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Materials and Energy Interface of CO2 Loadings & Decarbonization

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Abstract

Urban mobility and public transport have been building carbon footprints for rationalization of a materials-energy balance at rubbing contacts of automobiles. The global political regulations such as COP 21, IPCC, and FAME-II have created academic cum scientific inertia for designing or manufacturing of hybrid and electric vehicles preferred in reduction of anthropogenic load over urban environment. Transformation of conventional IC engines to hybrid and electric vehicles (EVs) have been rendered in India for manufacturing of car, two wheelers, and public transport buses. Friction, lubrication, and wear at interacting mechanical surfaces or tribology is promoting for scientific research of materials and energy domain.

Keywords; Political regulations, CO_2 footprints, Technology, Hybrid and EVs

1. Introduction

The 2030 agenda for UN Sustainable Development Goals adopted by all member states in 2015 is a common blueprint for peace and prosperity in harmony of planet health, to protect the planet from degradation, including sustainable production, managing its natural resources, and minimize environmental reactions [1]. The Paris Agreement adopted at COP 21 in Paris on December 12, 2015, fully realizing technology transfer for improving resilience to climate change, reducing GHG emissions, safeguarding collective framework to provide the well-functioning technology mechanism, and accelerating technology development [2]. The intergovernmental panel on climate change (IPCC) prepares scientific, technical and socioeconomic report on climate change is in its sixth assessment cycle for producing the Sixth Assessment Report (AR6) with contributions towards a refinement to its methodology reports [3]. The FAME scheme initially channelized in April 2015 to encourage electric and hybrid vehicle purchase by providing financial support ran until 2019 as first phase whereas FAME II or second phase aims at financial supporting the electrification of public and shared mobility of 7 k electric and hybrid buses, 500 k electric three wheelers' vehicles, 55 k electric four-wheeler passenger cars, 55 k four-wheeler cars, and 1000 k electric two wheelers [4]. Tribology at rubbing interface is one of the causes for influencing

economy, environment, and SDGs for modulation of conventional fuel oxidation by amalgamation of hybrid and EVs in reducing CO_2 loadings [5]. Economy is an implicit function of mechanical work done by mankind with innovative machines as per the integrity of 2nd law of thermodynamics. The green technology is fundamentally influenced with energy generation mechanism of urban transportation primarily passenger's cars for assessment of environmental reaction.

2. Urban mobility & CO_2 loadings

Sustainability for automotive industry is a sociotechnical challenge in designing and manufacturing of energy efficient vehicles by creating minimum harm for environment such as electric motors and associated battery mechanism, lightweight construction of vehicle, and reduction of CO_2 emission by technological upgradation [6]. Sustainable transport and mobility are the fundamental indicators in realization of the 2030 agenda for achievement of the 17 Sustainable Development Goals (SDGs) as transport sector accounted for 23 percent of global greenhouse gas emissions in addition to energy sector [7]. Transport sector alone creates 7 Gt of CO_2 load over atmosphere, 13 Gt of CO_2 load sum up from energy sector, and 7 Gt of CO_2 load evolves from industry for 17 Gt of CO_2 net atmospheric growth predicted in a thermodynamic cycle of biosphere heat engine with 21 Gt of CO_2 land/ocean sink [8]. "Insights into Future Mobility" MIT report present results and findings of influence on the future landscape for personal mobility, the climate change policies, fuel consumption, fuel prices, and economic output [9]. Atmospheric carbon dioxide (CO_2) emissions reduced by 5.2 per cent in 2020 during Covid#19 pandemic reinforced socioeconomic disruptions due to lowered energy demand whereas phasing out of pandemic restrictions and CO_2 emissions enhanced by 6 per cent for 2021 expressed under SDG13 or Climate Action [10]. The outlook of personal urban mobility with an emphasis on the disruptive role of autonomous vehicles is one the primary reason for evolution of anthropogenic environment. In the realm of sustainability, climate change is a scientific concern to mend a relationship of society with nature consciousness for reducing CO_2 load by human behavior, modulation of automobiles energy consumption domain to electric from conventional petroleum fuel, and fruitful implementation of fourth generation industry revolution ahead of digital era.

3. Hybrid and Electric Vehicles (EVs)

The primary objectives of Fame India scheme are to encourage electric vehicle manufacturers to manufacture a higher number of electric vehicles, to safeguard negative emission, to establish an

electric charging infrastructure, and to convert 30% of total transportation into electric vehicles by the year 2030 in streamline with sustainable development goals [11-12]. Smart hybrid technology encourages clean and green driving of automobile in enabling idle start/stop function for fuel-efficiency and torque assist function for acceleration enhancement by energy saving using brake energy regeneration [13]. The alarming air pollution for solutions to an environmentally conscious urban mobility as the lack of charging infrastructure hybrid cars are viable options extended by leading automobile manufacture in India for advancement of sustainability and promotion of green technology [14]. The major issues relating to mobility, environment pollution, sustainability for leading cities in India are addressed by first ever BS6/EURO 6 low floor city bus implemented public transportation for the transition to sustainable & clean mobility from conventional vehicles [15]. The electric vehicle charging station global market size is expected to rise from 2,354 thousand units in 2022 to 14,623 thousand units by 2027, at a CAGR of 44.1% with factors such as rising sales of electric vehicles, the growing demand for negative emission, and smart charging with load management of ultra-fast charging [16]. The new 27 electric vehicles charging stations have been recently installed in addition existing 97 charging stations in the national capital territory of Delhi whereas more electric charging stations are to be operational for efficient urban mobility for reduction of environmental disruptive reactions [17]. The Fourth Generation Industrial Revolution, United Nations Sustainable Development Goals, the 21st session of Conference of Parties, and the Faster Adoption and Manufacturing of Electric Vehicles Phase II altogether ease in designing and manufacturing of hybrid and electric vehicles (EVs).

4. Lithium Ion Battery

The industry for battery preferred for transportation is expected to rise towards electric vehicles for Nickel Manganese Cobalt, Nickel Cobalt Aluminum, and lithium-ion for economical productions. The automotive lithium-ion battery global market is reported $17.4 billion in 2019, expected to reach $95.3 billion by 2030, rising at an estimated CAGR of 17.1 % used in electric vehicles such as e-bikes, e-rickshaws, and e-cars for durability as compared to traditional batteries, such as lead-acid and nickel-metal hybrid batteries [18]. Energy storage and generation by lithium-ion batteries with nickel-rich layered oxide cathodes and graphene like graphite anodes have reached specific energies up to 300 Wh/kg useful for designing of durable electric vehicles [19]. Energy densities of required storage and generation up to five times than conventional lead acid

battery is required to achieve the performance of a future generation of smart hybrid-electric vehicles of full day running without charging for a broad electric range in mobility [20]. The growth of electric vehicles (EVs) on road is accelerated by government policy, regulation, and the socioeconomic indicators having share of ~2% than internal combustion engines or ICE vehicles may be overrule from economic manufacturing of high specific energy battery [21]. The graphene carried superb electronic properties for designing and production of high energy density batteries cathode due to excellent surface functionalization of 2-D carbon nanomaterials [22-23]. Fastrack utility of lithium-ion batteries is rendered to increase energy density, reduce cost, and improve the performance of batteries in the mechanical performance of electric vehicles. The economical production or installation of energy generation and energy storage is a challenge in India such as manufacturing of low-cost lithium-ion battery, super charging facility at public place, and scientific innovation.

5. Human behavior & NME

Human body is a thermodynamic heat engine consuming fuel, oxidation of fuel in an environment, and expend a portion of chemical energy of fuel in mechanical work. The ratio of mechanical work to fuel oxidation energy above resting is termed as net mechanical efficiency (NME) or a valuable parameter for prediction for prediction of sustainable pattern of life. The net mechanical efficiency of healthy driver or passengers in anthropogenic umbrella of urban cities may not in a broad spectrum of life for harmony at man and machine interface. Author is fundamentally focused on a streamline mechanical efficiency of engines such as personal vehicles, mechanical efficiency above resting for human being, and socioeconomic indicators at virtual interface of man-machine in performing mechanical work. The cytotoxicity of carbon footprints with urban anthropogenic environment is fundamentally due to supramolecular interaction of elevated particulate matter with respiratory biological membrane by amalgamation of functional groups namely as carboxyl, hydroxyl, and amino. The electroadhesion of charged molecules, electron transfer over surface, and surface energy are residual variables at the forefront of biochemistry. Friction is viable for rationalization of energy dissipation from molecular domain to engine sliding and rolling surface. The human behavior, regulation of self, and change of life style create harmony at man-machine interface for achievement of decent work.

Conclusions

The following points have been enumerated for balancing materials and energy interface ahead of covid#19 pandemic of India such as (a) The re-searching of sink zone may be a viable option for plant-based adsorption of CO_2 loadings of urban cities (b) The sociotechnical impacts in urban mobility are the forefront for promotion of green technology in reduction of anthropogenic load (c) The transport sector is primarily responsible for researching of effective energy mode in addition to hybrid and electric cars, public transport electric buses, and promotion of rail tracks (d) Heavy investment for the development of supercharger facility in India hybrid cars have been manufactured by leading automobile companies.

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Author Contribution

Author wrote the paper with inclusion of single author preprints

Conflict of Interests

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