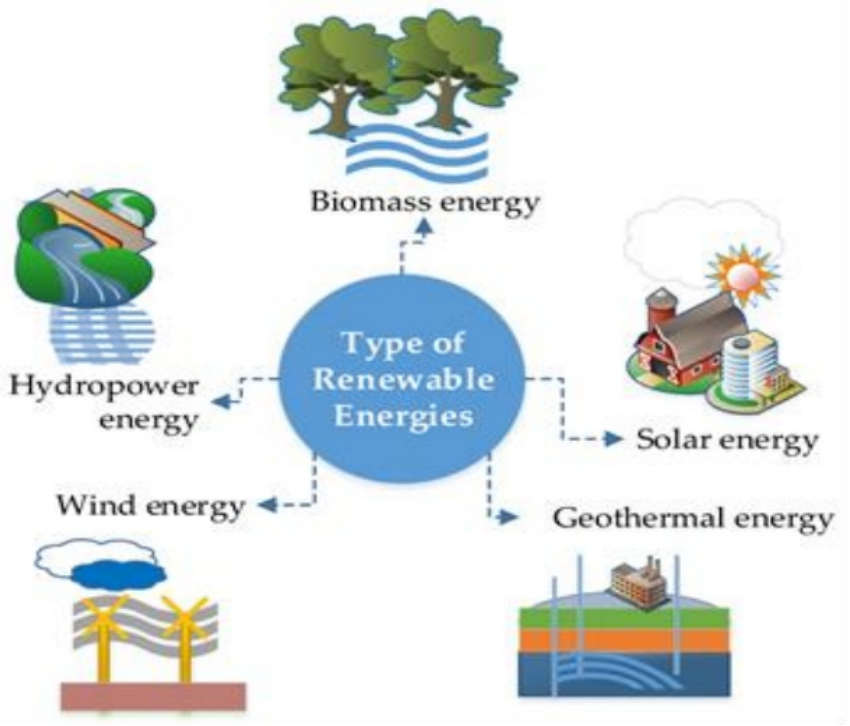

Figure 3: Renewable energy resources
(Source: Wang et al. 2020)

2.3 Hybrid electric vehicles

Hybrid electric vehicles refer to cars that rely on specific power resources such as petrol and electricity e for motion. Mostly the hybrid electric vehicles are relayed on electricity powers that come from renewable energy resources which helps to protect and save the other power resources such as petrol and diesel. There are mainly three types of hybrid electric vehicles such as fully hybrid, mild hybrids and the last one is plug-in hybrids (Qin et al. 2020). There are some advantages of hybrid electric cars such as these vehicles being environmentally friendly. Apart from that, it helps build effective financial conditions as it is less costly than petrol or diesel (Singh, 2019). Thus, the use of renewable energy resources and vehicle dynamic control systems for designing hybrid electric vehicles is discussed below in the research study.

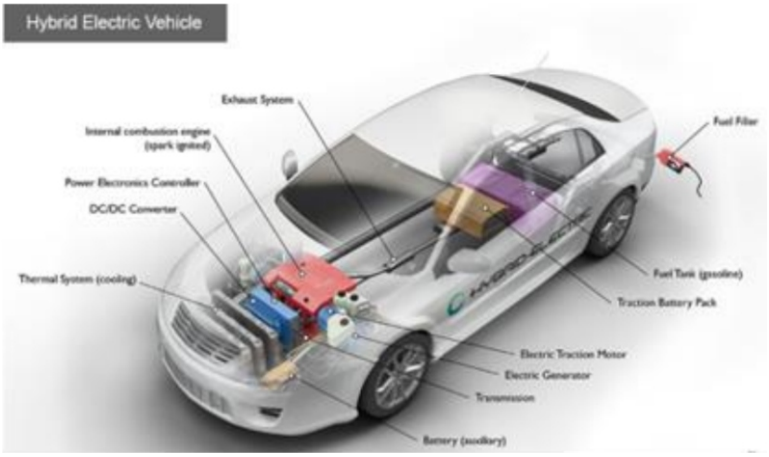

Figure 4: Hybrid electric vehicle
(Source: Qin et al. 2020)

2.5 Literature gap

Some literature based on the concept of vehicle dynamic control systems and hybrid electric vehicles is selected for review. Although the concept of the cycle main council system and renewable energy resources for hybrid electric vehicles is clear, the importance of hybrid electric vehicles for the environment is not clear which remains a gap in the literature review.

3. Methodology

Working mode	Power source	Power flow	Operation mode
Parking charging mode	AC power	Battery and super capacitor	Buck
Constant speed mode	Battery	DC	Boost
Acceleration mode	Super capacitor	DC motor	Boost
Braking mode	Braking energy	Battery and super capacitor	Buck
Super-capacitor charging mode	Battery	Super capacitors and DC motors	Boost or buck

Table 1: Different working modes of electric cars
(Source: Xia et al. 2018)

The different operation mode within hybrid electric cars has been identified in the above image where it can be assumed that braking mode within available working mode can be aligned with VDC (Xia et al. 2018). VDC is capable enough to control different types of brakes. Renewable energy resources in the form of solar hydroelectric power water and other renewable resources can be used to control brakes and reduce pollution. The power source can be assumed to be battery while power flow will be battery and super capacitor and operation mode will be boost. The methodology signifies that considering working mode, power source, power flow and others, it is possible to make use of renewable resources to develop electric cars.

4. Data analysis

Theme 1: Usage of Vehicle Dynamic Control system in car designing

Designing for any car using a Vehicle Dynamic Control system is important and the process is focused on vehicle motion. The driver's input is usually monitored along with vehicle motion where it has been found that electric vehicles have the ability to control brakes with the help of vehicle dynamic control. The engine output can be controlled through VDS. There are different companies such as Nissan that have been using VDS to control speed and have been applying brakes on wheels. The over steer and under steer are capable of applying brakes of the car through VDS (Nacpil et al. 2019). The strategies on energy management control are one of the requirements of charger stations are to design as well as control performance. A hybrid vehicle usually contains combustion engines along with an electric motor. The primary aim of an electric vehicle is to curb down the emission and pollution. Therefore, utilisation of respective VDS can be effective as an individual can reduce accidents through applying brakes of a vehicle.

In addition, parallel hybrid in association with gas engine and electric motor cause transmission in an electric vehicle. It has been seen that electric power along with gas engines offer propulsion power to an electric car. The designing of an electric vehicle through VDS involves three layers where the first layer is associated with calculation of lateral velocity as well as yawn rates. The yawn rate provides a yawn moment, and on the other hand, lateral force has been formed through the usage of methods of optimal control (Pondit et al. 2020). The dynamic behaviour of electric cars can be formed through the first layer revolving around the controller of the yawn moment. The second layer identifies the optimization of tire force that revolves around the distribution method of tire force through which tires of electric vehicles will obtain lateral force. Conversely, the yawn moment will need responses from the electric vehicle followed by meeting commands of the driver. The main aim of VDS is to enhance vehicle stability as well as enhance vehicle improvements (Piotrowski-Daspit et al.2020). The workload of tire can be evaluated through ratio of resultant force of tire in square and vertical load of tire in square while cost can be defined as follow:

$$J_1 = \sum_{i=1}^{4} c_i \frac{F_{xi}^2 + F_{yi}^2}{F_{zi}^2}, i=1..4$$

The above cost function can be illustrated through making assumptions where J1 is the workload of tires, C1 is assumed as a weighting factor in respect of relative equations while Fx1-4, Fy1-4 is about satisfying different constraints.

Theme 2: Importance of hybrid electric vehicles for the environment

Hybrid electric vehicles are important for the environment. The biggest advantage of hybrid electric

vehicles is that they have better mileage and the vehicles run cleaner. Hybrid electrics cars have an electric generator, electric training motor, battery pack, combustion engine that helps to generate the power of the hybrid electric vehicles. Hybrid electric vehicles have many advantages that also benefit the environment. The importance's are below here:

Less harmful emission of gas: The hybrid electric vehicles like hybrid cars have low carbon emission that helps to protect the environment. The big concern is Global warming that is fumes emitted from vehicles (Tucki et al. 2019). The harmful carbon-di-oxide or carbon monoxide damages the air and affects the environment. Hybrid electric cars when entered in the market, since then the hybrid electric cars use electric motors and for this reason hybrid electric cars burn less fuel.
Using hybrid electric vehicles causes a low rate of emission.

Better mileage of gas: Hybrid electric vehicles have better gas mileage where other vehicles do not have this facility. It also reduced the level of fuel consumption that is useful for the environment. The vehicle saves more gases and provides the extra power that also helps the environment (Brough and Jouhara, 2020). Instead of gas engines, hybrid electric vehicles use electric motors to save the fuel that also helps the environment.

Pollutant's reduction: In the environment electric vehicles do not grow the pollution level due to low carbon emission level. Electric cars do not release the toxins where other cars release toxins like carbon-di-oxide that are harmful for the environment (Siddiqui and Dincer, 2019).

5. Conclusion and recommendations

5.1 Conclusion

In the above article, vehicle dynamic control system refers to the aspects of monitoring the vehicle. The importance of hybrid electric vehicles for the environment is necessary. The article shows the usage of the energy resources for the vehicle dynamic control system. Hybrid electric cars are designed for the use of vehicle dynamic control systems that have many issues like control brake pressure, the driver maintains the output controls that helps to reduce road accidents. The engine of the vehicles is controlled through the vehicle dynamic system that controls the pollution and produces the low rates of emission.

5.2 Recommendations

In the above research, electric hybrid vehicles improve the feathers like charging the battery, running the engine smoothly, accessory use of the limits and also load lightly all the time. The electric hybrid vehicles always produce a low carbon emission rate that is friendly for the environment. Hybrid electric vehicles help the environment by reducing pollution and saving fuel. Every company will produce hybrid electric vehicles to reduce pollution that will help the environment. The electric vehicle producing company recommended for the low price of the product, time of recharging the battery and also low cost of operating vehicle that helps to increase the business of hybrid electric vehicle company.

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Role of Conductive Charging as a Low-Cost Charging Mechanism for Transmitting Power to Evs

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A B S T R A C T

Electric vehicle (EV) can be considered as a pattern of conveyance that is primarily powered through an electric motor drawing the power through a rechargeable energy storing device. EV often receives this electricity through plugging into that grid including that helps in storing it in batteries. Nowadays, utilization of this conductive charging is increasing and the conductive charging for electric conveyance has numerous benefits such as it being more cost-effective, simplicity along with that maturity as it basically makes utilization of plugs including sockets in terms of conducting electrical energy through physical metallic connection. This conductive charging can be beneficial for vehicles because through that, cars would be easily rechargeable in low-cost facilities.

The increasing concern about CO2 emissions, effects of greenhouse gas, along with that vast depletion regarding fossil fuels increases the essentiality to generate along with that adaptation of latest environment-friendly sustainability-oriented alternatives to the ICE drive conveyances. Due to this reason, in the previous decade, these electric conveyances have become in several ways widely spread, principally due to their negligible fuel gas-oriented emissions along with that lesser reliance upon oil. Considering the growth-oriented factors, EVs have basically advanced enormously amidst the last 20 years, in order to advance this deduction of battery prices along with that battery technology.

Keywords— Electric vehicle (EV), low-cost facilities, conductive charging

Introduction

Conductive wireless charging procedure or else simply this conductive charging utilizes conductive power transferring in terms of abolishing wires among the charger along with the device of charging. It needs the utilization of a board for charging as the power transmitter is supported in terms of delivering the power, including a device for charging with the help of built -type receiver in order to collect the power. This conductive charging needs a physical connection among the charger including the device needing charging is among the most major drawbacks regarding this method. In this research, the impact of this conductive charging process in terms of transmitting the power to EVs has been critically discussed and also advantages of this conductive charging procedure have been showcased.

Different methods of EV charging

The charging system of EV can be considered as a piece of equipment that is needed to condition along with that transferring energy through the continual frequency, continual voltage supplying network to the straight current, variable voltage oriented electric conveyance traction battery conveyance for the main motive of charging those batteries or else operating conveyances during the time of connection. Moreover, there are most probably three paths oriented to charging such as ***inductive charging, conductive charging*** along with that through charging those batteries. Utilizing the conductive process, the battery is interconnected through a cable including that is plugged straightforwardly into a provider of electricity (Dericioglu et al. 2018). The inductive process, on the other hand, works by

electromagnetic transmission despite having any connection among the EV along with that overall charging infrastructure.

Conductive charging or else plug-in charging can be considered as the mainstream chargeable technology in utilization. Requirements about EVSE about this conductive charging mainly depend upon several components such as battery capacity, methods of charging, type of conveyance, including power-oriented ratings. It is anticipated that in 2030 number of chargers for E-3W cargo vehicle will be increased to 9,826 (NITI GOV, 2021). This charging of EV includes a provider of direct current (DC) to those battery packs. As the distribution of electricity systems provides alternate current (AC), it is basically a converter that is needed to give DC power supply to the battery. This process of conductive charging can be either AC or else DC, and in this context of an AC EVSE, the power of AC can be delivered to those on board the charger of the electric conveyance, which converts it into DC. In recent days people are more interested in utilizing this conductive charging process and it can be either AC or else DC.

VEHICLE SEGMENTS	Share of public charging	Charger Types	Number of chargers - 2025	Number of chargers - 2030
E-2W	10%	Single phase 15A charger	634	3,866
E-3W (passenger / cargo)	20%	Single phase 15A charger	2,557	9,826
E-car (personal)	10%	Type-2 AC (70%) 50kW DC charger (30%)	32	306
E-car (commercial)	25%	Type-2 AC (60%) 50kW DC charger (40%)	262	2,303

Figure 1: Variety along with the estimation of public chargers
(Source: NITI GOV, 2021)

As per the views of Dericioglu et al. (2018), conductive charging methods utilize direct connection among the EV connector including charge inlet. This cable might be fed through a standard outlet of electricity or else a charging point of the station (Khalid et al. 2019). The major drawback of this solution can be considered as that the driver needs to plug into the cable, though obvious it is basically a connection-oriented issue.

The charging levels of EV

The level of charging often depicts the "level of power" regarding a charging outlet and there are mainly three levels in the charging process.

Level 1 charging

It can be considered as a process of EV that expands power of AC through the electric supply basically to a charger that is on-board charging from the basic grounded electric oriented receptacle utilizing a suitable cord set that is showcased in below figure.

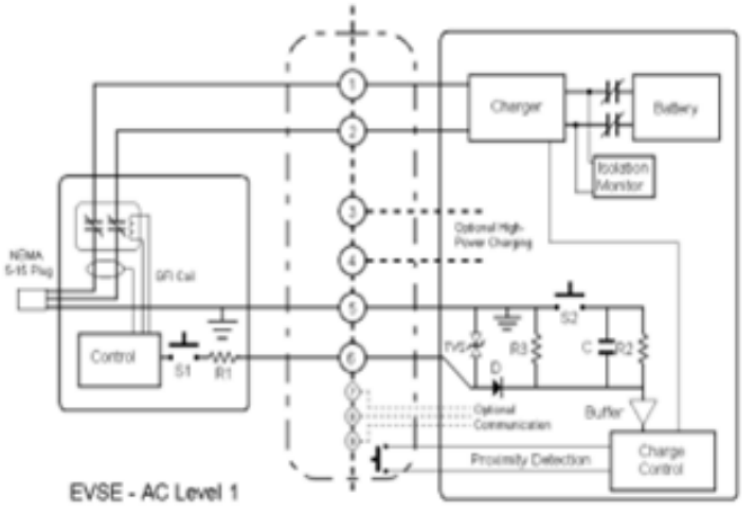

Figure 2: AC level 1 process configuration
(Source: Khalid et al. 2019)

Level 2 charging

This can be considered as a method that uses dedicated AC and this is a primary process of charging EV that expands AC power through an electric provider to an on-boarding charger through dedicated EVSE as showcased below figure.

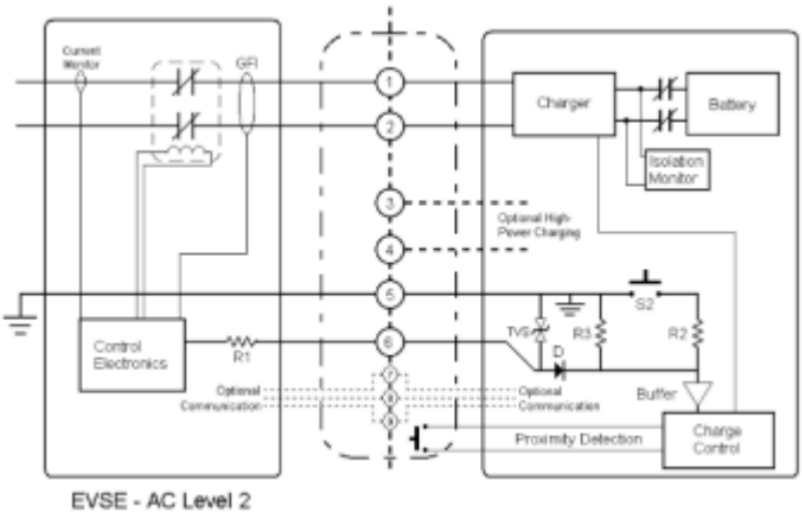

Figure 3: AC Level 2 process configuration
(Source: Khalid et al. 2019)

Level 3 charging

This method uses a dedicated process of direct current (DC), this EVSE to supply energy through a suitable off-boarding charger to the electric conveyance in private locations or else public.

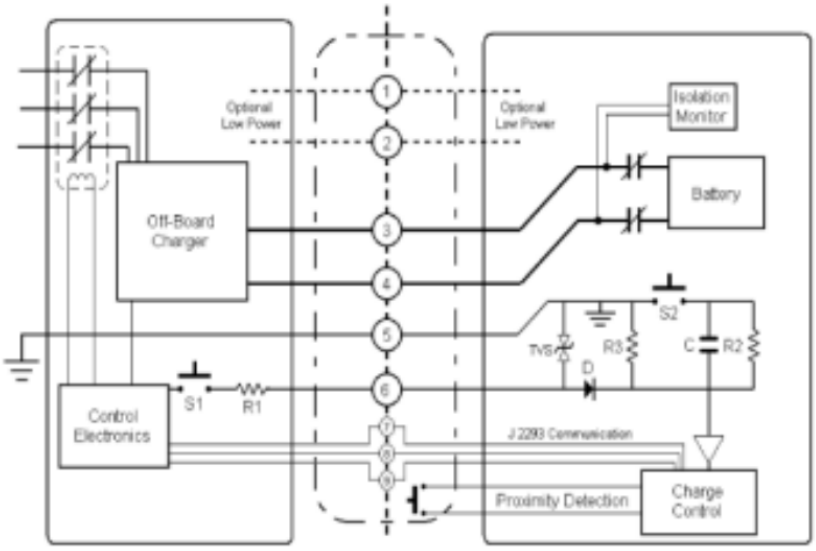

Figure 4: AC level 3 process configuration
(Source: Khalid et al. 2019)

Technology of conductive charging

The major significant features of this conductive charging technology that would provide it a benefit over several other beneficiary technologies is mainly the alignment tolerance including the lofty power efficiency regarding the transfer among the pad along with the car. It utilizes a patented double "D" quadrature design regarding the power pads that might transfer power including significant misalignment. A ***HALO system***'s power transferring efficiency is mostly comparable to a system of conductive charging. This conductive charging process can be ***1-2%*** greater efficient rather than the wireless power transfer, though the whole efficiency of this process will be in the vast range of ***90%*** or else above that (Mohamed et al. 2021). With the help of enhancement in power from ***3.3kW to 6.6kW*** including up to ***20kW*** the charging-oriented efficiency might enhance as the losses would remain equal.

Electric conveyance charging might be performed through either wired that is conductive or through the wireless process that is inductive charging. The wired charging process is a conductive system that utilizes metal contact among EVSE including the charging inlet about the conveyance (Mude, 2018). This conductive system is popular as it is cost-effective and it is wired charging, issues with filthy wires along with safety-oriented concerns in wet spheres are tremendous drawbacks about this system. These charging issues might be mitigated by charging those conveyance batteries as WPT. On the contrary, the concept of the wireless charging system is also popular, and this wireless thought can be traced before to the late nineteenth century, at the time Nicola Tesla was designed as the first wireless conveyance, a wireless bulb (Machura and Li, 2019). In addition, wired systems have gained more attention from consumers than wireless systems.

Materials and methods

Nowadays, utilization of conductive changing is continuously increasing in terms of charging electric vehicles and as wireless inductive charging method is expensive due to that it is comparatively less in utilization. A conductive charging method can be both AC and DC and in Indian standards, both methods of AC and DC are utilized (Mahmud et al. 2017). In India, the percentage of electric vehicles is numerous; therefore, the charging facilities of these electric vehicles are also different.

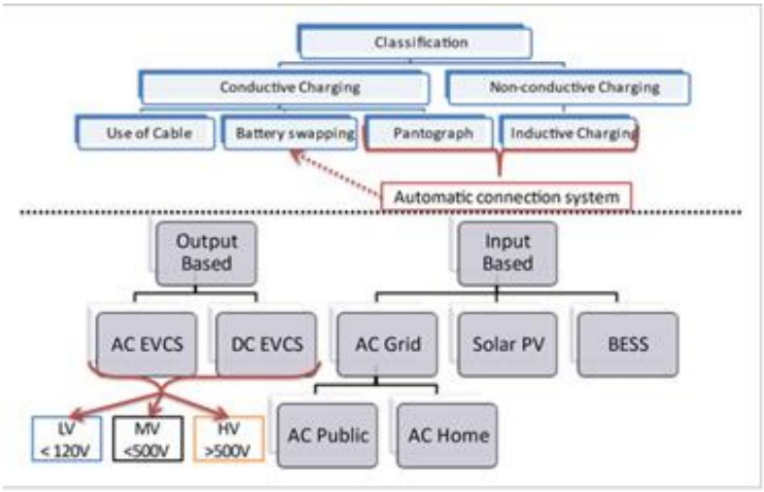

Figure 5: Conductive charging method
(Source: Mahmud et al. 2017)

Consumers naturally prefer low-cost charging facilities rather than higher costs; therefore, consumers prefer conductive charging methods. Charging the battery of EVs with the utilization of power cable or else charging cable is more classified as conductive charging of EV.

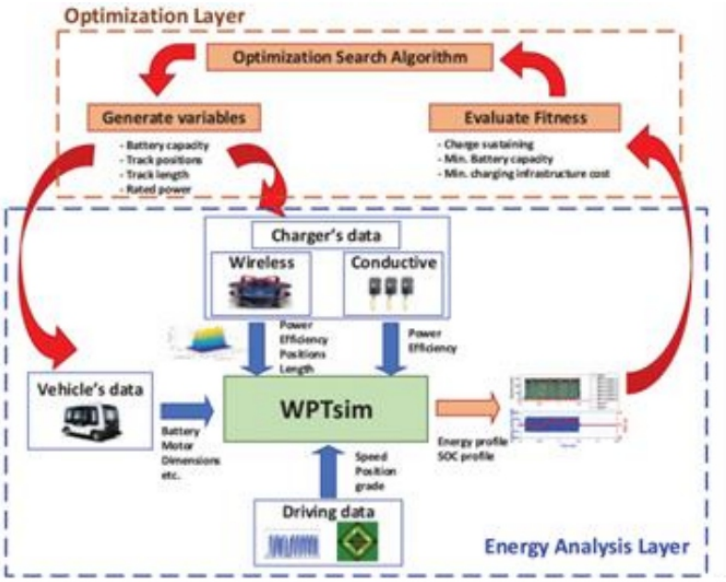

Figure 6: Conductive charging design
(Source: Mahmud et al. 2017)

Result and discussion

In this research, the unique EV charging processes have been represented. An electric conveyance might be charged through conductive or else inductive charging. Utilization of the conductive system the battery is interconnected through a cable including that plugged straightforwardly into an electricity supplier. Charging those vehicles with the help of a wired connection between the electric conveyances along with that electric conveyance supplying equipment will be beneficial (Nguyen, 2020). Conductive charging method utilizes direct connection among the EV connecter including that the charging inlet and the charging cable might be fed through a standard electrical outlet or else charging station. In addition,

EV levels related to charging modes including varieties are analysed in this overall research paper. The level of charging has been described through the "level of power" of a charging outlet.
Mainly there are three levels of technology-oriented to charging and these are mainly Level 1, Level 2, and Level 3 processes of charging. All these charging modes can be described as the safely communicating protocol among EV including charging stations. Considering the overall research process, it can be stated that the conductive charging process is more effective than the inductive charging process. The conductive charging process is more time saving, cost-effective and it helps in supplying fast charging procedures. On the other hand, the inductive charging process is nearly slow and as it is wireless, therefore, it is more expensive to utilize. Thus, it can be stated that a conductive charging system is a more effective method to use. Also, AC and DC charging levels have been meticulously described in this overall research paper. In addition, in this research process conductive and inductive charging procedures comparisons have also been showcased. It also depicts that the working of these two charging processes is Conductive along with inductive charging utilized in electric conveyances for charging batteries.

Advantages of conductive charging

Several charging processes are there in terms of providing charging to electric conveyance. These EVs are mainly taking over the share of the market of conventional internal combustion engine conveyances (Das et al. 2020). Conductive power transferring utilizes a conductor in terms of connecting two separate electronic conveyances to transfer the energies (Earl and Fell, 2019). Utilizing this conductive charging process has several challenges and it also has numerous opportunities to use.These opportunities of using conductive charging are manufacturing opportunities, massive surge in the ***B2B facilities, ICE scraping*** along with that ***battery technology***.
Conductive wired charging is always more effective than utilizing an inductive charging system. A cable connection is needed before charging because it is a wired method and currently this wired process is utilized to couple EV charging technology including EV. The major reason behind the utilization of the conductive charging process is it provides fast charging facility, and it is less expensive. This innovative ***charging facility*** offers several drivers effortlessly and it is a moretime-saving process. This system has a higher efficiency rate, it causes lower emissions, and it enhances more safety precautions. Therefore, it can be stated that the utilization of conductive systems can be more beneficial than using wireless inductive systems.

Scope of development

Some several new developments and methods can be taken in terms of making conductive charging methods more effective. Accessibility, including the robust networking of this electric conveyance's charging-related infrastructure, can be a significant prerequisite in terms of obtaining this ambitious transition (Karakitsios et al. 2018). The Indian Government has instituted several enabling policies in order to promote the effective development of the charging-oriented infrastructure network. As in India CO2 emission is continuously increasing and utilizing conductive charging is for lowering CO2 emissions. The Indian Government needs to make numerous policies to make conductive charging more effective in case it would lower down carbon rate.

Conclusion

Through the above overall research, it can be concluded that the conductive charging method provides more benefits than the other two charging methods. The increasing concern of CO2 emission, effects of greenhouse gas along with that adaptation of latest environment-friendly sustainable choices to the ICE

driven conveyances. There are mainly three varieties of charging methods in order to charge EVs. Charging can be done through conductive or else inductive charging method and the third process is through changing the batteries of conveyances.

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Usage of Electric Propulsion in Maritime to Design Green Marine Ships for Regulating Shipping Emissions in India

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ABSTRACT

Managing the pollution level caused by marine ships has become one of the serious matters of concern in the aspect of Indian pollution level. This study has focused on the invention of electrical marine ships to reduce the pollution level from the environment as well as save the fuel resources of India. Indian governmental legal factors also have been discussed in this tidy to identify the implementation of the regulations is whether maintained or not. Moreover, this study can help the readers to understand the effectiveness of the transformation of electrical marine ships to make zero carbon emissions.

Keywords— Atmospheric pollution, Electrical marine ship, Mitigation, Shipping, Zero Carbon Emission, Transformation

1. Introduction

Maritime transport is identified as one of the most cost-effective mediums to move heavy goods across the globe. In this recent decade, one of the important problems considered is reducing society's negative effect both on the environment and human health. Cutting down emissions can ensure a positive movement for the development of the environment. In this regard, electric propulsion in the sea can invent a new approach to bring zero emission of pollution. As India is one of the popular countries that have a huge amount of pollution level and the global warming has risen high day by day, it is necessary to bring invention in the emission of zero carbon effect. This study has focused on shipping emissions in India by introducing electric propulsion in maritime.

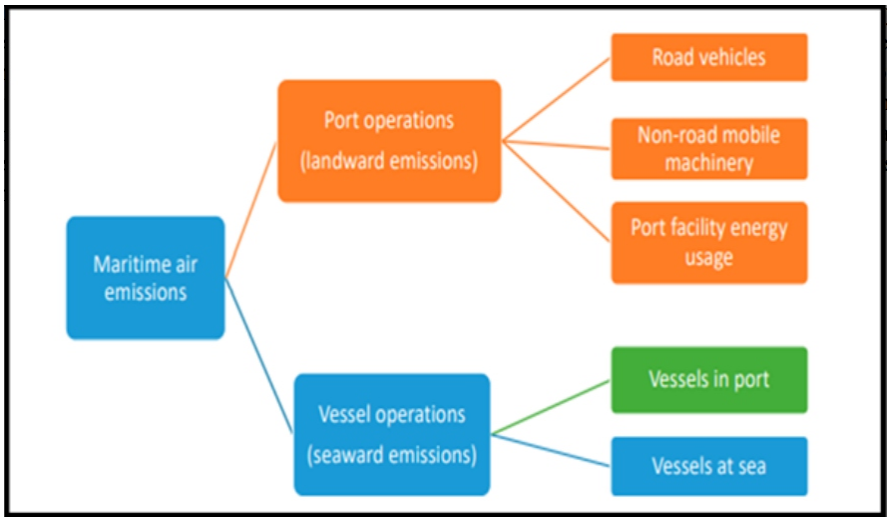

Figure 1.1: Different sources that cause air pollution
(Source: Koumentakos, 2019)

Depending on the pollution level, accompanied by the global aviation industry and contributors to greenhouse gas, only 2%CO2 emissions can be possible in India (Al-Enazi et al. 2021). According to the "***United Nations Conference on Trade and Development***", under maritime transportation, there are nearly ***80% to 90%*** of transported products that increase the pollution level of India. As per the view of Verma and Kumar (2021), ***13% and 15% of global SOx and NOx*** have occurred due to the production of marine ships. The maritime pollution has been caused due to port and vessel operations where it has been found that maritime pollution has resulted in ***60,000 deaths*** (Koumentakos, 2019). Since marine ships are releasing Sulphur oxides (SOx) and nitrogen oxides (NOx) that affect human health along with the environment, it is considered necessary to emit this impact.

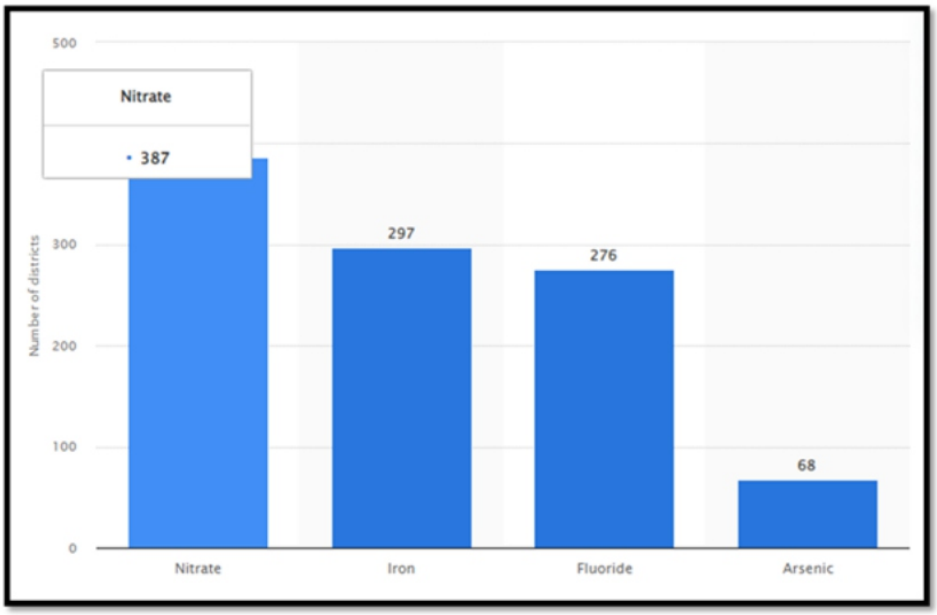

Figure 1.2: Number of districts with contaminated water in India in 2019
(Source: Statista.com, 2019)

In India the water pollution causes several types of diseases such as ***Typhoid, Amoebiasis, Cholera, Shigellosis,*** and Hepatitis A. Behind the water pollution there is a huge contribution that has remained with marine transport: ***it releases chemicals, discharges radioactive elements***, and ***releases solid waste.*** Due to the reduction of these pollutant elements, water pollution can be mitigated in India.

2. Aim and objectives

This study aims to introduce the usage of electric propulsion in maritime to regulate shipping emission through designing various green ships in India. The objectives are as below:

- To understand the advantages of electric propulsion in maritime in India.
- To find out the ways of inventing different designs in marine ships.
- To analyse the impact of the usage of electric propulsion to reduce pollution in India.

3. Literature Review

3.1 Diesel Engines and Electric Motors

In the propulsion system, the usage of diesel engines provides heat and continuous pressure that creates water pollution. Thus, beside the water transports, almost every vehicle in India runs through diesel

engines. As opposed by Koumentakos (2019), considering the constant reduction of petroleum resources as well as raising the unit price, the engineers have focused on the renewable energy sources to balance the ratio. Alternative fuels have also become a concerning area in the Indian rising pollution. Harmful gases such as ***particulate matter (PM), SOx, NOx, CO2, CO*** are produced by the sea level. As the marine is running through under the water level, it could not balance the pollution level. Considering all the obstacles in diesel engines, it has been considered that electric motors can play a vital role in the ***hybrid propulsion system***. It is a vehicle propulsion system that is combined with two or more resources in the propulsion system to modify the design. Accompanied by electric motors the release of harmful gases can be mitigated to reduce the pollution level in India.

Controlling speed and torque, direct current motors have been considered as helpful in direct proportion by current and voltage. In this regard, both the ***"stator"*** and the ***"rotor magnetic field rotate"*** have become helpful in operating the marine ships. As augmented by Kim et al. (2021), electrical energy is capable of converting into mechanical energy that helps marine ships to keep its running process and control the pollution level. Thus the engineers are continuously working on this process to bring invention in the design of green marine ships. With the rising concern regarding the health of the Indian people, the increase of demand for alternative propulsion systems becomes considerable. Observing the rising demand it can be understood that electrical marine ships have a promising future to sustain for a long term issue.

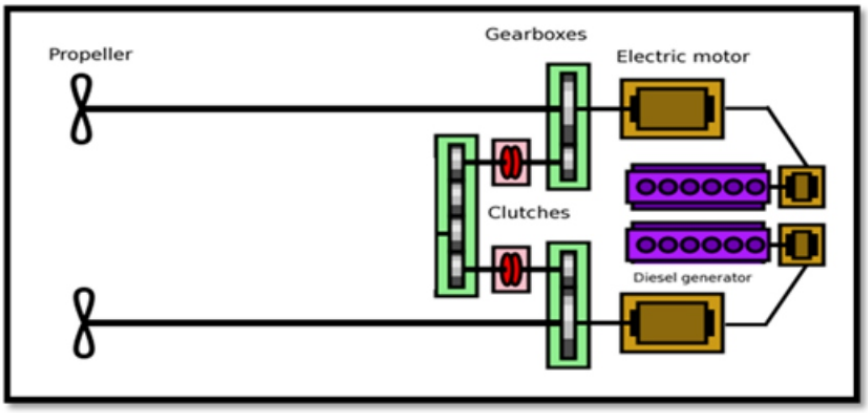

Figure 3.1.1: Possible Design of Electrical Marine Ship
(Source: Marineinsight.com, 2021)

3.2 Emissions and IMO Regulations

Considering the constant rising pollution in India, marine engineering designers have focused on the innovation to bring electrical marine ships for ***climate change, improving human health***, and ***atmospheric pollution***. As observed by Xing et al.(2020), the water pollution can be generated by two elements such as human-induced and natural. In this regard pollution caused through marine ships is entirely human-induced. According to the ***"International Maritime Organization (IMO)"***regulations the pollution level could not be as high as ***> 130 kW*** (D'Agostino et al. 2020). The entire standards of IMO represent the safety and security measures for the shipping procedure. In India, the shipping industry followed the instruction of IMO, but it could not balance the pollution level. Following IMO regulations Indian maritime can reduce at least 20% of pollution level to save the environment.

Comparing the pollution level of land vehicles and marine vessels, the researcher has identified that introducing electrical engines in marine ships will be more effective. According to Mauro, et al. (2021), the electric invention is able to complete the requirement of fuel that not only saves the fuel resources but also reduces the pollution level from the environment of India. The health issues of the people in India

are quite high compared to the other countries. Depending on this and following IMO regulations, the implementation of electricity can be executed by several steps such ***as switching to Liquified Natural Gas, switching to Low-sulphur fuel oil,*** and ***while using Scrubbers, continuing burning HSFO***. The main aim of this invention is about decreasing the high fuel consumption based on per unit power at low loads and brings an alternative way of propulsion to secure the environment of India.

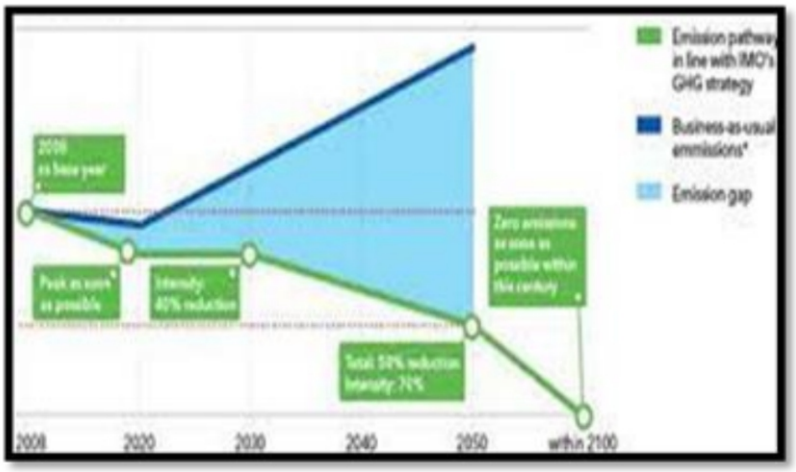

Figure 3.2.1: International Maritime Organization Regulations
(Source: Influenced by Xing et al. 2020)

4. Methodology

The researcher has followed qualitative research methods to lead this study further forward. In addition, the researcher has utilised a literature review method due to gather the relevant data to find out an effective decision after completing the research process. As stated by Serra and Fancello (2020), in the evaluation of large commercial vessels it is important to choose the correct source of data. As possible by the researcher several individually evaluated sources by measuring the levels of small vessels have been collected to analyse the valid data. Assessing several citations that were related to the topic have been found between the publications from 2017 to 2021 for inclusion in the dataset.

In addition, utilising Google Scholar due to looking for the headings that contain "boats" or "vessels" or "pollution emission" has been collected to make this study reliable and valid. In the words of Milios et al. (2019), having broadband sources in the publications can help in estimating proper resources to lead the research work in an effective way. Along withthis, investigating previous existing reports and studies also helped the researcher to identify the valid data to execute the study. Observing and discussing the matter with different vessel operators and collecting the samples based on vessel types, all appropriate information provided in the report.

5. Result and Discussion

5.1 Legal Framework for Monitoring CO2 Emissions from Maritime Transport

Due to observing the constant rise of carbon level the legal factor has been adopted by the Indian Government. Per year in India, the maritime transport system causes around ***100 million tonnes of CO2*** that is responsible for ***2.2%*** of global warming (Primorac, 2018). As the pollution is a matter of serious concern, the Indian government has taken a series of actions against the legal framework to reduce the pollution level from the Indian climate. As opined by Chou et al. (2021), in maritime the marine ship is the one vehicle that causes a huge amount of pollution and observing this factor it is needed to understand

the potential steps to control the negative impact.

The government has introduced the ***promotion of cleaner production processes*** that can enable the blend of fuel extract. In addition, by 2017 ***"Bharat Stage IV (BS-IV)"*** norms the cities have been restricted to Bio-medical Waste into water. As stated by Gabbar et al. (2021), under ***"Section 18(1)(b) of Water Act", 1974*** the government has declared the restrictions regarding water pollution and announced the renovation of zero emission marine ships. In this regard, ***Delhi Government*** has introdun. ced a ***Master Plan of Delhi in 2001*** in order to shift as well as stop water pollution.

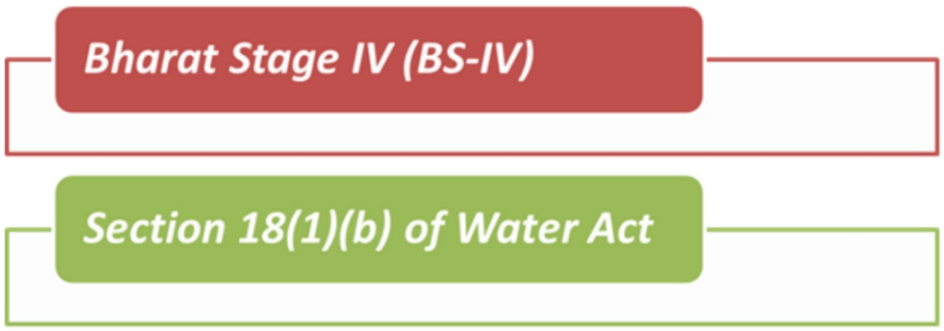

Figure 5.1.1: Legal Acts adopted by Indian Government
(Source: Influenced by Chou et al. 2021)

5.2 Enhancing the Security of Ships and Ports based on Port State Control

Maritime has been identified as the starting point of the maritime navigation that earns a huge amount for the development process of the Indian economy. As opposed by Hernández-Fontes et al. (2021), an implementation of a security can supports in the monitoring process whether the regulations are maintained or not. An investment of ***Rs. 6,000 crores*** has been invested by the government into the maritime ship development process to make the zero emission targets to save the world (Gov.in, 2020).

In return, it has been expected that the revenue at the end of the project ***1115.37 crores*** will be back (Gov.in, 2020). According to the governmental rule, the ship-owner has a duty to notice the weight of the ship to measure the potential fuel requirement. Compared to India, Europe has grown its CO2 emissions by 58% that is indicating a good approach. Observing all the facts, the transformation of electrical marine can save the risk factor regarding fuel reduction and a load of goods. Installing broadband resources, the implementation of electrical marine ships can be possible in a better way. From 1st January 2018, the implementation of regulations has been pressurized to be maintained strictly by the ship-owners.

6. Recommendations and Conclusion

Based on the above analysis it can be stated that following the constant rising pollution in India, it has become an essential factor to focus on the bringing process of alternative ways. Accompanied with advanced technologies and engineer's invention power, the marine ship can be converted into electrical transport that not only saves the fuel resources but also reduces the pollution level from the environment of India. As per the view of Zhen et al. (2019), in the invention process, design is one of the effective tools that influence the acceptance activity of the new machine. By increasing the alternative information value, an unbalanced random vessel effect can solve the pollution level as well as maintain the environmental impact.

In this regard, marine ships have remained one of the most affected polluted transport systems that released several harmful gases and fuels. In this study, all the issues behind the diesel engine marine have been discussed to introduce the potential possibilities to overcome the obstacles. This study can help the

readers to understand both advantages along with disadvantages of electrical marine ships to reduce the pollution level in India.

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