A Review of Green Technology and its Effects in the Auto Industry

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Abstract – The primary objective of green technology is to in climate change management, natural environmental preservation, non-renewable resource reliance, and mitigating environmental hazards. Some of the industrial sectors that are actively investing in this type of technology include waste management, energy and transportation industries. There are a lot of positives to using this technology, but it still has to mitigate some of the challenges before it is considered a standard. The green technology industry has seen rapid expansion in recent years. The significance of green technology in mitigating threats to the environment and preserving natural resources becomes more apparent every day, as does the need for more investment in such solutions. Since the majority of the world's pollution, especially CO_2 and other greenhouse gases, is produced by developing countries due to careless environmental policy implementation, addressing the issue of technology transfer is crucial. Emerging technologies for reducing emissions include improved solar cells, wind power, and electric vehicles, as discussed in this paper.

Keywords – Green Technology, Wastewater Treatment, Waste Management, Air Pollution, Sustainable Evolution.

I. INTRODUCTION

Technology refers to the use of a wide range of techniques, skills, methods, and procedures for any number of useful fields, including but not limited to the advancement of science. Green Technology (Green Tech) is any technology that minimizes its impact on the environment throughout any stage of its life cycle. Any tool developed to lessen humanity's toll on the natural world is considered "green technology." Technologies that decrease resource use and/or make use of renewable resources fall under this category. Technology that repairs environmental harm is also included, albeit such goods are uncommon. Green technology refers to the broad category of innovations made to restrict and lessen the destructive effects of human activities on the natural environment and its resources [1]. There is a finite supply of some natural resources in our environment; they are known as nonrenewable, or depletable, resources. As a result of human activity, a great number people have already perished.

Solar panels are a common example of environmentally friendly technology. Small solar panels on an RV may supply electricity while dry camping and larger panels on a home's roof can significantly cut a family's monthly energy costs. Passive solar panels are more frequent than solar concentrators, which may kill migrating birds in the process of concentrating the sun's rays. Concentrating solar power systems are expensive and space-intensive. Their only benefit is that they can produce steam to power turbines all night long because to the superheated column of salt within many designs. If you use solar panels and do not remember to charge your batteries before the sun goes down, you will be in the dark. Solar panels and wind turbines are two of the most talked about examples of environmentally friendly technology. In places with insufficient sun radiation, wind turbines may provide the same benefits. The ground below may be utilized for agriculture and grazing. Wind turbines are not without their drawbacks. Blades from wind turbines typically are not recyclable and have a limited lifespan. Too little or too much wind prevents energy production by wind turbines.

Though not as well-known as other green heating options, solar is increasingly being adopted. Using a solar cover to heat and maintain a warm pool without turning on the heater saves money on utility bills. Hot water from solar heaters is heated without using fossil fuels or electricity. Solar heating was also historically used in greenhouses. The phrase "greenhouse effect" comes from this phenomenon. By putting the recycled material to another use, you may reduce the need to mine virgin supplies. Aluminum, steel, plastic, and paper are the most typically recycled materials. Aluminum recycling uses only about one-tenth as much energy as primary aluminum extraction from bauxite. Rare earth metals are increasingly being reused. These are commonplace in modern gadgets like mobile phones. Due to trade battles and China's own stringent industrial standards, other countries have less access to these vital minerals. Japan has the best recycling program in the world. They were also among the first to recycle the rare earth elements that make up fluorescent light bulbs. Incineration is an option for recycling. Even though it is not ideal, waste materials like wood, paper, and plastic may be burned to create electricity in place of more scarce fuels like coal and oil.

Green technology is discussed, and its use in the automobile sector is reflected in this article. For almost a century, the automobile industry has been driven by the pursuit of improved quality at similar pricing points or maintaining quality at reduced cost. However, the rules have recently been altered significantly. Legislation, shifting consumer preferences, and even honesty play a role, but environmental stewardship is now paramount in the auto industry. Although there have been parallel developments in other industries, the standards for product enhancement in the automobile sector are particularly stringent. While aerodynamics and tribology may have a little impact, materials science has been the driving force behind the evolution of technology. Both the "cheaper or better" dictum and the prevailing development model necessitate that lighter weighing and a larger usage of recycled material coexist. When put in context, it represents one of the most fascinating revolutions in the history of the automobile. This study's overarching goal is to fill up the gaps in our understanding of natural fiber polymers utilized in the auto industry.

This study has been organized as follows: Section II presents a critical review of green technology. In this section, various segments of the green technology are discussed: water treatment, wastewater treatment, air pollution control, waste management, environmental remediation, and energy efficiency. Section III provides a brief overview of green nanotechnology. In Section IV, a case study of the auto industry is provided, wherein concepts of the natural fiber composites, sustainable evolution of the auto industry, key drivers of sustainable change (government intervention, changing expectations, and megatrends), how the industry is dealing with the pressure to change, and the techniques and materials in the auto industry, are discussed. Section V provides a conclusion to the study, as well as directions for future research.

II. GREEN TECHNOLOGY

The major reasons for developing Green Technology are to mitigate the effects of global warming, preserve biodiversity, lessen dependence on finite resources such as fossil fuels the mitigating the present environmental hazards. Although the Green Technology industry is only getting started, funding opportunities abound. Although green technology has become more widespread in recent years, many of the underlying business practices can be traced back to the heyday of the Industrial Revolution in the 18^{th} and 19^{th} centuries. In the early 19^{th} century, factories attempted to reduce their environmental impact by reducing emissions of soot and other waste products. However, the concept of "green innovation" as a distinct field of enterprise did not emerge until the early 1990s. In reference to the 2018 UN report, the global investment framework in green technology and renewable energy processes topped $200 billion in 2017. In addition, renewable energy has received $2.9 trillion in funding since 2004. According to the UN, China spent over $126 billion in the sector in 2017. **Table 1** summarizes the various eco-tech markets.

Table 1. Green Technology Sectors	
Energy	Most of the globe's energy is presently generated through the integration of fossil fuels. Green technology could be used to generate renewable energy sources to replace polluting fossil fuels. The combustion of fossil fuels often results in the creation of waste. Renewable energy sources such as the sun, the wind, and hydroelectric dams may be utilized in place of fossil fuels since they have a less impact on the environment.
Transportation	Gasoline and diesel cars and trucks are major sources of greenhouse gas emissions worldwide. As a result, many businesses are installing charging stations for electric cars and switching to compressed natural gas (CNG) [2] for their fleets of buses.
Waste Management	Green technology is also employed in the waste management industry for purposes like as trash transportation, waste storage, and waste recycling.
Water Filtration	Green technology is increasingly being employed for water purification on a global scale. Water purification and salt removal from saltwater are two examples of green technology that might be used to increase the availability of potable water in countries with scarce supplies.
Air Purification	By reducing carbon emissions and gases emitted by industrial sectors, green technology is also being utilized to clean the filthy air.

Environmental science and technology are used in green technology to create and implement solutions that protect natural resources and the environment from harm, or at least lessen the negative effects that humans have on it. The word "Green Technology" may be hipper than "Clean Technology" or the more often used "Environmental Technology," but it means the same thing. Everything from ways for producing alternative energy sources like solar power to management systems that aid in monitoring greenhouse gas emissions is included in the ever-expanding subject of green technology. To ensure that current and future requirements may be addressed while also protecting the natural environment and its resources, sustainable green technology development is essential. Having a 'bearable' environmental and social effect, 'equitable' social and economic solutions, and 'viable' economic and environmental possibilities may all be met at the intersection of these three fundamental aspects, making sustainable development a realistic goal. Environmental cleanup, waste treatment and management, energy conservation, and air pollution control are just few of the areas that have benefited from conventional green technology. Some foundational understanding and practical implementations of green technology in various arenas are covered here.

Water Treatment

To improve the quality of raw or polluted water, it must first be treated to remove harmful chemical, physical, and biological impurities. The goal is to create a kind of water that may be used in a certain setting. Human consumption (potable water), pharmaceutical, chemical, and industrial uses are only some of the potential outcomes of water treatment research and development. Pre-chlorination, flocculation, and coagulation, filtration, sedimentation, post-chlorination, disinfection, and fluoridation are the typical steps in water treatment see **Fig 1**. Pre-chlorination is done to get rid of the bad smell, taste, and organic compounds such humid acids that may be present in raw water. Fine and suspended materials in water may be filtered out using a chemical process including coagulation and flocculation. The sedimentation tank is used to collect the flocculated materials for disposal. Any remaining fine particles after the coagulation-flocculation-sedimentation step will be captured by the sand filter beds farther downstream.

Some cutting-edge treatment facilities utilize novel green technologies like membrane filtration to boost filtration effectiveness in unorthodox ways. Pathogenic parasites, algae, bacteria, fungus, and viruses may all be eliminated by chlorinating the water after filtration. More and more treatment facilities are converting to ozonation as the disinfection technique, despite the comparably higher initial and ongoing expenses, due to concerns about the production of carcinogenic trihalomethane in water for drinking as a result of the usage of chlorination. Ozone has no long-lasting disinfecting effects as chlorination does since it rapidly degrades back into oxygen after being created. Post-chlorination is still used by certain treatment facilities because it may give some residual disinfection. Fluoridation, the last stage of water purification, aims to reduce tooth decay by adding fluoride to the water supply.

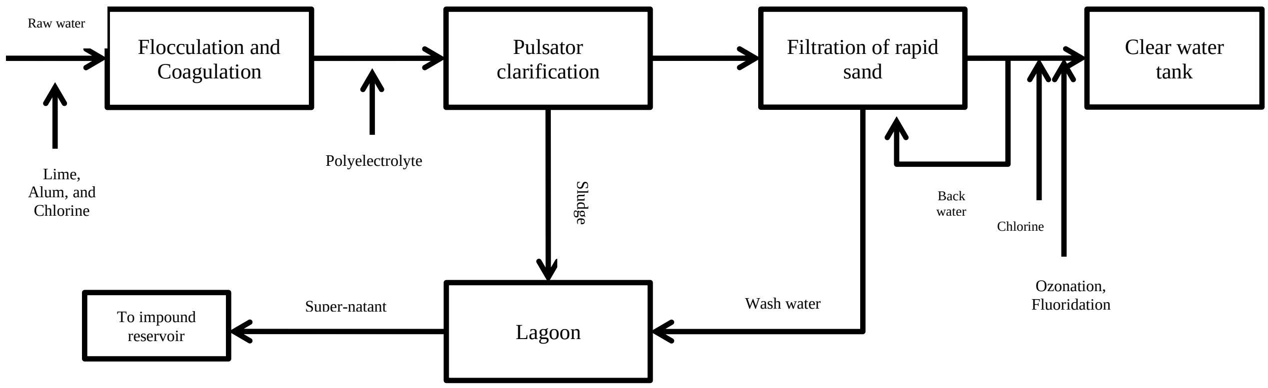

Fig 1. Unit Process Flow Diagrams of a Typical Water Treatment Plant

Governments or international organizations, like the World Health Organization, often determine what constitutes acceptable quality for drinking water. A visual inspection of a water sample will not reveal whether or not it is of sufficient quality. Although costly, chemical analysis is the only way to get the data needed to choose the best treatment option. An estimated 1.8 million people per year lose their lives due to water-related illnesses, and a 2007 report by the WHO (World Health Organization) concluded that approximately 1 billion people in the world do not have easier accessibility to improved drinking water supply. According to the WHO, almost all of these episodes of diarrhea may be avoided by improving environmental conditions, particularly the availability of clean water. Chlorination filters, and sun disinfection, together with proper storage containers, might save a significant number of preventable deaths every year. Waterborne illness prevention seems to be a top priority in public health initiatives in many third world nations.

Wastewater Treatment

The goal of wastewater treatment is to purify wastewater and sewage from both industrial and home sources. The goal is to create a treated effluent stream that is safe for the environment and uses a suite of environmentally friendly technologies to do it. Wastewater treatment is done so that the receiving watercourse is not contaminated. In order to safeguard the well-being of humans and environmental purity, wastewater must be treated or purified before being released back into the environment. To do this, wastewater treatment facilities are built to: eliminate most of the suspended particles; kill harmful bacteria; and minimize soluble biodegradable organics.

Effluents must meet nutritional limits when discharging into sensitive regions that are at risk of eutrophication. Total phosphorus and total nitrogen are two more key indicators. Most infectious diseases can be killed by disinfecting with chlorine. **Fig 2** shows a simplified illustration of a typical wastewater treatment facility. The floating and suspended particles in wastewater are removed during the main and preliminary treatment stages. Screening and sedimentation are common methods for achieving this separation. Typically, first treatment effluent will have a high biochemical oxygen demand (BOD) [3] because it contains a lot of organic material. The term "secondary treatment" refers to further processing of the initial wastewater. Biological processes are often responsible for removing the organic materials and the remaining suspended material. Secondary treatment often produces effluent with low BOD. When water reuse or the prevention of eutrophication in receiving waters necessitates the removal of soluble and suspended contaminants that remain after conventional biological treatment, advanced treatment is used.

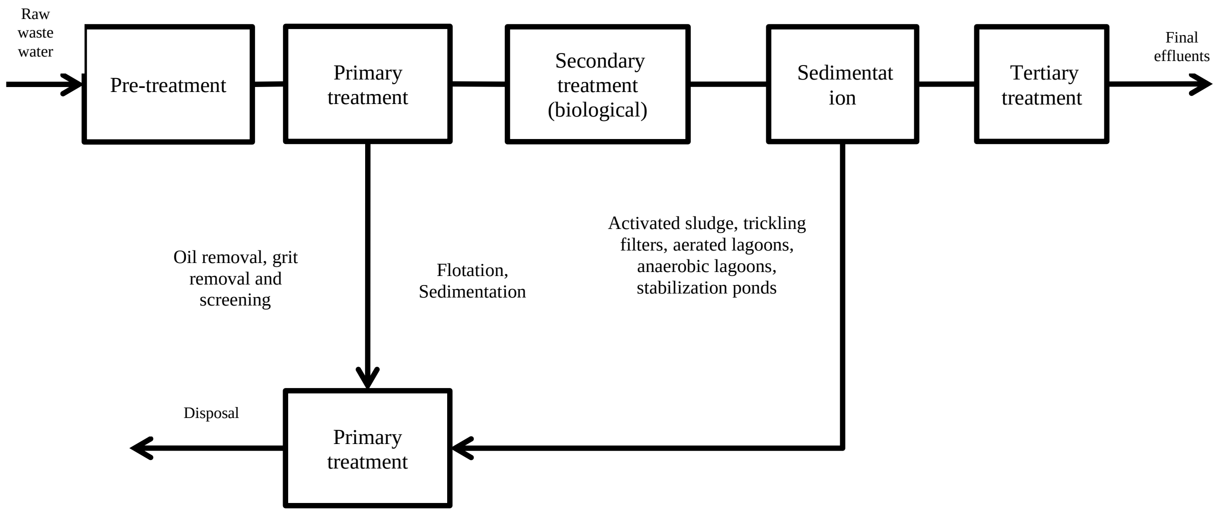

Fig 2. Typical Water Treatment Process Flow Diagram

Many companies have implemented green technology to lessen their carbon footprints and wastewater generation in response to the growing expense of water as a natural resource and increased environmental consciousness. In order to meet their water demands, many businesses have turned to technological solutions like desalination of seawater and procedure/wastewater recycling because of rising demand for ultra-pure water from other sectors. Reusing wastewater effluent for things like drinking water is now feasible because to developments in environmentally friendly technologies. In dry regions, where fresh water is scarce, treated wastewater is a lucrative resource for a number of businesses (including those involved in animal watering and irrigation). Manufacturing companies across the board are using closed-loop recycling systems to cut down on operational expenditures. Producing the ultra-pure water needed in manufacturing is sometimes a significant contributor to overall production expenses.

The general agreement is that treating water by recycling spent water is more cost-effective in many situations throughout the process at industrial plants. This provides these establishments with water of far better quality than would be available from a more conventional source. As a result of using reclaimed water, product quality is improved while costs are reduced in the factory. When compared to developing a strategy for producing pure and ultra-pure water from raw groundwater sources, recycling water with known elements, like the process water, is much easier. Recycled water is predicted to become competitive with alternative water service choices as a result of efficiency improvements and breakthrough technology advancements. For instance, developments in membrane technology have expanded the scope of applications for membranes in the treatment of process water and wastewater streams, making them competitive on the basis of both cost and quality. Water recycling equipment adoption will increase as lower prices provide relief to price-conscious consumers in the face of rising levels of competition.

Air Pollution Control

Air pollution occurs when harmful substances (such as chemicals, biological materials, or particulate matter) are released into the atmosphere and have the potential to injure or distress people, animals, or plants, or to damage the natural or built environment. Particulates, nitrogen oxides, acid gas/SO_2, mercury, volatile organic carbon, dioxins, and furans are only some of the air pollutants that may be controlled through pollution control systems employed by industry and transportation before they are released into the atmosphere. Our worries about air pollution continue to grow. Pollutant concentrations from urbanization and industrialization have therefore risen to levels that are adequate to have negative effects on our living environment, surpassing those generated by natural events. Greenhouse gas emissions are becoming more worrisome as the primary cause of global warming and climate change.

Increases in surface and lower tropospheric temperatures may be attributed to the greenhouse effect, which occurs when greenhouse gases produce a situation in the upper atmosphere that traps heat. Emissions of CO2 from fossil fuels burning are the key contributors to global warming. Methane, perfluorocarbons, hydrofluorocarbons, nitrogen oxides, chlorofluorocarbons, ozone, and nitrous oxides are all other greenhouse gases. In the last century, scientists have developed a firm grasp of this impact, and because to progress in technology, we now have a wealth of information about it. The development of fossil fuel substitute fuels like renewable energy, biofuels, carbon dioxide sequestration, and many other strategies and means to minimize emission of greenhouse gases are now being investigated by scientists as part of efforts to mitigate greenhouse gas emission.

Waste Management

According to Fernando [4], local governments are responsible for waste management, which includes sorting, collecting, recycling, reusing, disposing, and treating garbage and trash. Solid waste management often involves the disposal of items generated by human actions in efforts to mitigate the harmful effects on human health, the ecosystem, and the built environment. Diverse approaches and areas of expertise are required for the handling of diverse types of waste, such as those involving solids, liquids, gases, and radioactive materials. Green waste management is sometimes done to salvage usable materials. Different green waste management strategies are used by residential and industrial producers, in urban and rural locations, and in developed and developing countries. In urban settings, local governments are often responsible for managing nonhazardous household and institutional garbage, whereas the generator is typically responsible for managing nonhazardous commercial and industrial waste. Technology advancements like global positioning systems (GPS) [5], Radio Frequency Identification (RFID) tags [6], and integrated software packages have been slowly adopted by the waste management sector, despite the fact that they allow for the collection of higher quality data without resorting to guesswork or human data input.

Presentment rates for curbside pick-ups may be analyzed alongside recycling bin use thanks to new technologies like RFID tags. The productivity gains from using GPS monitoring are most noticeable when thinking about ad hoc pick-ups, in which consumers request pickup only when it is convenient for them. In order to compile this information for the purpose of optimizing garbage collection operations, integrated software packages are helpful. The goal of integrated waste management is to provide the most environmentally friendly choices for green trash management by employing life cycle analysis. Many studies have concluded that anaerobic digestion for the production of energy and compost/fertilizer from the organic waste fraction, and the recycling and reuse of the non-organic waste fraction, is the best waste management strategy overall. In contrast to incineration, which destroys valuable resources, non-metallic trash may be reused or repurposed in a society that is eventually forced to restrict its supplies.

Environmental Remediation

For the sake of public health and environmental sustainability, as well as to prepare a Brownfield site for redevelopment, environmental remediation involves cleaning up contaminated or polluted environmental media such as groundwater, sediment, soil, or surface water. Remediating an area that has been damaged by pollution or contamination is known as environmental remediation. The combination of chemical, biological, and bulk movement techniques, as well as environmental monitoring, allows for this to be achieved. Depending on the specific situation, remediation may be subject to either mandatory or recommended standards, or it may be based on evaluations of human health and ecological concerns in the absence of either. A wide range of ex-situ and in-situ cleanup technologies have been developed. While ex-situ treatments need the removal of contaminated soils before they can be treated, in-situ approaches try to address the issue without disturbing the ground. Soil is dug up and sent to a landfill in the "dig and dump" method, while groundwater is pumped and treated in the "pump and treat" technique. Solidification and Stabilization are two examples of widely used in-situ technologies.

Energy Efficiency

The term "energy efficiency" [7] is used to describe the pursuit of a less-expensive use of energy in the production of goods and services. Reducing one's reliance on the grid necessitates the adoption of energy-saving green technology and equipment. Efficiency in energy usage may be improved by increasing the proportion of useful energy used, decreasing overall energy use, and/or decreasing use of traditional energy sources. Increasing efficiency in energy use may be done for several reasons. If the extra expenses of deploying an energy efficient technology are outweighed by the savings from reduced energy usage, then customers will come out ahead. By decreasing demand for power, energy efficiency measures help minimize fossil fuels burning and, in turn, assist in minimizing emissions of greenhouse gases.

Increases in financial capital, human effort, national security, environmental quality, and personal security are all possible outcomes of improved energy efficiency. Direct energy users opt to save energy because it helps them save money and gives them peace of mind. Energy efficiency improvements may have a significant financial impact on businesses and industries. Global greenhouse gas emissions may be reduced by one-third by 2050 if energy efficiency in homes, industries, and transportation is increased, says the International Energy Agency. Sustainable energy strategy is stated to be built on the twin pillars of energy management and renewable energy. Energy efficiency is considered as beneficial to national security in many nations because it may be utilized to decrease dependence on energy imports from outside and has the potential to delay the pace at which indigenous energy supplies are exhausted.

III. GREEN NANOTECHNOLOGY

The term "Green Nanotechnology" [8] alludes to the employment of nanotechnology to the improvement of the ecological sustainability of processes that have unintended negative consequences. As part of this effort, we will be processing eco-friendly nanoproducts and using them in sustainable ways. Improved solar cells, usable fuel cells, and eco-friendly batteries are just a few of the areas researchers are exploring using nanomaterials. Some of the most cutting-edge applications of nanotechnology in the energy sector include: energy storage, redevelopment, manufacturing modifications through slower material and process rates energy conservation, and the development of renewable energy sources. The unique activity of green nanotechnology towards stubborn pollutants also has promising applications in water purification.

Two main objectives of green nanotechnology are the safe and healthy creation of nanomaterials and products, and the development of nano-products that address environmental issues. Making nanomaterials and nano-products with no harmful components, a reduced temperature, using renewable inputs, and less energy wherever applicable, and wit lifecycle consideration included into every step of the design and engineering process is made possible by using the concepts of green chemistry and green engineering.

Green nanotechnology alludes to the employment of nanotechnology to enhance the ecosystem friendliness of existing manufacturing processes for materials and products that are not produced using nanotechnology. Nanoscale membranes, for instance, may aid in the purification of byproducts from chemical reactions in plants. With the help of nanoscale catalysts, chemistry may be performed more effectively and with less waste. Nanoscale sensors integrated with nano-enabled information systems may be used as part of process control infrastructure. Another option to "green" manufacturing is to use nanotechnology to create alternative energy systems.

The second objective of green nanotechnology is the creation of goods that have positive effects on the natural world. In addition to sensing and monitoring environmental contaminants, nanomaterials and products may immediately clean harmful waste environments, treat pollutants, desalinate water, and prevent pollution. Fuel cells and light-emitting diodes (LEDs) [9] powered by nanotechnology can reduce environmental damage from energy production and aid in the conservation of fossil fuels. Initiating nanoscaled surface coating and self-cleaning can cut back on or even do away with many cleaning agents used during routine maintenance. By considering nanoparticles and products as a whole, Green Nanotechnology helps to reduce unintended effects and plan for long-term repercussions.

Scientists are now investigating how nanomaterials might be used to improve the performance of solar cells, fuel cells, and sustainable batteries, among other applications. Storage, conversion, industrial improvements through reduced materials and process prices, reducing energy consumption (by better heating and cooling, for example), and improved renewable energy sources are some of the most cutting-edge applications of nanotechnology in the energy sector. Using nanotechnology to improve solar cells is a key current area of research and development. Smaller solar cells are more efficient, and solar power is a sustainable option. Solar power costs less than a dollar per watt.

Nanowires and other nanostructured elements are the focus of current research aimed at developing solar cells with improved cost-effectiveness and efficiency over traditional planar silicon solar cells. Hydrogen fuel cells, which might employ a catalyst, which was structured from carbon-based noble metallic participles 1-5 nm in size, are another example. Hydrogen might be stored in materials having nanoscale holes. The incorporation of nanomaterials in batteries has the potential to result in improved energy density and recharge time, respectively. Nanotechnology may potentially find usage in batteries Photovoltaic (PV) and solar thermal panels currently benefit from nanotechnology-enhanced coatings that increase efficiency. Solar panels with hydrophobic and self-cleaning qualities perform better in adverse conditions, such as rain. Nanotechnology coatings on PV keep the panels cleaner for longer, which helps them produce the same amount of energy year after year.

IV. AUTO INDUSTRY CASE STUDY

Technology is the key to enabling the automobile sector into a new world of sustainability and mobility. Because of the continuing components and shortage in semi-conductors, the automobile industry is still coping with shipping and supply chain challenges caused by the pandemic. In spite of these ongoing changes, the sector is being pushed forward by both internal and external forces toward a new normal that includes enhanced mobility and more sustainable practices. When people talk about making cars more eco-friendly, they often talk of "greening" the industry as a whole. Sometimes a manufacturer must sacrifice one environmental program to meet the criteria of another because the regulatory requirements of distinct "green" aims are at odds with one another. Two of the biggest problems facing the automobile industry are the high price and the heavy weight of the components used in cars. A short time ago, it was simple to introduce recycled materials since anybody could make recycled components that weighed the same as virgin materials.

With the current emphasis placed on lightweight construction, employing recycled materials is not always the best option for getting a product to market. Lightweight applications make it more difficult, but not impossible, to use recycled materials. Lightweight biomaterial components may be used in lieu of conventional metal car parts. Many scientists are now investigating the potential of these lightweight biomaterial components. It has been recently highlighted by experts that the introduction of hybrid automobiles and "clean" electric vehicles to the market has coincided with a return to the usage of composite materials by developers. Most viable versions with an electric motor need a large battery pack or fuel cell pack to be installed. Using composite materials may cut down on structural weight by as much as 30 percent, and placing the machine's hefty batteries in the lowest feasible location improves stability. The usage of composite materials has a measurable monetary impact in this instance.

Natural Fiber Composites

Although the concept of recycling old vehicle parts to make new ones is nice and tidy, and the auto industry is happy to point out its successes, it is not always the preferred method of production. The natural fibers utilized in automobile parts ranged from cellulose to grass to seed to roots to woot and sheath. Composites made from natural fibers have advantages over those made from synthetic ones, particularly in terms of weight, cost, surface quality property, and biodegradability.

Automakers used to prioritize meeting technical requirements, but now they are prioritizing cutting weight by adopting natural fibers. When it comes to automobile engineering, Germany is far and away the world leader. They were the first to use organic materials like cotton and hemp in car parts. The door panels of the E-class series were made by Mercedes-Benz using a jute-epoxy matrix composite. Flax-sisal-polyurethane reinforced composites were also employed by Audi. Toyota has produced eco synthetic materials from sugarcane for use in automobile interiors.

Sustainable Evolution of the Auto Industry

The automotive industry has not always been environmentally conscious. Many modern production facilities still rely on outdated assembly-line techniques, despite the enormous environmental and economic costs associated with these methods. In addition, once built, most automobiles still need fossil fuels to run, which results in further pollution. The process as a whole has had significant environmental effects that have led to the current state of affairs. Although COVID-19 has caused a halt in production and sales of automobiles, it is instructive to look back at the industry's trends before the onset of the pandemic. In reference to Gupta, Jain, and Joshi [10], approximately 86 million vehicles sold in 2018 were responsible for approximately 10% of the emission of greenhouse gasses in the entire world.

For this reason, it is fundamental to execute actual transformation, and realize the beneficial effects of adopting more methods that are environmentally-friendly to the automotive sector. Leaders in the business world are doing a U-turn because they see the need for radical innovation in the automobile sector. In reference to Sanga and Koli [11], manufacturers are the pioneers to sustainable develop as interests towards sustainable development continue to increase. The researches demonstrate that manufacturing leaders are the most proactive in their efforts to improve sustainability.

Companies of all sizes in the automotive sector are feeling the push to reevaluate their strategies. They need to take a fresh look at every step of the process, from brainstorming and prototyping through production and distribution, and beyond to vehicle use, maintenance, and disposal. All industry participants need to come on board if we are going to see any significant change in the growth of the business, although some CEOs are already concentrating on the rethinking approaches to match sustainability objectives (for instance, Volkswagen is establishing a new factor to produce electric cars).

Three Drivers of Sustainable Change

The automotive sector is making strides toward sustainability for three primary reasons. Important factors include:

Government Interventions

There is increasing movement toward sustainable behaviors, and government organizations are playing an important part in this. Automotive businesses are scrambling to find ways to reduce their carbon footprint in light of recent regulations like the Paris Agreement, and the European Green Deal. The European Commission has proposed a reduction of 55% in CO_2 emissions from vehicles by 2030 and minimization of it by 99% by 2035. If implemented, these targets would effectively eliminate the market for vehicles powered by fossil fuels inside the European Union. These pacts come on top of the many carbon taxes, rewards, and subsidies already in place at various tiers of government to promote the use of electric vehicles. Therefore, the car industry is collaborating with the oil and gas business to establish a sustainable future, as oil and natural gas industries transform into different energy firms committed to creating vehicle charging infrastructure and other alternative energy sources to support the dynamic mobility sector.

Changing Expectations

The shifting expectations of customers, investors, and even workers are having a significant effect on the market. Consumers who value sustainability and cutting-edge technology are putting pressure on the car industry to prioritize environmental friendliness and alternative fuel vehicles like electrics. Many automobile manufacturers are under internal pressure from a reorganizing workforce on top of the external pressure from consumers and investors. Long-serving workers are leaving the company, taking their ingrained habits and perspectives with them. A new generation of workers that value innovation, sustainability, and questioning the status quo frequently takes their place. As a result, an increasing number of workers are questioning their employers about the environmental impact of car production and offering suggestions for cutting costs and waste. Therefore, both internal and external factors are increasing in intensity, calling on companies to make lasting changes.

Megatrends

Multiple megatrends in the automobile sector are pushing for significant technological advancements. Autonomous vehicle and fleet advancements, data mining from connected vehicles, vehicles-sharing models, alternate transportation-on-demand models, and model shift towards electrical vehicles are all examples. The conventional method of making automobiles has been revolutionized by the widespread usage of cutting-edge technology and the growing popularity of electric vehicles. The transition to producing electric vehicles has resulted in the elimination of several positions and rendered the assembly line method of production unnecessary. Line manufacturing procedures are being staged due to modular manufacturing approaches, whereby automobiles remain in a specialized and centralized location; highly-skilled groups go to the vehicle at different procedural stages. This enhances sustainability metrics by decreasing the need for resources including floor space, electricity, and labor during production.

How The Auto Industry is Dealing with the Mounting Pressure to Change

Many companies and organizations in the car industry are committed to making long-term improvements. The difficulty is in achieving unanimity throughout the automobile value chain, which consists of original equipment manufacturers, dealerships, suppliers, services, and aftermarket stores. To combat these persistent issues, businesses are using cutting-edge technology to boost supply chain visibility and fostering more inter-sector cooperation. Future prosperity requires supply chain transparency. In fact, according to the poll, sustainable supply chains were considered by approximately 63% of manufacturing directors as a major competitive advantage. For this reason, groups of original equipment manufacturers (OEMs) and technological industries are collaborating to mitigate issues like those mentioned above, as well as the electrification of charging stations and vehicles, control of business lifecycle, and sustainable business activities, which result to smaller carbon footprints.

Industry organizations may collaborate on building product lifetime management from the ground up, when new problems emerge, such as battery lifecycle management for electric vehicles. This includes everything from battery design and construction through manufacturing to reuse and recycling. Companies need to work together across sectors to find sustainable answers to this problem loop. By measuring the environmental effect of goods across their entire lifespan, modern technology not only increases industry visibility into supply networks, but also gives organizations greater insight into product footprints. As more and more publicly traded organizations try to strike a sustainable balance between profits and environmental effect, the use of such cutting-edge technological solutions is becoming more crucial.

Techniques and Materials in the Automotive Sector

Composites, which are predominantly carbon fiber goods, are increasingly employed in several fields, including transportation, where they have been popular for quite some time. Carbon fiber's lightweight and durability are its most notable features. These carbon fiber parts are gradually being replaced with natural fiber parts, or a hybrid of the two. Using composite materials made from natural fibers may cut the vehicle's overall weight by 20-25 percent, saving money on gas in the process. Synthetic and natural fibers based on polymers are used to create carbon fibers. Materials with varying structures and characteristics are generated depending on the processing technique and feedstock. The fundamental benefit of composite materials is their tailor-made qualities, which may be determined at the outset.

Based on current trends in composites research and application, we may predict that production vehicles will soon have a composite body and several composite components and assemblies. The methods used to fabricate composites into finished products have likewise evolved. At the moment, they are produced (just like metal parts) on automated lines staffed by robots. Metal fasteners are pushed into the assembly during molding to facilitate installation at the assembly's interaction with other components. Welded, bolted, and riveted connections are all viable options when using this technique. Such goods (as well as metal ones) are sensitive to vibrations and alternate loads without the danger of fatigue fractures and breakdown of the panels.

Green Composite Materials

When added to automobile components, green hybrid natural fibers composites are preferable than adding a single kind of fiber due to the many benefits they provide. The use of sugar palm fiber and glass fiber in boat construction improves the composites' mechanical qualities. According to a study conducted by Abdul Razab, Mohd Ghani,. Mohd Zin, Nik Yusoff, and Mohamed Noor [12], which examined the mechanical features of kenaf bast fibers with kenaf core fiber, the latter was shown to be superior. The key benefits of green composites were their high-specific stiffness and strength. In addition to lowering carbon dioxide emissions, the manufacturing process for natural fiber composites requires very little energy.When deciding between natural and synthetic fibers for car upholstery, price is the primary consideration for manufacturers. In comparing the qualities of natural fiber with glass fiber, Buitrago, Jaramillo, and Gómez [13] found that the latter were more ecologically relevant in execution. NaOH pretreatment of natural fibers improves the composites' mechanical characteristics. According to the research, the most promising fibers for the automotive sector include kenaf, jute, coir, flax, and hemp. The majority of the floor and door panels are made from natural fibers such as flax, and hemp. At first, natural fibers were incorporated into components with simpler geometric designs, but today, complicated geometries for automobiles are entering the manufacturing phase.

The flexural modulus, tensile strength, impact strength, flexural strength, and hardness of natural fiber composites are the most important mechanical qualities. Natural fiber has a density that is around half that of glass fiber. When contrasted to the glass fibers, natural fibers have a greater specific stiffness. Natural fiber complex materials are increasingly being used in the production of vehicle components. High tracking resistance, electric strength, high resistance, and arc resistance to UV radiation, and the capacity to utilize dyes to establish are just some of the benefits that come from using natural fibers in technical products manufacturing. Novel natural fiber complex materials are undergoing extensive testing for midsize vehicles at now, with the eventual goal of manufacturing springs for big trucks. There must be a high degree of strength, elasticity, and stiffness in these materials. Natural fibers and glass fibers that have been twisted together and strengthened with epoxy resin and other materials may be used to complete this project successfully. Steel springs rust and corrode easily, while springs made from complicated high-tech polymer complex materials do not react with chemicals and reagents often found in vehicle washes. The production of such springs also requires less energy, making them cheaper. Smaller-scale workshops are enough for their manufacturing; huge factories equipped with steel furnaces are unnecessary.

Electric Vehicles (EVs)

Electric vehicles (Evs) are increasingly being seen as a practical alternative to gas-powered automobiles. When it comes to pollution and greenhouse gas emissions, electric vehicles are proving to be even more environmentally friendly than the most fuel-efficient conventional automobiles. It is possible to establish that just using renewable power to charge EVs eliminates all emissions. Although electric vehicles themselves produce no greenhouse gas emissions, the energy used to power them is still often generated from fossil fuels in many areas of the globe. The car, and the battery in particular, need a lot of energy to produce. The carbon emissions of power plants that generate energy from fossil fuels are included in the statistics indicating that the carbon footprint of an EV is the same as conventional automobiles. However, the same argument can be made for traditional automobiles when considering the carbon emissions generated by the extraction and processing of crude oil. Countries that generate a large portion of their power from coal will see less of an EV's advantages. Emissions from driving the present EVs will reduce substantially, and output emissions for novel EVs will reduce, as the globe moves toward decarbonizing power production. As there are fewer moving components in an EV, maintenance expenses are reduced significantly. Before factoring in the decreasing carbon intensity of electricity production during the lifespan of the vehicle, the lifecycle emission in every kilometer of EVs Nissan Leaf were indicated to be nearly three times lower compared to normal modern automobile in 2019.

There are many factors to consider when comparing conventional cars to electric cars, including the vehicle’s size, the precision of the calculations used for fuel-economy, the approach employed to quantity emissions, the assumed driving habits of the drivers, and the weather and road conditions in the areas where the cars are used. No universal method of calculation may be used. Also, several studies have reported wildly contrasting numbers for the amount of pollution produced by making EV batteries. Emissions from battery production will have a bigger impact on the environmental advantages of EVs as battery costs decline and car manufacturers continue to create larger batteries with longer driving ranges. The energy required to manufacture and install batteries accounts for around half of their total emissions. Pollution from batteries may be considerably reduced if they are produced in areas with reduced carbon electricity or in factories for renewable energy such as the American Tesla's Gigafactory. The manufacturing and delivery of the power utilized by EVs are the primary sources of pollution [14]. When compared to the 355 grams of CO2 emissions produced by a typical gasoline-powered vehicle per kilometer driven, the 213 grams produced by a typical electric vehicle charged using an average electricity grid demonstrate that EVs are more environmentally friendly even when operating on dirty grid electricity.

Most nations' electric and conventional vehicle emissions during their lifetimes originate from driving, not manufacturing. Some nations, such as Norway and France, are an exception since practically all of their energy comes from carbon-free sources like hydroelectric or nuclear power. Burning a liter of gasoline (motor spirit) or diesel results in a significant amount of pollutants, although this is not the case when using electricity. Life cycle emissions from electric vehicles are much lower in nations like France and Norway, which rely heavily on nuclear power and renewable energy, respectively. Electric vehicles already have a leg up on their gas-powered counterparts, but if the emissions objectives outlined in the 'Paris Agreement' are to be met, electricity generation must become far less carbon-intensive. In the United Kingdom, for instance, electricity generating emissions have decreased by 38% over the past 3 years and are expected to decrease by more than approximately 69% by the middle to late 2020s.

V. CONCLUSION AND FUTURE PROSPECTS

With growing public concern about the damage we are doing to the planet, the need for environmentally friendly technologies has never been higher. This realization is driving innovation in environmentally friendly technology. One current illustration of this need is the popularity and growth of electric vehicles. The Paris Agreement has prompted several countries to increase their purchases of environmentally friendly technology. In order to win over customers, corporations are increasingly investing in environmentally friendly technologies to give off the impression that they care about the planet. Innovations in green technology are becoming more popular and more eco-friendly as time goes on. Green composite materials' significance in the automobile sector is laid out in detail. The research shows that seven different types of natural fibers are utilized most often in the automobile sector to create natural fiber composites: jute, hemp, flax, kenaf, sisal, oil palm, and coir. Abaca fiber is only one of several untapped natural fibers with potential in this area. Abaca fiber has been shown to have impressive flexural strength, tensile strength, flexural modulus, tensile modulus, hardness, impact strength, and wear qualities, according to the research done on the material. In the Philippines, abaca is known as Manila hemp. Its resistance to salt water and its durability are two of its most impressive features.

Energy, innovation, sustainability, nanotechnology, green fuels, green chemistry, regenerative design, and many other green technological endeavors have the potential to enhance life on Earth while also conserving it for future generations. When it comes to environmentally friendly technologies, energy efficiency is seen as the top priority. If we keep using fossil fuels, we will surely perish, which is why we need to look at additional possibilities. As the world's energy sector increasingly prioritizes the research and development of renewable fuels and energy sources, we are pleased to be at the forefront of our industry by developing the first hydrogen fuel cell sweeper, which operates solely on hydrogen; in addition, we have been manufacturing fully electric cleaners for over a decade. If we are serious about decarbonizing the future, we cannot ignore hydrogen's promising future applications. The simultaneous usage of both would have profound effects on our world.

The ability of enterprises and organizations to conceive, develops, and apply novel manufacturing and chemical processes to goods and materials is crucial to the development of sustainable technologies in the future. All of these modifications have the potential to lessen or eliminate the production and use of potentially harmful chemicals and materials. Thankfully, we find ourselves in an age of invention and technology that has enabled certain businesses and individuals to set in motion profound shifts in the manner in which people all over the world go about their daily lives and conduct their careers. Many governments, businesses, and organizations are doing or intending to make significant changes in the near future, all with the objective of preserving our planet. The future of green technology is bright, but we still need to work hard and invest our time and effort to achieve this shared objective if we want to see a significant improvement for our world. Because of their lax environmental policies, developing nations are responsible for the vast bulk of global pollution, especially carbon dioxide (CO2) and other greenhouse gases.

Data Availability

No data was used to support this study.

Conflicts of Interests

The author(s) declare(s) that they have no conflicts of interest.

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