The Deployment of EVs to Mitigate Growing Global Warming in Urban Areas

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***Abstract*— Transportation has crucial role in everyday life. Non-conventional energy resources and new vehicular technologies can suppress the emerging threat of Global Warming (GW) and climate change, it can also mitigate the greenhouse gas (GHG) emissions from conventional road haulage. This paper evaluates the electric power train deployment cases in vehicles for the city of Amsterdam till 2030, considering European (EU) policies developed to reduce CO_2 emissions using futuristic technological advancements to contain EU CO_2 emissions. Netherlands gross domestic product (GDP) statistics, energy resources statistics and the suppression in EU energy means statists are compiled into a comprehensive case study for road haulage sector. It computes and analyzes the projected ecological effects of these policies for reducing GHG (CO_2, NO, Sox, NOx) emissions. This paper proposes a strategic model for zero GSG emission from vehicles in the city of Amsterdam, aims to prepare a low GHG emitting transportation network, which will cope the issues like advance urban development, life cycle optimization, increasing efficiency and reducing energy consumption to mitigate the climate change.**

Keywords*— Electric Vehicles, Smart Grid, Fast chargers, Greenhouse gas emissions, Smart cities, Climate change.

I. Introduction

The motive of the European (EU) program of "Climate Action: for 2030 is to minimize energy procurement by 30% in accordance with the 2030 business as usual projection, the reduced GHG emissions by 30% as compared to 1990 statistics and to enhance the renewable energy production by 30% in 2030 [1]. The share of transportation industry in the global energy consumption is about one-fifth, and emits a quarter CO_2 out of overall emissions, and about half of these GHG are produced by passenger cars and buses [2]. In the quest to significantly minimize the fossil burnings for energy generation in urban areas, while enhancing the environmental quality and improving the conveniences and quality of life, it is mandatory to enhance and encourage the penetration of unconventionally powered vehicles for transportation purposes [3]. The emerging use of electric vehicles (EVs) is a feasible change, since to decarbonize the urban areas, quantify energy independence to achieve improved climate for future generations. A modern power grid with EVs penetration, normally reduces 50g of CO_2 emission after each kilometer (km) drive, which is much lower, as compared to the most modern and efficient internal combustion engine vehicles (ICEVs) which emit around 110 to 160 g of CO_2, while covering the similar distance [4].

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In the past few years, several EU policies are being made, to cope the emerging GHG emission threat, to make transportation sector emission free and to encourage EVs penetration as a preliminary source of road haulage. The EU "Policy of Sustainable, Reliable, and Efficient Energy Source 2030" ensures the deployment of suitable markets which encourages the investments in low GHG emission technologies to increase vehicles electrifications as desired [5]. The Plan of regulating the electric vehicles standardization, and the roadmap actions aim to create the suitable opportunities for the expansion of the EVs market to increase such vehicles' use in Europe. By the deployment of green EVs as transportation mean, the EU commission tends to develop the comprehensive techniques to use the alternative fuels, in daily transportation means [6]. In compliance with this action the proposed policy concentrates on the defined standards and developing infrastructure. It will overcome one of the complex hurdles restricting EVs wide usage is the lower numbers of fast charging stations with appropriate facilities. It is projected that to overcome this contingency the minimum number of desired charging stations for EVs will be constructed in in urban premises in near future [7].

The rapidly growing urbanization requires an efficient transportation sector, which shows that consistently increasing CO_2 emissions and 80% of the GHG discharges of different pollutions are affecting around 72% European population living in urban areas and this proportion is likely to increase [8]. The urban areas and major cities are the governors of economic development, because 86% of the European GDP is produced in major cities. Obstacles, like traffic jams, congestions, safety, ecological factors, urban saturation, and emerging transportation demand (specifically contented by private passengers and car owners) [9] Now it has become mandatory to deal with this issue, but it is becoming difficult to maintain a higher quality life standard as desired, with appropriate and highly efficient mobility of the population and road haulage [10]. Reliability is the basic objective that encourages recent research dynamics and optimized solutions to reduce greenhouse gas emissions of ICE vehicles. The sustainability of any system depends on strategies and polices being made for highly reliable and sustainable transportation network collectively for ecological and geographic conditions, as well as addressing social problems [11]. In this scenario, electric vehicles for on road transportation is enormously important, specifically considering the higher potential of EVs to mitigate climate change and maintaining air quality and better source optimization.

The basic objective of this research is to investigate how aforementioned goals could be implemented at urban level; therefore, we have used a case study of Amsterdam to effectively project the future of green technologies. Additionally, the purpose of this paper is to deploy an integral technique to evaluate the effectiveness of deploying and integrating nonconventional energy resources, like, electric vehicles penetration in a city and biodiesel deployment. This research analyzes driving energy resources. In this scenario, to assess the ecological implications of vast EVs, deployment to find out suitable policies and required measures to be taken, to testify the development of alternatively power vehicles in major cities and urbanized regions, correlating the halving deployment of conventional ICEVs in different cities. This approach is to be taken into account for the current and forecasted requirements of urban regions to execute an intelligent, suitable, reliable and comprehensive development with a reliable transportation network, as defined by EC in 2010, for future EU development till 2030 [12]. It allows the observation of most complex obstacles being faced to mobilize and enhance the EVs penetration, to evaluate the recent and forecasted role of EU with regards to these policies.

II. Methodology

The proposed methodology is assessed by case studies. Therefore, a computational model has been developed to reckon and forecast the GHG emission (CO_2, NOx, CO, and HC) of vehicles being used in Amsterdam to deploy non-conventional fuels. The basic data has been acquired from Netherlands Transportation and road infrastructure ministry [13] and collected from literature sources [14 – 17].

In accordance with the case studies, there are numerous ambiguities between literature and practical deployment. Therefore ‘case studies’ are considered as the most precise evaluation according to various experts, these analyses specifically carried out to support the understating of probable future development forecast of complex networks. This case study projects, two key factors significantly distressing the Netherlands power network; the technological advancements and economic development, thus two-dimensional horizon has been developed, each having four quadrants, which represents the scenario shown in Fig 1. Each case involves a probable future policy [16, 17]. Each forecast introduces an unpredictability deteriorating the power network and each case involves a technological option set. The most common aspect in each case is the integration of intermittent energy production resources in the distributed generation scenario, to suppress the adverse effects of fossil fuel usage in correspondence to the deployment of alternative energy means in transpiration system, which conforms that the national laws increasing obligations due to EU energy policies.

While analyzing each study, Netherlands current economic logistics are preliminary assessed, it is imperative to evaluate, how load flexibility affects the power consumption. Flexibility is a statistical measure with respect to demand and supply to tariff [17]. The simulated flexibility of demand response relatively alters according to required demand and it is charged in units. The forecasted energy procurement corresponds to the flexibility of power consumption and GDP. The power procurement flexibility in accordance with GDP, shows the per kilowatt (kW) consumption rate being charged by GDP as presented in Eq. (1).

$$w = \frac{\partial W}{\partial GDP}\frac{GDP}{E} = \frac{\frac{\Delta W}{W}}{\frac{\Delta GDP}{GDP}} \qquad (1)$$

It is apparent that, while deploying the reduced and higher flexibilities, in correspondence to two divers GDP proportions of growth (high and low) are preeminent to different load demands in each case.

The proposed model has been developed in MS Excel and visual basic (VB). It predicts GHG emissions of cars and higher road haulage in Amsterdam emitted from fossil fuel burnings and unconventional energy means, till 2030 by penetrating various vehicular technologies. In order to compute based on the proposed model, the unit emissions factor by IJPESTO [18] the database has been used. The transportation vehicles which are basically used as a base year are conventional internal combustion engine vehicles (ICEVs). The advance vehicles which conjunct the fleet while simulating, are diesel ICEVs and hybrid gasoline cars, PEVs and BEVs.

The model is tested from 2018 to 2030 with a two-year step time. The preliminary year for estimation is 2018, while 1945 is selected as a foundation year to show the historical context of vehicles. The proposed model can be used to probe the effects of various scaling parameters on key driving outputs, for instance, projected technological advancements in vehicular industry, the proportion of different vehicles in road haulage fleet depends upon the type of fuel and GHG emission ratio of multiple fuels.

The database shows that the total number of vehicles in Amsterdam has reached about 2,522,860 passenger vehicles. The total distance covered in each vehicle per year has been estimated with respect to the age of vehicle, which provide a rough estimate that a vehicle covers about 10,000 km/year. This estimation shows that for an average car the 10,000 km/year is a common drive, such projections and calculation enforce a fact that, vehicles with older engines are not in use nowadays. As long as technological advancements are concerned the acquisition of technology sets has been accomplished in accordance with yearly model distribution. After analyzing the model (set), the corresponding emission levels (cost in Euros) are allocated, e.g., if 100% gasoline car is in use, the corresponding emission levels will be: 1, 2,..5 euro. Additionally, two different emission levels are defined, as given below [13].

- Euro 1: remain legitimate until 1972, usually known as Pre-ECE.
- Euro 2: remain legitimate from 1973 to 1991 under ECE regulation (ECE Law 15,01, ‘Directive 74-290/EEC’, ECE Law 15,00, ‘Directive 71-220/EEC, ECE law 15,02, ‘Directive 79-666/EEC, ‘ECE Law 15,0,4.5).

After 2005, the vehicle distribution in different models is made in accordance with the manufacturer’s GHG emissions level (Euro 2, 3, 4, 5), while the proportion having 0.5% or other unclear figures where GHG emission levels were not accurate; this distribution is placed in Euro 2. Those vehicle models which are manufactured before 2005, having no emission data, are distributed by 75% to the imposed emission levels in each year, further the 25% of the emission level of the prior year, denotes the secondhand vehicles. The

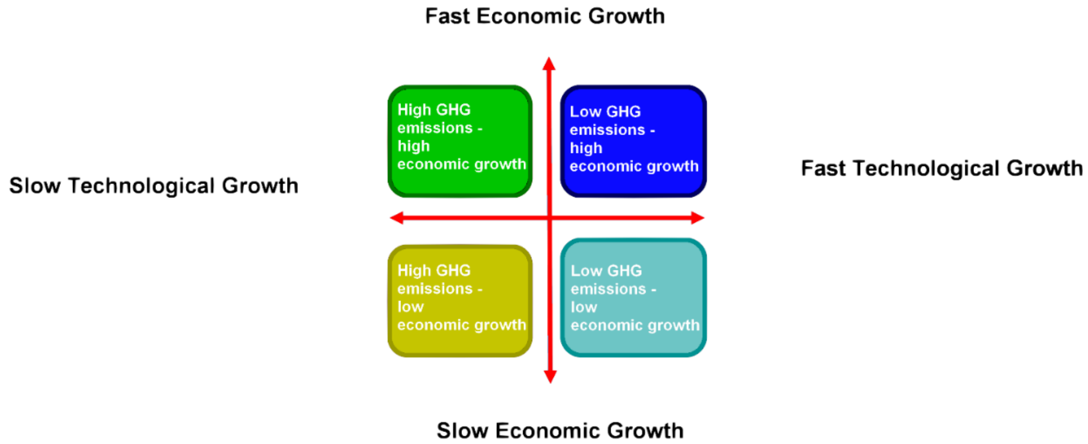

Fig 1 : Proposed Methodology for Case Studies Framework

TABLE I shows the summarized data of vehicular distribution according to technological sets and emission levels, CO_2 emission (gram/km). The data for GHG emission levels for the period of 2001 to 2017 was reckoned by literature survey and are placed with the typical CO_2 discharge of newly manufactured cars in Netherlands [19]. Prior to 2001, the CO_2 discharge rate was reckoned, considering a stable proportional rate of change about 1.2% /year.

Each technological set shows a specific level of GHG emissions. The GHG emissions like (CO, HC NOx) and CO_2 are defined in g/km. To compute the overall GHG emissions the km drive has swiftly distributed in each technological set, as shown in TABLE **I**, and the corresponding GHG emission levels in Eq. (2).

TABLE I
Vehicles Distribution in Accordance with Technological Set and GHG Emission Levels [12]

Distribution /year	Emission Standards						
Models	**Pre Euro 1**	**Pre Euro 2**	**Euro 1**	**Euro 2**	**Euro 3**	**Euro 4**	**Euro 5**
1945-1972	100%						
1973-1991	25%	75%					
1992-1995		25%	75%				
1996-2001			25%	75%			
2002-2005				25%	75%		
2006-2017				0.5 %	9.3 %	78%	13%

$$\sum_{c}^{n} (\text{GHG emissions } c/Km)c\,.(Treveled\ km)c \qquad (2)$$

where c denotes the c^{th} GHG (CO_2) emission level and n denotes the total emission levels.

III. Amsterdam Transportation Netowrk

Amsterdam is the most famous metropolitan area in the Netherlands with 3.8 million population; the region covers about 1432 km^2 area surrounded by 80 local authorities and municipal organizations in 5 sections. Amsterdam situated in Northern Holland province, the city, is commonly known as “Venice of North” due to enormous canals and beautiful country sides the Amsterdam urban authorities are managing the total area of 641 km^2. Moreover, Amsterdam is a densely populated area (5862 people are living in a km^2). As aforementioned, it is surrounded by canals, and it is also called the commercial capital of the Netherlands. This city is also famous for cultural heritage. The headquarters of various Dutch institutes is located here; it is also called the technological hub of Europe. Within the main urban area, various bridges, and complex road network, usually cause traffic problems. The Amsterdam urban area has rapidly expanded in the past few decades, and it is continuously expanding, mainly population is increasing on the Northern side. The transportation system in Amsterdam includes a complex road net of about 9000 km. The major roadways cover about 2100 km. The middle area of this city is connected by inner ring roads (11.6 km^2). Furthermore, a central ring-road network also exists which is surrounded by 142 km^2 area. The traffic in Amsterdam on both public and private transport levels face significant traffic jams and low driving speeds (usually remain under 13 km/h^{-1} during peak traffic hours) consequential to rigorous overcrowding phenomena.

The on road registered vehicles accounting, increasing about 9% each year, are supposedly the basic reason of massive GHG emission constraint. Specifically, Amsterdam on road haulage fleet subsist of 2,846,487 vehicles, accounting about 2,522,860 are passenger vehicles, and about 302,638 are heavy semis (trucks), and 9,720 are public transport providing buses and 11,208 are taxis. The higher percentage out of afore-mentioned are non-sparked vehicles (0.95 million) or running on older diesel engines (0.25 million) [20]. The average on road life of a Dutch passenger vehicle between 1945-2017, are reckoned about 14 years, TABLE II illustrates the vehicle segregation according to the type of fuel. It is found that, most of the Amsterdam’s vehicles are gasoline powered. The number of hybrid and electronic vehicles has increased about 20,310 cars till 2019 and total number of LPG cars is also increased and reached to 19,500, additionally, about 578 vehicles are powered by natural gas correlating garbage trucks and local buses [21].

IV. Developed Methodologies for Case Studies

The alternative energy, fuels, which have been considered for the development of case studies are natural gas, electricity, and biofuels. Regarding advertising and to promoting the gradual penetration of biofuels as a main fuel source for transportation in the Netherlands, it is found that according to EU's law of 2003/30/EC, the objective was 2.5% of the transportation fuel must be biofuel by 2005, and 6.2% by the year 2011 must be harvested from intermittent renewable sources [13]. In accordance with the biofuel penetration in this case could increase from 5% to 10%. Recently, the natural gas is being used as a main fuel in municipality road haulages and busses. There are three filling stations which are supplying biofuel in Amsterdam, located in the premises of Amsterdam Zuid, Amsterdam Noord, and Amsterdam Centrum areas, additionally, there are three major fast electric charging stations and about 10 mobility electric charging stations. However, Netherland government has deployment a new legislative authority, which is responsible for deployment and managing the EVs charging stations, aims to encourage the use of EVs in Netherland. In such prospective, the penetration of EVs and natural gas driven vehicles in Amsterdam could be enhanced by 40% till 2030.

TABLE II
Segregation of Vehicles According to Fuel Type [15]

Type of Fuel	Number of Vehicles
All Electric Cars	3,980
Hybrid Vehicles	16,330
Diesel Engine Vehicles	116,782
Sparked Engine cars	22,670
Unleaded Gasoline	2,027,081
LPG Driven Vehicles	712
UNL 95/LPG	19,488
Natural Gas Driven Cars	578
Unleaded Gasoline (LRP)	638,788
UNL 95 Natural Gas	12
Total	**28,464,421**

The deployment of non-conventional fuels has increased about 20% in the total energy use in Amsterdam, which shows that common cars will cover about 4.9 billion km (24.5 billion km with an average of 10,000 km each year). It is projected that; this proportional growth will soon replace the higher portion of gasoline fueled vehicles from renewable driven fuel vehicles. It is evident that, 20% of the passenger vehicles in Amsterdam are equal to about 4,95,000 vehicles. In this research work, five penetration cases of different technology vehicles have been developed. The scenario which is used as a foundation case for other four cases, inferred that no market has been developed for EVs and PEVs, TABLE III represents the substitute fuel deployment cases under consideration.

- **Case-0 (foundation)** has been developed using the approach of "common business" which denotes the present position, inferred that gasoline is the main fuel source (100%) for Amsterdam vehicles. This case is leniently understandable, (in contrast to other four cases) since this case projects the Netherlands energy consumption statistics till 2030 by continuously monitoring the recently implemented energy policies and restricted technological growth. Hence, the energy procurement proportion until 2030 has been achieved with the flexibility of power consumption and GDP. Power procurement correlates to low flexibility, consequently lower energy demand is achieved. The TABLE IV encapsulates gasoline GHG emission levels, used in this case.
- **Case-2Y (yellow)** has been developed by considering an assumption that 70% of the Amsterdam\s vehicles fleet consists of gasoline driven vehicles and remaining 30% vehicles are driven by diesel fuel. This case has been incorporated by reduced economic growth and restricted technological advancement. The coal (lignite) fulfills major energy requirements of the country. The inadequate growth of RES in this case is credited to higher investment jeopardy. This case is developed by lower power procurement. The energy demand in the future corresponds the higher energy, flexibility, due to restricted technological advancements. The penetration of EVs, and PEVs or supplementary low GHG emitting vehicles, and biodiesel driven vehicle penetration is zero, the TABLE **V** shows the GHG emission levels defined for diesel.

TABLE III
Fuel Distribution of Amsterdam Vehicular fleets

Fuels	**Proposed Cases**				
Types	**Zero**	**2Y**	**2G**	**3**	**4**
Electricity	0%	0%	0%	0%	10%
Natural Gas	0%	0%	10%	10%	10%
Diesel	0%	30%	30%	30%	20%
Biodiesel	0%	0%	0%	5%	10%
Gasoline	100$	70%	60%	55%	50%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

TABLE IV
Defined Emission Levels for Gasoline [8,11]

GHG	**Pre-Euros**		**Euros**				
g/km	**1**	**2**	**1**	**2**	**3**	**4**	**5**
PM	0.05	0.05	0.0056	0.005	0.0036	0.003	0.006
NOx	2.6	1.3	0.46	0.24	0.16	0.07	0.06
HC	11	1.8	0.26	0.15	0.23	0.12	0.14
CO	51	14.5	2.73	2.3	2.4	1	1

TABLE V
Defined Emission Levels for Diesel Engines

gr/km	**Diesel (Euro-5)**
PM	0.05
NO'x,	2.60
HC'	12.55
CO	51
CO_2	139

- **Case-2G (green)** is developed on the assumption that till 2020 in Amsterdam 30% vehicles will be diesel driven, 10% will be fueled by natural gas, and 60% will be powered by gasoline. The case two, shows the increase in the economic growth and a lower development of technological sector. The technological advancements are restricted; consequently, it encourages the development of conventional energy resources like hydropower, specifically on the local level. The higher energy demand in correlation with lower technological advancements increased the GHG emissions. The natural gas has a vital role in the following fuels segregation. However, lignite is considered, as the most vital conventional resource for electricity generation. The energy procurement in case 2 is significantly higher because the proportion of economic development is high which leads to higher electricity consumption. TABLE VI, presents the emission levels defined for natural gas.

TABLE VI
Defined Emission Levels for Natural Gas (N.G) [14]

g/km	N.G Emissions	N.G emissions% by diesel (Euro 3)	Diesel (Euro 3)
PM	0.00	-96%	0.06
NOx	0.05	-87%	0.055
HC	0.06	100%	0.05
CO	0.35	-47%	0.65
CO_2	111.79	-20%	139

- **Case-3 (sky)** is proposed by assuming that in 2027, there would be 30% diesel driven vehicles, 10% would be driven by natural gas, 55% of the Amsterdam's vehicles will run on gasoline fuel, and 5% will be driven by biodiesel. This case shows the low economic growth rate and higher technological advancements era. Since in this case the capital investment is limited, therefore, these technological advancements could not be completely implemented. Although, a significant use of lignite in the power generation is recorded, while the penetration of windmills and micro hydro generation plants have been enhanced. This case exhibits lowest power procurement in contrast to the earlier cases which have been attributed due to economic degradation comprising lower energy, flexibility TABLE VII shows the emission levels defined for biodiesel fuel.

TABLE VII
Emission Levels for Biodiesel [14]

GHG g/km	Biodiesel (Emissions)	Biodiesel Emission % (Diesel Euro five)	Diesel (Euro-5)
PM	0.03	-48%	0.006
HC	0.00	-67%	0.06
NOx	0.21	-10%	0.19
CO	0.27	-49.6%	0.6
CO_2	29.76	-78.1%	139

- **Case-4 (blue)** is proposed by assuming that till 2030, in the city of Amsterdam, about 20% vehicles would be diesel driven, 10% will be plugged in hybrid electric cars, 60% would be gasoline powered, while 10% vehicle fleet will be all electric powered. It is apparent that, in this case the GHG emission penetration from zero to reduce GHG emitting vehicles has reached to 30%. The case is comprised by economic development and higher proportion of technological advancements. In this case, the increased energy demand is evened out by mutual cycle power plants (natural gas driven) and by enhanced deployment of windmills to produce electricity and micro hydro power plants. The penetration of latest renewable energy technologies to the Netherlands power generation network may reduce GHG emissions. The TABLE VIII illustrates the emission levels defined for electric vehicles.

V. RESULTS

The results of mentioned case studies of penetrating intermittent energy resources in Amsterdam are encapsulated in TABLE IX and TABLE X. The steady degradation of gasoline in Amsterdam's energy production sector can significantly reduce GHG emissions and ecological pollutions. In order to, reduce CO2 emissions, Case-4 exhibits considerable results.

TABLE VIII
Defined Levels for GHGs Emission for EVs

GHG g/km	EVs Emissions
PM	0
HC	0
CO	0
NOx	0
CO_2	87

TABLE IX
GHGs Emission According to Each Case (g/km/car)

g/km/car	Zero	2Y	2G	3	4
PM	0.007	0.003	0.003	0.004	0.004
HC	0.36	0.12	0.11	0.07	0.07
NOx	0.27	0.15	0.14	0.12	0.12
CO	2.97	1.27	1.08	0.98	0.82
CO_2	166.37	122.67	150.08	143.17	131.3

TABLE X
GHG Emissions Comparison

GHGs	Zero	2Y	2G	3	4
CO	0.00	-57.5%	-65%	-66.5%	-72.4%
HC	0.00	-68.5%	-71.6%	-73.8%	-77.7%
NOx	0.00	-46.2%	-51.4%	-50.8%	-57.3%
PM	0.00	-36.9%	-39.3%	-40.2%	-49.8%
CO_2	0.00	-6.7%	-9.7%	-13.8%	-21.2%

Specifically, the substitute of gasoline powered vehicles and the higher deployment of Amsterdam's vehicles of diesel-powered road haulage, the Euro five technologies at a proportion of 30%, as illustrated in Case 2Y, consequently it may suppress the greenhouse gas (GHG) emissions by 36.9% to 68.7%. However, the implications of this Case, to GHG emissions are adverse as it only suppresses GHG emission by 6.4%. The deployment in Amsterdam's vehicular fleet powered by natural gas at a proportion of 10%, as illustrated in Case 2G, the impact of the reduction of GHG emission reached at 39.4% to 72.7%: whilst the CO_2 emission is reduced to 9.7%. The impact of biodiesel fueled vehicles on Amsterdam's vehicular fleet results at a proportion of 6%, as illustrated in Case-3, its effect on GHG emission reduced to a level of 40.3% to 74%: while the CO_2 emission reduced to the range of 13.8%. It is evident that proportion of CO_2 emission deduction, which is exceeding to 4.5% than the above-mentioned Case 2G, is disseminated as, the vehicles driven by biodiesel emit lower GHG in contrast to the natural gas driven haulage. As mentioned, however the biodiesel is under investigation, has initially developed the technology at the combination of 5-12% biodiesel, a minute raise in NOx discharge has been analyzed (0.7%). In last the deployment of EVs or PEVs to Amsterdam's transportation sector in a proportion of 10% as elaborated in Case 4, which results as a reduction in GHG discharge by the proportion of 49.6% to 78.1%: whilst the diminution in CO2 discharge reaches at 21.2%. The reimbursements, in sense of ecological impacts and GHG emission diminution, can be enhanced if EVs deployment will be enhanced and the penetration of biodiesel driven vehicles is encouraged.

The Fig 2, Fig **3** and Fig **4** show the gradual diminution of PM, HC, CO, NOx and CO2 discharge (emission) with respect to per km of a vehicle. The substitute of gasoline driven cars could be biodiesel and natural gas or EVs as illustrated in the aforementioned cases, which can result in a considerable decline in GHG emissions. Maximum suppression in CO_2 discharge can be achieved by 21% (170.6 g/km in Case-0 in contrast to 132.30 g/km achieved in Case-4) shown in Fig **4**.

VI. DISCUSSION

This research analyzes the impact of five different technology vehicle cases on the progress of PM, NOx, CO, HC and CO_2 discharges (emissions) resultant from Amsterdam's vehicular fleet in accordance with a forecast for the future from 2018 to 2030. Regarding the assumptions inferred, and implemented all over this research, it exhibits that deployment of 10% EVs, 10% biodiesel driven vehicles and 10% natural gas driven cars to the energy sector of Amsterdam's vehicular fleets, and by using the diesel engine driven vehicles having Euro 5 technology, GHGs emission can be suppressed about 49.5 to 78%, while CO_2 discharge from these vehicles may come to 20%.

While analyzing these cases, various key factors have been taken into consideration which can affect the future growth of the energy sector in Amsterdam, for instance, growing energy demand, economic development, limited technological advancements, as well as ecological factors. The creation and deployment of advanced technological solutions in the transportation network of urban regions have an enormous significance to the lower CO_2 emitting transportation network.

This research presents that the penetration of substitute fuels and the deployment of EVs may develop a low CO_2 emitting city, which could contribute effectively to the environment and controlling climate change policies, defined by EU. To achieve the target to deploy these case studies, it seems mandatory to clarify future strategies and roadmaps for the transportation sector, acquiesced across many stakeholders on a national level. Least expensive energy consumption and saving potential in the transportation system could not be achieved completely as desired by deploying above cases in the transportation system of Amsterdam, as alternative fuels and EVs markets are not going to develop and evolve abruptly in the next few years.

This is to be done to fulfill the required enhancement to upraise the energy saving potential. Various factors affect this growth, like multiple markets and failure of regularity mechanisms. Furthermore, the implementation of environmentally friendly technologies and EVs mobility in urban regions are still depreciated due to political and economic impediments. For acknowledgement, a Strategically Zero Carbon Emitting Transportation Framework for Amsterdam must be developed, aiming to develop a low GHGs emitting transportation network that will include the most important narratives such as lifecycle optimization, reduced energy consumption, energy procurement and effective urban planning.

Considering obstacles, that can affect the penetration of these strategies, have an enormous significance. Multiple research studies have indicated these obstacles [15-17]. These involves internal alias as follows:

- Building infrastructures for electric vehicles charging (least density of charging hubs, as well as identifying the early adopting hotspots etc.)
- Accessibility and preparation of relevant industries (new transportation models (vehicles models) and business strategies etc.)
- Electric vehicles battery storage technologies (material recycling, developing cost, energy density, and SOCs)
- Standardization the electric vehicles infrastructure (billing system, charging outlets voltage, data protection etc.)
- Effects of GHG emissions and energy efficiency and reliability (power management, electricity generation network etc.)
- Consumers' need accomplishment (driving range anxiety, satisfaction, incentives, willingness to pay, safety precautions etc.)

It is clear that, all electric driven vehicles (AEDVs) only powered by electric energy, which have zero silencers emission, however, the electricity generation source may emit GHG emissions, for instance, coal power plants: a country producing most of its electricity using coal and gasoline that would only have micro greenhouse emissions benefits thorough vast EVs penetration [15–17].

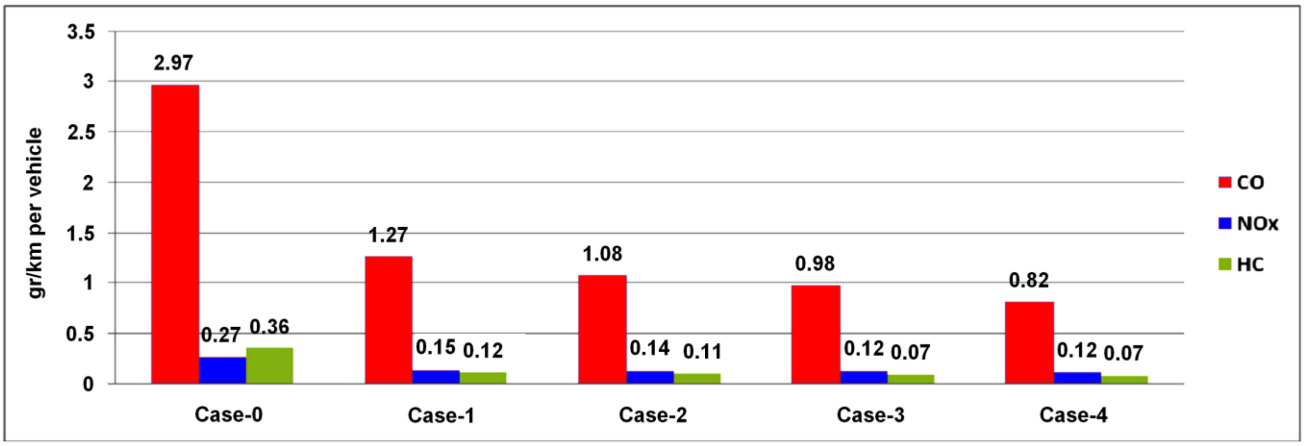

Fig 2 : Average Cost of GHG Emissions for Each Case

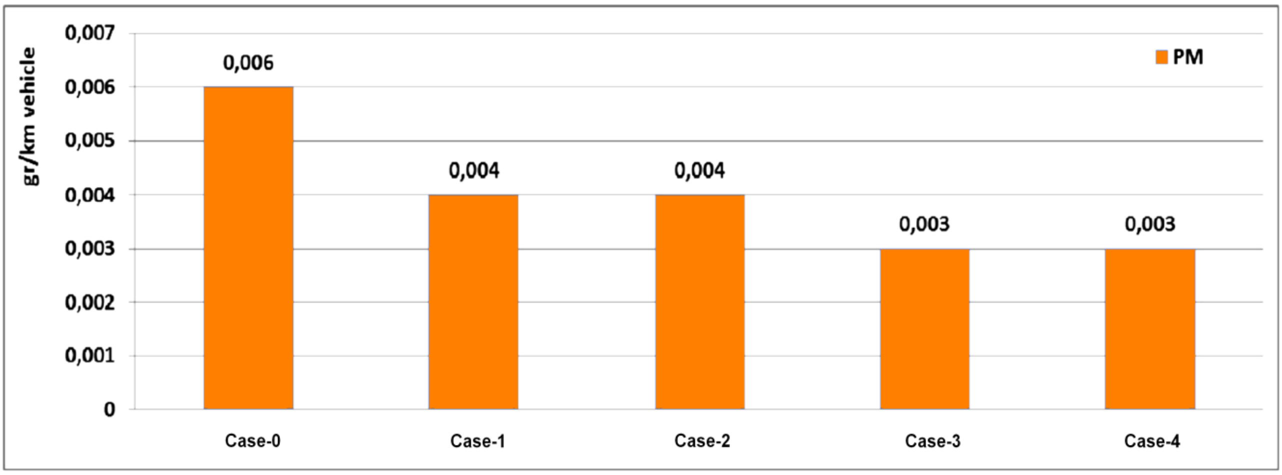

Fig 3 : Average Cost of PM Emissions for Each Case

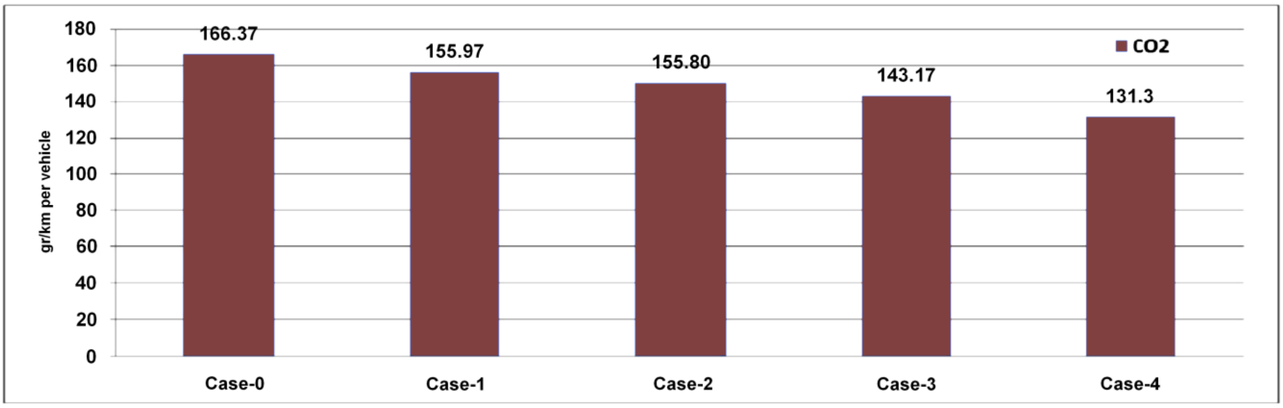

Fig 4 : Average Cost of CO2 Discharge (emission) for each Case

This highest reduction advantage is linked to the vast deployment of renewable resources which is being achieved on least value where EVs are massively deployed, i.e., emerging societies as "carbon free societies" [22], where most of the electricity being generated by intermittent renewable resources as by deploying modern technologies like; photovoltaic, hydropower, wind, geothermal, biogas, or through animal waste [23]. Although in a time horizon where dominant power generation technologies will be renewable (Case-4), EVs is considered as a path towards gradual decline in GHG emissions. Additionally, the forecasted demand for biofuels will be exaggerated by EU laws and policies, which already fixed a goal that 10% of the European road haulage will be driven by biofuels by the year 2030; Netherlands is already committed to achieve this goal.

Furthermore, the narrative of Netherlands government concerned about the energy producing fuels being used for transportation purposes will exhibits a crucial part in future dynamics of green fuels. The lower dependency of diesel fuel currently in use as a major fuel for transportation will encourage biodiesel use in future.

Countering the afore-mentioned obstacles is a complex task to be achieved, that requires a comprehensive planning. In such scenario, intelligent urban cities development can play a considerable role, such as, it is mandatory for such development to be strategically sound depending upon holistic transportation change effect on population, which should be motivated through infrastructure development (Involving energy production and new technology vehicles) [24]. Furthermore, auxiliary service providers and automobile industry, should work collaborating with urban city developers, planners and municipal authorities to evaluate the common passenger's transportation requirements living in urban areas. It will also increase the business activities that are supported by service providers and implementation managers, by accumulating services of third party.

The initiatives that may encourage preliminary EVs penetration are optimistic for prosperous future of EVs, despite less reduction in fossil fuels consumption and GHG emission in upcoming years. The framework is to boost the long-term development of EVs and gradual transition of transpiration fleets to alternative green resources by motivating consumers to use EVs, the governments are encouraging the service provides to build supportive infrastructure and encouraging EVs industry to develop low cost electric vehicles and assure the spare parts availability and easy accessing. To expend the EVs share in existed automobile market on major level will need new innovative designs autonomous features and enhanced performance, but the required early initiatives necessary to be taken are technological advancements and market development, that will identically proceed to preliminary mass penetration, if we will wait for technological advancements before developing support markets.

Fig 5: Long term impact of vast EVs penetration and deployment of non-conventional fuels in Amsterdam vehicular fleet.

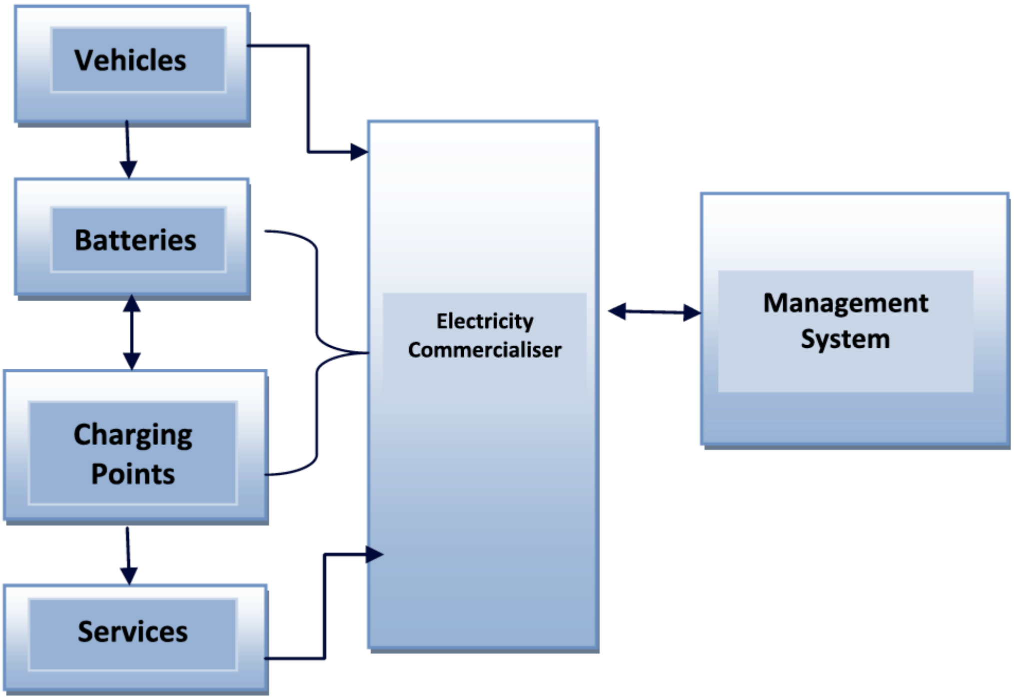

Fig 6: Basic infrastructure required for vast EVs penetration in mainstream transportation sector

By implementing this data, the afore-mentioned constraints could be overcome, as an optimization approach could be developed. This data will cover each sector of energy related industry, including economic growth, social awareness, marketing business expansion, infrastructure building, ecological benefits, lack of opportunities. By effect dissemination measures, the knowledge level and awareness level of each stakeholder will expand.

Consumers with better knowledge and understating can intelligently compare the evolving and conventional technologies and, and the utility services providers would be aware enough that they would not hesitate in executing better decisions to accommodate the technological advancements and deployment, whilst this data will work as tool for policymakers through which they will convince the concerning stakeholders about the relevance of futuristic technologies. The vast electric vehicles penetration and deployment of renewable fuels will help to develop substitutes for conventional automotive industry; consequently, the use of fossil fuels will reduce with time in urban transportation sector.

Additional diminution of CO_2 emissions could be achieved by deploying the green fuel combination from second generation of developed fuels and EVs till 2030. This GHG degradation must be facilitated by policies in Europe that should define CO_2 emission levels for each type of vehicle. Furthermore, supportive actions are required to assist these policies for second generation biofuels to achieve the market maturity level and broader development scale.

Specifically, in the city of Amsterdam, the penetration roll of EVs depends on the deployment and installation of fast charging stations. Due to limited electricity generation reserves in Netherlands, because since 2011 most of the electricity is imported from other European countries, correlating growing energy requirements with EVs charging. It is clear that intelligent charging infrastructure is mandatory to fulfill EVs charging needs. To achieve this goal, the electric infrastructures in Amsterdam required following key components presented in Fig 6.

EVs accommodating components which are mandatory equipment in order to interact with existing power network; related components for batteries assistance which enable EVs charging operation and individual charging outlets (charging points) which allow the interaction between charging station and EVs, fast charging facilities. In order to charge EVs in shorter time (electricity aggregator) the managing agent who is legally authorized to start or end charging, additional services (to accommodate charging cycle), associates for providing potential services, like parking facilities, EVs battery leasing, financial services, highly efficient management network: responsible to govern various services. Simultaneously (data collection, information security, financial matters) linked with EVs charging, that ensures the technological compatibilities between various networks and EVs mobility services, by assuring a charging infrastructure on national level which should be easily accessible to a common consumer.

The resources of the proposed afore-mentioned strategic zero GHG emitting transportation infrastructure for the Amsterdam is projected to achieve the technological objectives along with innovative goals. The economic statistics shows the relevance of the futuristic actions, and it is also validated through set targets. The overall required budget of implementing the zero GHG emitting transportation system accounts 8,518,785 Euros. Given Netherlands current economic statistics, and due to current credit crisis, from total mentioned amount 6,520,340 Euros can be provided by EU upon request, hence consequently about 76 % funding could be arranged. However, all expenditures would not be covered by the funding of EU therefore rest of the amount should be arranged by municipal resources.

VII. Conclusion

In this research paper, the diverse effects of the greenhouse gas emissions on the environment have been evaluated. It also proposes that how we can minimize this vigorous GHG emissions produced by the conventional internal combustion engine vehicles in urban areas. It is proposed that by replacing the conventional fossil fuel vehicles with electric vehicles the consistently growing threat of global warming can be significantly minimized till 2030.

Furthermore, a comprehensive transportation model has been proposed which can be implemented and tested considering the demographic conditions of Amsterdam. Four case studies have been carried out to test the proposed model and it is found that proposed framework can be effectively beneficial in reducing GHG emissions in the urban areas all over the world.

VIII. Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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