MACROECONOMIC ENERGY CONSUMPTION AND GREEN MARKETING

Dr. N. Das Mohapatra

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CHAPTER 1

UNDERSTANDING HOUSEHOLD ENERGY CONSUMPTION PATTERNS: A GLOBAL PERSPECTIVE AND IMPLICATIONS FOR SUSTAINABILITY

Dr. N. Das Mohapatra, Assistant Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id- neel@muit.in

ABSTRACT:

Household energy consumption is a critical aspect of daily living, encompassing activities such as cooking, lighting, space heating, appliances, and water heating. This study explores the significant variations in household energy consumption across regions and countries, particularly highlighting the disparities between developed and developing nations. Factors contributing to heightened energy consumption in developed countries include larger household sizes, greater availability of energy-intensive appliances, higher living standards, and increased demand for energy-consuming amenities. In contrast, developing nations often exhibit lower energy consumption due to factors such as smaller household sizes, limited access to modern energy technologies, and reliance on traditional methods. Understanding these variations is essential for devising targeted strategies to promote energy efficiency, reduce environmental impacts, and enhance energy access globally.

KEYWORDS:

Consumer, Decision-Making, Ecological, Marketing, Strategies.

INTRODUCTION

Energy consumption in households encompasses various activities essential for daily living, including cooking, lighting, space heating, appliances, and water heating. These energy-consuming tasks are fundamental to maintaining comfort, convenience, and functionality within residential spaces. However, the magnitude of energy consumption at the household level varies greatly across different regions and countries.In particular, developed nations such as the United States and Canada exhibit notably higher rates of energy consumption within households compared to many other parts of the world. This heightened consumption can be attributed to several factors, including larger average household sizes, greater availability and utilization of energy-intensive appliances and technologies, higher standards of living leading to increased demand for energy-consuming amenities, and households in developing nations often exhibit lower levels of energy consumption due to factors such as smaller household sizes, limited access to modern energy technologies, reliance on traditional cooking methods and lighting sources, and lower overall energy demand associated with less affluent lifestyles.This disparity in household energy consumption highlights the complex interplay between socio-economic factors, technological advancements, cultural practices, and policy interventions shaping energy usage patterns globally. Understanding these variations is crucial for devising targeted strategies to promote energy efficiency, reduce environmental impacts, and enhance energy access and affordability for all households, irrespective of their geographical location or economic status[1], [2].

The fashion business serves as an example of how consumer choices affect sustainability and climate change. We examine the connection between home consumption and sustainability in detail in this chapter. First, we outline home consumption habits and how they affect the

amount of energy used. Next, we outline procedures intended to influence prepurchase and buy choices and provide a framework for consumer decision making. Examining consumption and post consumption choices brings this chapter to a conclusion. We must look at the quantity and kind of energy used in the house if we want to have any impact over it. Twenty-nine percent of the energy used worldwide is consumed at home. An outline of the energy that families utilize and how that energy has evolved throughout time.

Energy is used by households for cooking, lighting, space heating, appliances, and water heating. Furthermore, families utilize energy indirectly via the purchase of food.Compares the world's per capita energy usage. The US and Canada have per capita consumption rates that are twice as high as those of the other OECD nations. Furthermore, these two nations consume at a pace that is more than seven times higher than the majority of other markets. People are working to improve fuel economy in these two markets as well as other regions of the globe, but North American consumers have the most potential to impact home energy conservation. First, let's talk about the energy use for space heating.

Warming of Space

Space heating accounts for the biggest share of residential energy usage, at 53 percent. Many OECD nations have implemented required energy efficiency regulations since the 1970s oil crisis, with the goal of reducing energy consumption associated with building design, insulation, and heating equipment.Crucially, space heating analysis has to look at the system's whole productivity rather than just one aspect of it. The whole-building approach takes into account the home's location, utilities, infrastructure, and auxiliary equipment. Lighting and appliances are examples of accessory devices; they are covered in a later section.

Customers who want to keep their space heating expenses to a minimum should take the whole-building idea into account. The location is the first thing to think about. The temperature and the particular home location are factors to consider while choosing a place. The U.S. Department of Energy, for instance, divides the contiguous forty eight states' climates into five climatic areas. The requirement for heating and cooling, as well as the effectiveness of substitutes for these household utilities and infrastructure parts, are determined by the climate. For instance, since they tend to concentrate warming and sun glare, windows that provide the best insulation in colder areas are less than ideal in warmer ones.

The actual location of the residence is another crucial factor to consider. When choosing a site, solar energy and light management should be taken into account. A house's orientation depends on the site's characteristics and the design of the building, but it may save a lot of money on heating and cooling expenses. residences with a preference for north or south exposure get less sunlight and are thus favored over residences with obvious exposure to the east and west for the majority of designs. Shade tree planting reduces a home's exposure to sunlight, while landscaping and site grading help to preserve the building's structural integrity.

The infrastructure represents the second component of the cost of heating a house. The home's walls, roof, foundation, windows, doors, natural lighting, and duct system are all considered parts of the interior architecture. The majority of infrastructure components have differing levels of energy efficiency depending on climatic zones, design requirements, and environmental conditions. Multiple-pane windows and doors with argon or krypton gases provide significant energy savings, reducing the demand for larger heating and ventilation systems. However, depending on the climate zone, these doors and windows have different values for the customer. A product's ability to keep heat from leaving a house or building is

indicated by its U-factor, while its ability to block heat from the sun is shown by its solar heat gain coefficient. Products that block heat loss are preferred in northern regions, whereas those that provide shade are preferred in southern temperatures.

The regions where air is transferred between the interior and exterior of the house must be taken into account while examining the infrastructure. Potential sources of heat and energy transmission in a single-family home. According to the U.S. Environmental Protection Agency, air sealing a house and installing the right insulation in the basement, crawlspace, and attic may reduce energy expenses by 10% for homeowners.The air conditioning and heating systems in the house are considered utilities. Governments have started setting regulations for these residential utilities since the mid-1970s oil crisis. The productivity of these systems has grown along with the advancement of technology, as have the efficiency criteria. For instance, gas steam boilers sold in the US now need to be at least 84% efficient, compared to the minimum 75% efficiency needed in 1987[3], [4].

While insulation and space heating capacities have improved, the number of homes inhabited by fewer people has outweighed these benefits. Even if a home has fewer occupants, the cost of heating it could not go down. In some markets, the size of a property increases the requirement for space heating. In the United States, for instance, homes constructed after 1950 had 33% less floor area than residences constructed in the 1990s. The housing industry has also been included to the Energy Star brand. Customers may find builders of modular and on-site houses that provide Energy Star homes by visiting the EPA website. Furthermore, customers have access to lenders that provide exclusive rates for energy-efficient homes.

Appliances

A comparison of energy usage shows the differences between big and other appliances. Televisions, washing machines, dishwashers, freezers, and refrigerators are examples of large appliances. Over time, there have been changes in how these goods use energy. With the exception of TVs, all big appliances have seen a decrease in their average energy consumption over time, despite the fact that they once accounted for more than 60% of fuel usage. Although television technology has improved energy efficiency over the last 20 years, ordinary screens have grown significantly in size. A growing portion of residential energy consumption is being accounted for by the widespread usage of small appliances. Mobile phones, laptops, audio equipment, and other household electronics are some of these gadgets. Even when their batteries are recharged and they are not in use right now, a lot of these items still need energy. As a result, inactive mode energy absorption has been minimized, a goal pursued by product developers. The efficiency of these gadgets while in operational mode is another factor in productivity. In the United States alone, there are around 2.5 billion gadgets in use that depend on power supply. These items, which include cordless phones, answering machines, video games, computer speakers, and cordless tools, may be found within or outside of vices. Studies show that improved power supply efficiency might result in savings equal to 1% of the total amount of energy used in the US. This annual energy savings of 32 billion kilowatts is the same as the electricity produced by seven big coal- or nuclear-fired power plants.

Heating of Water

Heater water accounts for the third highest portion of household energy use. Different nations utilize different methods for heating water, but sometimes there is a lack of statistics about the percentage of sustainable energy sources used. The majority of conventional storage units in the US are either electric or gas-powered. 4.8 million conventional electric resistance and 4.7 million conventional gas storage water heaters were shipped out of a total of 9.8 million

water heaters in 2006. The market share of advanced water heating technology is rather low. The market share of gas tankless water heaters is 2.6% among cutting edge technologies. Tankless water heaters only run when there is a need for hot water; they do not have a storage tank. Energy usage is decreased by 10% to 15% when standby losses from the tank are eliminated. In the same year, an estimated 2,430 solar water heaters were sent.

DISCUSSION

Each nation uses solar energy for heating water in a very different way. The amount of solar energy used today to heat water equates to averting 34.1 million tons of carbon dioxide emissions annually and 12.1 billion liters of oil. There were 111.0 gigawatts of solar thermal energy in operation globally by the end of 2005. Of them, 23.9 GW were linked to unglazed plastic collectors used to heat swimming pools, and 86.3 GW were linked to flat-plate and evacuated-tube collectors, which are mostly used for residential water heating. China accounts for 48% of the global flat-plate technology market, making it the biggest. When it comes to the overall demand for evacuated tube and flat-plate technologies, Turkey, Japan, Germany, Israel, and Greece are also at the top. The unglazed plastic collector technology's main market is the United States.

Cooking and Lighting

Together, lighting and cooking account for 10% of the energy used in homes. Appliance manufacturers who sell lighting and cooking equipment have created required efficiency requirements in various parts of the globe. The most inefficient versions have been successfully removed off the market because to standards like Energy Star. Moreover, nations have introduced endorsement badges that highlight the most energy-efficient items and labeling that indicates how much energy a product uses. A worldwide branding scheme for superior, energy-efficient lighting goods is called the Efficient Lighting Initiative. The China Standard Certification Center was given the task of creating the worldwide ELI certification and branding system in 2005. The ELI Quality Certification Institute is in charge of running the extended ELI program. With assistance from a group of multinational specialists from Asia, North America, and Latin America, CSC is in charge of this institution.

Currently being promoted by the ELI Quality Certification Institute are optional technical requirements for fluorescent lighting that uses less energy. With an emphasis on Latin America, Africa, and Asia/Pacific developing nations, it aims to unify its performance standards and test procedures with those of other voluntary labeling programs worldwide.23 Food The direct energy consumption related to grocery shopping, food preparation, and food storage is included in the energy usage linked with food consumption. The expenses related to food processing, distribution, and agricultural production are known as indirect costs. Compared to the direct expenses, the indirect costs are much higher. Methane and nitrous oxide are released throughout the food production process in addition to the use of fossil fuels. Fertilizer produces nitrous oxide, whereas animal production is linked to methane.

Despite being potent greenhouse gases, these gases are not the main energy sources used in food intake. The main uses of food energy are in food delivery and processing. The production of food accounts for around 10% of the main energy supply in the United States. A mere 20 percent of this energy is used for farming. Farm vehicles account for 34% of the energy consumed in agricultural production, followed by fertilizer usage (28%), irrigation, crop drying, insecticides, and other farm activities. In contrast, food processing, storage, packaging, and retail distribution need the remaining 80% of energy. Three-quarters of all food sales worldwide are comprised of processed goods, and processing food comes at a high expense. For example, the energy required to produce breakfast cereals is more than five

times that of the cereal itself. These processed goods are often packaged in separate bags, boxes, and wrapping. Despite requiring a lot of energy and raw materials during production, the majority of this packaging ends up in landfills.

The realization that food processing is a major contributor to food energy prices has led to conjecture on mitigation strategies. Using organic food has been promoted as a means to improve food quality and save expenses associated with pesticides and fertilizers. However, the yields per acre of organic farms are lower, requiring more fuel for land clearance, planting, and harvesting.

The extent to which the consumer diet is heavy in meat items as opposed to cereals, vegetables, and fruits is a second factor to take into account. Since the production of meat often uses more energy than that of vegetables, cuts in this area should have an impact on carbon emissions. However, switching to a diet that is both ecologically and nutritionally sustainable will only have a little impact on energy consumption and greenhouse gas emissions, according to new Swedish research. These results imply that a deeper understanding of consumption and its implications for energy usage and other critical domains, such as nutrition, is required[5], [6].

Recognize the Process of Consumer Decision-Making

The sequence of actions that purchasers perform before to, during, and after consumption is known as the consumer decision-making process. Marketers has the ability to impact consumption across the whole purchasing process. A summary of each step of the procedure, from product disposal after purchase to prepurchase assessment. The process a customer goes through to decide whether to trade in a car they presently own for a new vehicle offers the chance to look at every stage of this decision-making process. Prepurchase is the initial phase of the decision-making process. Need recognition, or the moment at which a customer perceives a gap between an ideal state of affairs and the existing one, is the initial part of this stage. For instance, a 1996 Camry driver can come to the realization that the expense of needing regular maintenance for her vehicle puts her in an undesirable position.

When buyers see a discrepancy between the actual and ideal circumstances, they start looking for alternatives. Therefore, the term "search" describes initiatives made to find data and answers to unmet demands. Customers hunt for ways to close the gap between the real world and their ideal version of events. For instance, the Camry's owner can look for new vehicles with warranties that imply consumers won't have to spend time or money on auto maintenance. The prepurchase assessment of non-natives is the third step of the prepurchase process. Customers assess the possibilities they found while searching during this phase. As a result, the Camry's owner may assess modern Toyota and General Motors vehicles according to factors like cost and fuel economy.

Following their participation in the prepurchase assessments, customers go on to the second phase. The phase at which the customer chooses whether and under what circumstances to acquire the product is referred to as the "purchase stage." If the Camry owner wants to buy a new Prius car, they may choose to visit their neighborhood Toyota dealer. The consumption of a product offering is the subject of the third stage of the decision-making process for consumers. The way the user uses the product is referred to as this stage. For instance, a new Prius owner may choose to operate the vehicle in a number of ways that have an impact on the environment. For instance, if the car's tires are not properly inflated, the vehicle's fuel economy would significantly decrease. The post-consumption stage is the last and fourth phase of the consumer decision-making process. Following the start of use, the customer periodically assesses the product's performance in relation to their pre-purchase expectations.

Evaluation of a product conducted after consumption is known as post consumption evaluation. The customer eventually realizes that a product they now possess does not have a significantly lower value than alternatives. According to the previous owner of the Camry, the Prius is worth more than the vehicle. Divestment is the process of getting rid of goods that are no longer useful to customers. Understanding the nature of decision-making across the consumer decision-making process is crucial for green marketers hoping to have an impact on the whole consuming process. Consequently, the rest of this chapter is devoted to comprehending and influencing customer decision-making[7], [8].

Determine Ethical Advertising Strategies Intended to Affect Prepurchase Decisions

Before they are ready to make a purchase, consumers may go through three stages, and green marketing campaigns may be crucial throughout this time. When a customer notices a difference between the intended and actual circumstances, they enter the first step, known as need recognition. Consumer views of the present situation might be influenced by a number of innate factors. For instance, a person purchasing groceries for their house is aware that food quality is affected by the passage of time.

The marketer may have significant influence on both aspects of need recognition, even if the customer may perceive a difference between desired states and existing circumstances. Marketers often increase demand by changing consumers' opinions of the things they already possess. For instance, the GE Silicone III advertisement warns customers that leakage from microscopic cracks and holes in a home's façade may result in the loss of up to 40% of the energy consumed to heat and cool the structure. The silicone-sealed house outside is the intended condition, while the porous exterior that exists now is less desirable.

Changing the perceived value of alternative items is the second strategy to affect need recognition. A company that chooses to promote need awareness may do this via two key channels. Initially, the company could use a broad need awareness strategy to highlight the whole product class in an effort to increase demand. Prime examples of marketing campaigns intended to increase demand for compact fluorescent lightbulbs as opposed to products from a single manufacturer, like Osram/Sylvania.

Advertisers often highlight the product class rather than a particular product since many ecologically focused product offers are still in their infancy. In addition to being product dealers, advertisers supporting sustainability and green marketing initiatives may also represent other interest groups. Industry-wide advocacy groups, non-governmental organizations, government agencies, utilities, industry foundations, and other parties are examples of these groupings. For instance, initiatives to encourage the adoption of compact fluorescent light bulbs may be funded in part by non-governmental organizations and utility corporations. These organizations are all driven to reduce their energy use, and fluorescent lighting makes this goal easier to accomplish.

The term "brand-specific need recognition" describes initiatives aimed at generating demand for a particular brand of product as opposed to the sector or technology. For instance, the Burt's Bees advertisement places more emphasis on brand purchases than product class sales. In certain sectors of the market, promoting the benefits of a single supplier must come first in order to raise awareness of a particular product category. For instance, highlighting the benefits of beeswax while also drawing attention to the Burt's Bees brand.As soon as customers see requirements that are unfulfilled, they start looking for ways to fill them. The customer may engage in internal or external search activities. While external search refers to gathering information from outside sources, internal search refers to recovering knowledge from memory. Consumers often base their search efforts exclusively on past encounters.

According to consumer psychology, one's capacity to recall information, level of confidence in one's decision-making, and happiness with previous choices all influence how much one relies on past experiences[9], [10].

The recognition of the degree to which a consumer frames judgments based on personal experiences is the strategic significance of the internal search. Customers who exhibit strong brand confidence and report high levels of satisfaction are unlikely to be persuaded to reconsider their purchase choices in light of fresh facts. If a marketer is fortunate enough to have this consumer as a client, they should focus their efforts on showcasing how new product offers maintain features that lead to high customer satisfaction while also giving unprecedented environmental advantages above previous products. The duty of advertising is significantly more difficult when the customer is not presently a client of the company since it could be essential to convince them to look for more information. In order to evaluate product offers, external search operations gather data from the surroundings. Opinion leaders, family, friends, and the media are examples of information sources unaffected by product marketing. Word-of-mouth or, increasingly, computer-based word-of-mouse contact are two possible sources of this information. It has been shown that the most significant source of influence when it comes to buying home items is word-of-mouth communication.

Furthermore, studies show that recommendations made by other customers on a service have a greater impact than the total of material created by marketers. Through word-of-mouth communication on Facebook, Twitter, and other platforms, customers may cultivate connections, improve brand assessments, get insight into marketers' attempts to sway choices, and consider their own consuming experiences. Nonmarketing organizations have the chance to influence consumer decision-making processes via external search activities. Consumers doing searches may get useful information from nongovernmental groups. For instance, every year Greenpeace releases a Guide to Greener Electronics, which rates electronics manufacturers according to their use of chemicals, e-waste, and energy. Comparably, Consumer Reports has assessed how well manufacturers have lived up to their product promises, including being soft on the environment, biodegradable, and ecologically friendly. Based on these outside sources of data, marketers need to take a number of factors into account. They must first assess the level of consumer involvement in the transaction, since interested customers are more likely to take their time weighing their options and gathering data.

When buying an automobile, for instance, consumers are more likely to gather information than when buying paper towels. The extent to which the customer is likely to depend on the information supplied by the third party is the second factor the marketer has to take into account. Considering the volume of information accessible nowadays, it is possible that many reliable sources of information are overlooked during search operations. For instance, the United Nations and Underwriters Laboratories both provide a significant quantity of product information, but it's debatable whether customers really utilize this data when doing external searches. Although it would be irresponsible for the marketer to disregard these information sources, decisions are not usually made based on the sources' input.

The third factor to take into account when developing a green marketing strategy is the kind of external source assessments that are conducted. Positive testimonials from outside sources may be powerful components of a marketing effort. For instance, the Honda Motor Company backs up its claim that it is the most fuel-efficient automaker in North America with statistics from the US Environmental Protection Agency. When customer opinions of the business's goods are negative, the organization have to look into the assessment procedure. Marketers must to be clear in voicing their worries about the evaluation's foundation if there are any

flaws in it. Additionally, assessments that point out shortcomings in the present product lineup serve as inspiration for future product concepts. For instance, the unfavorable reviews of previous General Motors vehicle models served as part of the impetus behind Chevrolet's launch of the Volt electric vehicle[11], [12].

Customers do their preliminary prepurchase assessments after engaging in search activities. Customers often compare various brands and goods using evaluation criteria, which are standards and specifications. Consumer psychology makes a distinction between determinant product features, which affect the choice of brand or product, and salient product attributes, which are crucial to the selection. While consumers may be aware of the advantages of green marketing campaigns, they are seldom the main factor in their decision to buy. A product offering's whole value cannot be evaluated by a green marketer based alone on its environmental benefits. Daniel Esty and Andrew S. Winston stress that a product's green advantages are usually at least its third benefit in their book on sustainability strategies.39 Because of this, marketing strategies need to take into account the range of advantages that hybrid cars provide in addition to their fuel economy. According to Japanese experts, for example, while drivers are aware of the harmful effects of greenhouse emissions, they do not always buy fuel-efficient vehicles.Forty researchers found that cost restrictions prevented certain hybrid or fuel-efficient automobiles from being purchased in the Japanese market. Marketers that want to encourage environmentally friendly consumption must provide consumers a product that is both equally valuable and beneficial to the environment. Customers should be more likely to make a purchase if they understand the full value that items made with sustainability initiatives give.

CONCLUSION

Household energy consumption patterns vary significantly worldwide, influenced by socio-economic factors, technological advancements, cultural practices, and policy interventions. Space heating, appliances, lighting, and water heating are key contributors to household energy usage, with notable differences in consumption across different regions. Strategies aimed at improving energy efficiency and reducing environmental impacts must consider these variations and address specific challenges faced by different communities. By promoting sustainable consumption practices, enhancing energy access, and leveraging technological innovations, we can work towards a more equitable and environmentally sustainable future for all households, regardless of their geographical location or economic status.

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CHAPTER 2

NAVIGATING SUSTAINABILITY: UNDERSTANDING AND IMPLEMENTING ECOLOGICAL MARKETING STRATEGIES ACROSS THE CONSUMER DECISION-MAKING PROCESS

Dr. N. Das Mohapatra, Assistant Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id- neel@muit.in

ABSTRACT:

This study explore the intricacies of the consumer decision-making process, which encompasses a series of actions individuals undertake before, during, and after making a purchase. Beginning with the crucial stage of need recognition, consumers identify a disparity between their current situation and an ideal state, prompting them to seek alternatives. Subsequently, consumers meticulously evaluate available options, considering factors such as pricing, brand reputation, and perceived value. Upon reaching the purchasing stage, decisions are influenced by sustainable marketing strategies, aimed at promoting eco-conscious choices and responsible consumption habits. Post-purchase, consumers transition to the consumption phase, where ecological marketing strategies continue to impact usage patterns, emphasizing energy-efficient practices and proper disposal methods. Ethical marketing practices extend beyond purchase, guiding consumers in evaluating product performance and making informed decisions about divestment and recycling. Through transparent communication, eco-labeling, pricing incentives, and educational campaigns, businesses can empower consumers to make sustainable choices throughout the decision-making process, fostering a culture of environmental stewardship.

KEYWORDS:

Consumer, Decision-Making, Ecological, Marketing, Strategies.

INTRODUCTION

The consumer decision-making process unfolds through a sequence of actions that individuals undertake before, during, and after making a purchase. The initial phase, known as the prepurchase stage, begins with need recognition, wherein consumers perceive a gap between their current situation and an ideal state. This recognition prompts them to start seeking alternatives to fulfill their needs or desires.Following need recognition, consumers engage in a thorough examination of available alternatives. This involves researching different products or services, comparing features, prices, and reviews, and evaluating their suitability based on individual preferences and requirements. This process of exploring options is crucial in aiding consumers to make informed decisions that align with their goals and preferences.

The subsequent phase, known as the purchasing stage, marks the point at which consumers make a decision regarding whether, when, and under what conditions to proceed with the purchase. Factors such as pricing, availability, brand reputation, and perceived value influence consumers' final purchasing decisions during this stage.Once a purchase has been made, consumers transition to the post consumption stage, where they begin to use the product or service they have acquired. This stage involves experiencing and evaluating the performance, quality, and satisfaction derived from the purchased item. Consumers may assess whether the product meets their expectations, fulfils its intended purpose, and delivers

the anticipated benefits. Additionally, the post consumption stage encompasses ongoing interactions with the product or service, including maintenance, troubleshooting, and seeking customer support if necessary. Consumers may also share their experiences and opinions with others, contributing to word-of-mouth marketing and influencing future purchasing decisions.The consumer decision-making process is a dynamic and iterative journey that involves multiple stages of awareness, evaluation, and experience. Understanding and effectively catering to consumers' needs and preferences at each stage is essential for businesses to succeed in today's competitive marketplace[1], [2].

Need recognition, the pivotal moment when a consumer identifies a disparity between their current situation and their desired state, serves as the initial catalyst in the decision-making process. Ethical marketers acknowledge the significance of need recognition and strive to influence it in ways that align with responsible business practices. While some marketers may seek to enhance demand by altering consumers' perceptions of their existing possessions, others may focus on shaping need recognition itself, thus elevating the perceived value of alternative products. To stimulate demand for a specific branded product, companies may employ either a general need recognition approach or a more targeted brand-specific need recognition strategy. However, ethical considerations mandate that such practices prioritize transparency, honesty, and respect for consumer autonomy.

The moment a consumer decides to make a purchase marks a critical juncture in the decision-making process. Various factors influence this decision, and sustainable marketing strategies can play a significant role in shaping consumer choices. Consumer engagement during the purchasing process is key, as actively involved buyers tend to discern differences between brands, exhibit curiosity about product categories, and compare features across competing products. In low-involvement scenarios, environmental cues surrounding the purchase, such as in-store promotions and point-of-sale displays, can sway consumer decisions. Sustainable marketing practices aimed at influencing purchases prioritize eco-friendly attributes, ethical sourcing, and transparent supply chains to resonate with environmentally conscious consumers and promote responsible consumption.

As consumers transition from the purchase phase to product usage, the consumption process unfolds. At this stage, individuals must decide when, where, and how to use the product optimally. Sustainable marketing strategies aimed at changing consumption patterns focus on promoting environmentally friendly behaviors, such as energy-efficient usage, proper disposal, and recycling initiatives. By providing consumers with information, guidance, and incentives to adopt sustainable consumption habits, marketers can contribute to positive environmental outcomes while fostering brand loyalty and goodwill.

As product consumption commences, the consumer decision-making process nears its culmination. Consumers evaluate whether the product's performance meets or exceeds their expectations, influencing their satisfaction levels and future behavior. Eco-friendly marketing strategies aimed at post-purchase decisions prioritize delivering products that align with sustainability principles and meet consumers' performance expectations. Enhanced satisfaction levels resulting from eco-friendly products reduce price sensitivity, increase repeat purchases, and drive positive word-of-mouth endorsements. Conversely, dissatisfaction with product performance may prompt consumers to reassess their needs, leading to further involvement in the decision-making process and potentially the acquisition of new products. Eco-friendly marketing strategies post-purchase emphasize the importance of delivering value, quality, and sustainability to consumers while fostering a responsible approach to consumption and environmental stewardship.

Ecological marketing strategies aimed at influencing purchases play a crucial role in promoting environmentally responsible consumption habits and fostering sustainable behaviors among consumers. These strategies leverage various approaches to encourage individuals to make eco-conscious choices during the decision-making process.One key aspect of ecological marketing strategies is raising awareness about the environmental impact of products and services. By providing transparent information about the ecological footprint of their offerings, companies can empower consumers to make informed decisions based on their environmental values. This may involve highlighting the use of sustainable materials, energy-efficient manufacturing processes, or the reduction of carbon emissions throughout the product lifecycle. By emphasizing the environmental benefits of their products, companies can appeal to environmentally conscious consumers and differentiate themselves in the market.

Another effective approach is the implementation of eco-labeling and certification schemes. Eco-labels, such as ENERGY STAR for energy-efficient appliances or Forest Stewardship Council (FSC) certification for sustainably sourced wood products, provide consumers with recognizable symbols indicating a product's environmental credentials. These labels serve as a trusted guide for consumers seeking eco-friendly options and can influence purchasing decisions by signaling a company's commitment to sustainability. By obtaining and prominently displaying eco-certifications, companies can enhance consumer trust and confidence in their products, ultimately driving sales and market share[3], [4].

Furthermore, ecological marketing strategies often incorporate pricing incentives to encourage sustainable purchasing behavior. This may involve offering discounts or rebates for eco-friendly products, implementing tiered pricing structures that reward environmentally responsible choices, or introducing eco-friendly product lines at competitive price points. By aligning financial incentives with environmental objectives, companies can motivate consumers to prioritize sustainability without compromising on affordability or quality. Additionally, initiatives such as carbon offset programs, where a portion of the proceeds from product sales is allocated to environmental conservation projects, can further incentivize eco-conscious purchasing decisions.

DISCUSSION

Ecological marketing strategies intended to impact purchases focus on engaging consumers, providing transparent information, and offering tangible incentives to promote environmentally responsible consumption. By integrating sustainability into their marketing efforts, companies can not only drive sales and profitability but also contribute to positive environmental outcomes and foster a culture of sustainability among consumers.

Recognize Ecological Marketing Strategies Intending to Impact Purchases

The choice to buy is made by the customer at the second stage of the decision-making process. There are a lot of factors in this choice that a green marketing strategy might affect. The real product acquisition is what this step is all about. One of the main factors influencing the decision-making process is the degree of customer engagement in the transaction. When buyers are actively engaged in the transaction, they notice variations across brands, show an interest in learning more about the product category, and compare the features of other companies' products. It is possible to craft appeals to highly engaged customers by showcasing the long-term benefits of buying ecologically friendly products. Marketers need to determine where these purchasers get their information from and keep an eye on reviews of their items there. For instance, a car owner who is very interested in purchasing a vehicle that is environmentally friendly and fuel-efficient may depend on evaluations from

publications like Consumer Reports and Car & Driver. It is obvious that staying up to date with news stories in these journals is crucial for public relations managers and strategists at car firms. The majority of choices made by consumers don't need much customer input. In fact, the majority of routine transactions are made with little mental effort. Conditions around the purchase are more likely to affect the choice to pick in low-involvement situations. As a result, when these customers make purchases, in-store promotions and point-of-sale displays may have an impact.

There are a few noteworthy strategies used by marketers to control the amount of paper used in packaging and how much emissions result from purchases. Lower emission costs are often the result of buying less paper. Considering that packing accounts for $1 of every $11 spent at the grocery shop, it should be noted that this expense is significant. Simpler packing is favored since it reduces waste. Paper may be almost completely removed, for instance, when software is downloaded by the user instead of being bought in a shop. The kind of good has an impact on the carbon emissions related to product sales as well. Marketers in a variety of sectors provide items that use recyclable materials or minimize product consumption. Energy usage is limited via recycling and cost-effective design. For instance, 155 million gallons of water, 1.48 million cubic feet of landfill space, 373,000 trees, and one roll of 1,000 sheet virgin fiber washroom tissues might be saved if every American customer replaced it with recycled paper. Paper is not the only product where recycled materials may be used; numerous sports gear and bedding brands provide their goods using recycled materials. Providing things that are reusable is an alternative to recycling. Refillable razors, for example, allow the user to reuse the product and dispose of the cutting mechanism alone. Some customers' choices to buy should be influenced by these initiatives to recycle or reuse products.

The time of the transaction is a second inherent factor. Purchasing decisions have an impact on the product's environmental costs in addition to delivery expenses. For instance, take into account the fact that the US Postal Service delivers over 10 million items every day. The transportation sector accounts for 75% of the $2.35 billion allocated annually. A one-ounce letter costs $0.42 if the customer chooses to send it by regular postal delivery. Nevertheless, the fee is $16.50 if the letter has to be sent overnight. Regretfully, postal services do not yet advise customers of the expenses associated with mailing a letter due to carbon emissions. It is probable that accelerated services have higher carbon costs since they include the use of quicker transportation methods that produce more carbon dioxide. It is logical to assume that customers who are aware of greenhouse gas emissions may encounter scenarios where the environmental impact of overnight delivery outweighs the service's returns.

The choice of when to make a purchase is connected to the choice of location. Customers have several options when it comes to shopping in today's online economy. For example, some businesses support online purchasing since it saves fossil fuels for the individual making the purchase from home. Of course, the expenses associated with moving the product and the customer between the two other sites have an impact on the environment. Online book buyers may save money on personal transportation, but the carbon costs of shipping many volumes will probably be more than what a neighborhood bookshop would have to pay. It is obvious that when deciding where to buy, the whole cost of buying in relation to carbon must be taken into account. Keep in mind that services like Apple's iTunes result in low costs for product delivery and customer transportation[5], [6].

The limited fraction of solar heating that persists is influenced by the timing of hot water heater purchases. For instance, two thirds of water heater replacements in the US are the result of an existing model's unexpected breakdown. Sixty percent of such replacements are

necessary ones.46 When a water heater breaks down unexpectedly, customers usually get a new one from their plumber or contractor that is the least expensive, easiest to install, and most widely accessible. The urgency of the purchase and the need for a speedy replacement discourage customers from taking the time to think about lifelong cost reductions or cutting-edge technologies.

Determine Ethical Marketing Practices Aimed at Changing Consumption

As the customer moves from purchase to use, the consuming process continues. The person who purchases the product must choose the best time, location, and mode of consumption. All these aspects of consumption may be guided by socially conscious marketing in a way that encourages sustainability. First, think about when to consume. Although the timing of purchases and consumption are connected, these temporal issues often happen at distinct periods. Most of the time, consumers are quite flexible when it comes to when they purchase goods. In the food industry, for instance, customers who purchase groceries and vegetables often keep an eye on the expiry dates. In one study, consumer psychologists discovered evidence that as much as 12% of items purchased for the pantry are never used.

This same research also shows that 57% of food products that are stocked in a customer's pantry prior to use are thrown away. As a result, the product's manufacturing and distribution have an environmental cost, while the purchase has no positive effects on the customer. Hence, a purchase made without consumption increases the consumer's carbon footprint without providing any additional benefit. Marketing items intended for certain uses in the run-up to their expiration date is one marketing strategy. For instance, sales of canned pumpkin have to be advertised in close proximity to the Thanksgiving holidays in the US and Canada. Furthermore, timely and regular marketing messages on product use are important.50 For instance, the Campbell's Soup website and advertisements provide beneficial usage ideas and reminders, which reduce the chance that the food would be hoarded.

Advertising prioritizes the immediate purchase of things above use, even with the benefits of promotional activities that stress optimal product usage. Given that educating consumers on how to use products properly lowers their carbon footprint and increases customer happiness, marketers need to think about allocating a certain percentage of their advertising to product use. Many of these food items that will never be eaten may also be recycled and donated to community organizations. Public service announcements that support this kind of recycling benefit the poor and reduce the community's carbon impact.

Whereabouts

The environment in which a product is used may have a significant impact on how long it lasts. For instance, since 1988, customers in the restaurant business have purchased more takeout than on-premise meals. Restaurants like this trend because it boosts sales without increasing the expenses related to operating eating establishments. However, the quantity and kind of ingredients required for carry-out usually outweigh the price for meals served on-site. Traditionally, the quick-service segment of the company has been linked to the carry-out sales trend; nevertheless, a growing number of casual eating establishments are providing takeout as a substitute for meals at home. 47% of casual dining restaurant owners predicted a rise in carry-out business in 2007. Takeout food from casual eating establishments is often intended to be reheated in a microwave. The restaurant owner often needs to choose between the higher cost of packaging that is produced responsibly and the cheaper cost of alternative packaging[7], [8].

Mode of Consumption

How and how much of a product a customer uses is referred to as their way of consumption. This step should guarantee product use reductions in line with the reduce, reuse, recycle approach. By using green marketing strategies, the consumption of many energy-consuming items may be increased. Despite the fact that there is a lot of information accessible on energy use, many customers either do not act on this information or are ignorant that it exists. First, think about how energy use for home heating may be reduced.

The quantity of energy used as well as the associated element of how the energy is used must be addressed in any effort to improve space heating. The typical American house wastes 30 to 50% of the energy it consumes, despite advancements in fuel efficiency for heaters. When a house is adequately sealed and insulated, the consumer's energy cost and carbon footprint are at their lowest. Because porous duct systems lose significant amounts of energy, duct systems should be frequently examined for leaks. In a similar vein, duct insulation is recommended for unheated areas of the house in order to minimize heat loss from the system. Since dirt removed by clean filters lowers the performance of heating systems, air filters should be replaced according to manufacturer specifications. Additionally, customers need to utilize ceiling fans rather than air conditioners whenever feasible.

The cost of operating ceiling fans is far lower than that of room and central air conditioning units.53 Additionally, homeowners should be aware that modern heating systems are more efficient than those from the past.

The cost of energy for the customer will probably decrease with a new system if the central heating unit is fifteen years old. Additionally, consumers want to think about setting their thermostats to comparatively high summer temperatures and low winter ones. Digital controls for home energy managers allow you to maintain the utility of several appliances, regulate them, and save energy.

The way that water heaters are used affects not just how efficient they are with fuel, but also how much carbon dioxide they emit. First of all, customers need to understand that they may save more than four gallons of water for every minute they save in the shower. Showers that are shorter utilize less water and energy to heat the water. Low-flow plumbing fixtures do the same by using less water and energy. Twenty percent or so of the water used inside is used for showers. A family of four may save almost 20,000 gallons of water annually by switching out their normal 4.5-gallon-per-minute showerheads with 2.5-gallon-per-minute units. Each of these low-flow gadgets costs less than $5. Insulating hot water pipes and the water heater is another way to reduce energy use. Pipe insulation lowers energy expenses, and water heater insulation jackets may save 4 to 9% of water heating expenditures. Keeping the water heater at a lower temperature also conserves energy; a 10°F drop in water temperature typically results in a 3–5% decrease in water heating expenses.

Effective usage may also reduce the cost and carbon emissions related to lights and appliances. Even while they make up less than 1% of municipal solid trash, many appliances employ batteries, which are disproportionately responsible for the harmful heavy metals found in that waste57. Rechargeable batteries contain significantly more harmful compounds in their waste than single-use alkaline batteries, despite the former having less in their composition. Lead-acid and nickel-cadmium batteries are prohibited from being disposed of in solid waste facilities in many states, and they are the subject of an upcoming regulation from the European Union. Over the course of its lifespan, a single rechargeable nickel-metal hydride or nickel-cadmium battery may replace up to 1,000 single-use alkaline batteries.

Rechargeable batteries, with the exception of alkaline ones, can all be recycled due to the poisons they contain. Switching off these electronics while not in use may also help cut down on fuel used for lights and appliances. Turned-off appliances and communication gadgets waste ten percent of the energy used in the house. The United States could save over $100 million if its inhabitants switched off their laptops and mobile phone chargers when not in use. The way that food is eaten also affects the environmental costs associated with it. By making an effort to reuse and reduce food-related goods, consumers may reduce their carbon footprint. Reusing drinking containers helps customers reduce the quantity of solid trash they produce. In order to reduce solid waste, store-bought water bottles may be reused again[9], [10].

The water that flows from the faucet is less costly and subject to stricter regulations than bottled water. Customers who consistently utilize ceramic coffee mugs as opposed to Styrofoam cups also reduce the environmental impact of product preparation and disposal. Additionally, patrons may cut down on consumption by using fewer napkins at home and at restaurants.

The usage of paper products is another area of consumption where conservation is beneficial. Less paper is used in conservation efforts, which reduces the amount of energy used in production and the amount of trash produced after use. Using both sides of paper while writing or making copies is an easy technique to save money. Additionally, printing numerous pages on either side of a page helps reduce paper expenses. Customers should now consider if using paper for communication is still essential. Email can now transmit a large number of messages without sacrificing message equality or substance. Customers should also think about whether they really need paper copies of their bank statements, pay stubs, and ATM receipts. Carbon emissions are reduced each time a customer chooses to purchase these products only in digital form.

Determine Ethical Marketing Practices aimed at Impacting Decisions Made

After some product use has started, the customer moves on to the last phase of the decision-making process. Evaluation of a product conducted after consumption is known as postconsumption evaluation. The purchaser assesses if the product's degree of satisfaction matches or beyond prepurchase performance expectations. Consumers report higher levels of satisfaction when a product performs as expected or better than expected. This is because higher levels of satisfaction encourage repeat purchases, allay price sensitivity, and affect word-of-mouth advertising about a product.

Furthermore, when consumer satisfaction declines, they are more likely to notice a discrepancy between the product's ideal and actual conditions. Low satisfaction levels make it more likely that a need will be identified, which will encourage the customer to participate in the decision-making process. The customer no longer needs the older items when this procedure results in the acquisition of new ones. When a product is found to no longer be sufficiently useful, it should be carefully considered what to do with it. Divestment is the process of getting rid of goods after customers decide they are no longer useful. Choosing what to do with things that are no longer useful is a crucial decision. The volume of solid garbage generated in the US in 2005. Keep in mind that the rate of reclamation varies significantly depending on the commodity, ranging from 2.4% for food to 72% for nonferrous metals.

The percentage of recovery for lead-acid batteries is 98.8%, while significant amounts of aluminum cans, news articles, corrugated boxes, large appliances, and steel packaging are also recovered. The customer must determine if the goods adds value to them or to another

consumer before disposing of it. Therefore, it is up to the customer to determine if the product may be used again. Packaging and shopping bags, for instance, are often used again for storage. Although consumers have always participated in this activity in some capacity, they are becoming more aware of the benefits of repurposing goods in creative ways. For instance, in the US, food and yard trash make up almost 25% of all consumer waste. Divestment via landfill disposal is not the most ecologically friendly option. In landfills, yard waste decomposes gradually and releases acidic leachate and methane gas. By composting this material, it is possible to minimize municipal solid waste by about one-fourth and enhance the structure, texture, aeration, and water retention of the soil. Product donation is another way to encourage reuse. Even while a user may no longer see value in computers, smartphones, and other devices, these things may still be useful to other customers.

It is important to think about whether a product still has value for other consumers after it is no longer helpful or reusable by the consumer. Several product classes provide examples of how to make things accessible to other customers. In the automotive sector, for example, buyers often trade in or sell their old vehicles when they buy new ones. In the auto business, facilitating the resale of automobiles after they were no longer useful to the customer was one of the driving forces for the establishment of franchised channels. In some markets, soft drink and malt beverage bottlers collaborate with the government to facilitate reuse. For instance, in Norway, almost 95% of all beer and soft drink containers are recycled, returned, or reused.64
The Internet is the most popular medium for making things accessible for usage by other customers. For instance, in 2007 eBay handled more than $60 billion in transactions, and the great majority of them entailed offering things that already existed to other customers.65 eBay and other online retailers provide virtual marketplaces for the resale of almost any kind of commodity.

The customer must find another way to get rid of the merchandise when it is not practicable to reuse or resell it. Depending on the product class and the demands of the customer, recycling may take many different forms.

For instance, Unwanted Appliances specializes in the removal of water heaters, air conditioners, electronics, exercise equipment, and home appliances. While some of the goods they purchase are resold to other customers, the majority are sold for scrap. Certain collaborative industries do an amazing job of recycling discarded goods. For example, almost 95% of car batteries sold are recycled by the US and EU auto sectors. Customers in the consumer electronics sector are interested in recycling as well as making sure that their private information is secure and not accessible after recycling. After buying a new computer from Dell, old PCs and accessories are recycled for free. When a product is determined to be resaleable, the corporation returns the revenues to the buyer. Dell recycles products that cannot be resold in a way that complies with national, state, and local regulations. Significantly, these services allow the user to safely dispose of their computer, recover a portion of their computer investment, and help the environment.

Community and business initiatives to promote the return of items that endanger those exposed to them after use are becoming more prevalent. The average home can accumulate up to 100 pounds of household hazardous waste, which is stored in closets, basements, and garages.68 Community action plans allow customers to dispose of paints, cleaners, oils, batteries, and pesticides that require special handling during disposal. Americans, for example, produce 1.6 million tons of household hazardous waste annually.

Even while post-consumption has received much of our attention when discussing recycling, it's important to remember that recycling really started with the creation of new products. Astute marketers are creating items such that a large portion of the product may be recovered after use. Approximately 15 million cars and trucks in the auto industry reach the end of their useful lives each year, and over 75% of the materials from these vehicles can be profitably recovered and recycled.69 Post-consumption planning increases the value of products for customers and reduces their environmental impact.

CONCLUSION

The consumer decision-making process is a multifaceted journey that unfolds through distinct stages, each presenting opportunities for ethical and sustainable marketing interventions. Need recognition serves as the initial catalyst, driving consumers to explore alternatives and seek products aligned with their values and preferences. Sustainable marketing strategies play a pivotal role in shaping purchasing decisions, leveraging pricing incentives, eco-labeling, and transparent communication to promote eco-conscious choices. As consumers transition to the consumption phase, the focus shifts to fostering sustainable consumption habits, such as energy-efficient usage and proper waste management. Post-purchase, ethical marketing practices guide consumers in evaluating product performance, encouraging responsible divestment and recycling. By integrating sustainability into every stage of the decision-making process, businesses can not only drive sales and profitability but also contribute to positive environmental outcomes and societal well-being. Through collaboration and innovation, marketers can empower consumers to make informed choices that prioritize environmental conservation and long-term sustainability.

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CHAPTER 3

SUSTAINABILITY INITIATIVES IN THE SERVICES SECTOR: A COMPREHENSIVE OVERVIEW AND ANALYSIS

Dr. N. Das Mohapatra, Assistant Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id- neel@muit.in

ABSTRACT:

This study delves into the sustainability initiatives within the services sector, with a focus on energy consumption and efficiency. By analyzing various industries such as accommodation, retail, food service, and administrative offices, the study provides insights into the energy usage patterns and the efforts undertaken to enhance sustainability. The example of Kimpton Hotels serves as a case study, showcasing the sector's endeavors to minimize environmental impact. Despite the significant contribution of the services sector to GDP and employment, comprehensive data on energy consumption within this sector remain scarce. The study sheds light on the prevalent energy sources and consumption trends, highlighting areas of improvement and innovation. Through a detailed examination of energy-efficient technologies, such as lighting systems, heating equipment, and electronic controls, the study underscores the potential for reducing energy consumption and carbon emissions. Furthermore, it discusses sustainable practices in waste management and product sourcing, emphasizing the economic and environmental benefits of adopting green strategies. Overall, this study provides a comprehensive overview of energy usage in the services sector and underscores the importance of sustainability initiatives in fostering a greener economy.

KEYWORDS:

Energy-Efficient Technologies, Energy Sources, Greener Economy, Sustainability initiatives.

INTRODUCTION

The example provided by Kimpton Hotels highlights the efforts being made in the services sector to improve sustainability. It is important to assess the sustainability initiatives that are currently underway in this industry in order to support these efforts. Thus, this chapter's goal is to provide a general summary of how the services sector affects energy use. We start by giving a general description of this industry and how much energy it uses. The usage of energy in recycling, administration, education, healthcare, and accommodation is then covered.Even though in most developed economies services make up over 50% of GDP, very few nations gather comprehensive data on energy consumption in this industry. The most comprehensive data on energy consumption in the services sector is available from Japan, the US, and Canada. Our evolution of energy usage concentrates on the United States due to the scale of the American economy and the dearth of worldwide information. Take into account this sector's total effect first.

Services are product offers that differ from products and other product offerings in a number of ways. The personnel-based aspect sets these items apart from commodities since most services are delivered dependent on human effort. Services are basically intangible items that differ according to the supplier. The quantity of services that are provided is perishable as they are dependent on the time that the service provider has available to give them. Religious organizations, fraternal organizations, educational institutions, and penal facilities are all included in the service sector. An economy's service sector contributes significantly to GDP

and jobs. For instance, in the US, the services sector generates 80% of GDP and more than 80% of all employment in the economy. The services sector contributes 12% of carbon emissions and 9% of total final energy consumption worldwide. The U.S. services sector's total on-site energy consumption exceeded 6.5 quadrillion British Thermal Units in 2003. This estimate of U.S. energy consumption only includes energy used at a location; it does not include energy used to generate and transmit electricity. The expenses involved in producing and delivering power are almost equal to those expended on-site. Our talk focuses on on-site energy use since the information supports initiatives to increase efficiency at the point of service[1], [2].

For services, fuel oil, natural gas, and electricity are the three main energy sources. More than half of all energy is used for electricity, which is mostly used for air conditioning, lighting, refrigeration, ventilation, and office equipment. Natural gas is the main energy source for space heating, water heating, and cooking, accounting for close to 40% of energy usage. Many tasks can also be completed using electricity, although gas is often a more practical and efficient energy source in many situations. The main use for fuel oil is space heating.In the services industry, lights and space heating make up the bulk of energy use. Six to eight percent of energy is used for refrigeration, air conditioning, ventilation, and water heating. In this industry, 3% of energy is used for cooking and office equipment.

Notably, the overall energy consumption in this sector has not grown at similar rates despite a steady growth in the number of commercial buildings and floor area. Energy efficiency has significantly improved in almost every use, from computers to space heaters. Furnaces and boilers are the main means of heating spaces. Boilers heat water to produce steam or hot water for heating, while furnaces heat air and distribute it via ducts. Baseboard radiators or radiant floor systems may be used to distribute hot water, while pipes are used to transport steam to steam radiators. Larger structures are more likely to have boilers, whereas smaller ones are more likely to have furnaces.

The yearly fuel usage efficiency of a boiler or furnace is used to determine its energy efficiency. For consumer comparison, the U.S. Federal Trade Commission mandates that the AFUE of each new boiler or furnace be displayed. The boiler's or furnace's annual fuel efficiency (AFUE) is the ratio of heat production to total energy used by the boiler or furnace. A furnace with an AFUE of 95%, for instance, consumes 95% of the energy as heat, with the remaining 5% escaping down the chimney or in other directions. Federal minimum efficiency standards for gas-fired furnaces, oil-fired furnaces, and gas-fired boilers are 84%, 83%, and 82%, respectively, according to the U.S. Department of Energy. These minimums fall short of the current Energy Star standards, which are set at 85% for boilers and 90% for furnaces.

Over time, boilers and furnaces have become much more fuel-efficient. Upgrading space heating systems results in significant cost savings and a concurrent decrease in carbon emissions due to the increased efficiency. For instance, the AFUE of many furnaces constructed in the 1970s was 60%. The replacement of one of these systems with an AFUE of 95% results in a $37.80 reduction in fuel consumption costs for every $100 spent on energy.18 As a result, the upgrade to more efficient space-heating technology decreases both fuel prices and carbon emissions.

The lighting utilized in this industry has seen a significant shift in energy use during the last ten years. Compared to the residential sector, there are much more places in the services sector that employ fluorescent lighting as opposed to incandescent lighting. The energy savings from changing to fluorescent lighting are more noticeable, even if there are some energy savings to be realized by replacing the incandescent lighting. Lighting control systems

and electronic ballasts are two improvements made to commercial lighting. Devices called ballasts are designed to control the amount of power flowing through an electric circuit. Prior to the 1980s, magnetic ballasts were employed in fluorescent lighting; now, a growing number of electronic ballasts are replacing these devices. These more recent gadgets boost fluorescent lighting efficiency by 25%.20 For instance, an analysis of a 440,000-square-foot office complex in Washington, DC, showed that the building owner could save almost $27,000 annually. Replacing fluorescent lamps and magnetic ballasts with smaller-diameter bulbs and electronic ballasts results in these savings. All of these lighting adjustments resulted in a 20% reduction in electricity per fixture—from 110 to 88 watts. American estimates. According to a National Academy of Sciences research, $15 billion in energy savings might be realized by using electronic ballasts through 2005. Furthermore, because of their increased efficiency, electronic ballasts now make up over 80% of the ballast industry[3], [4].

Advancements in lighting and space heating equipment efficiency are complemented by improvements in electronic control technologies. The advent of digital thermostats has made it possible to regulate a home's temperature on a daily, weekly, and hourly basis. Therefore, it is possible to properly manage facilities that operate in climates where heating and air cooling are required on the same day. Furthermore, one may adjust the temperature in a space thanks to the heaters' electrical programming. As an instance, the U.S. According to the Department of Energy, if the setback period lasts for eight hours, one can save up to 1% for every degree of temperature change.22 Digital thermometers that are set correctly to lower the temperature by 10° to 15° for eight hours can save between 5% and 15% of annual heating costs and reduce the amount of carbon emissions related to the location. In a similar vein, fuel costs and emissions are reduced with digital lighting control equipment. Timer, sensor, and dimming devices are some of the lighting control equipment. When dimmers are used with fluorescent lighting, much more energy is saved compared to standard fluorescent lamps since they are specialized fixtures and bulbs. Dimmers used with incandescent lights, on the other hand, do not improve energy efficiency. Devices that detect motion, light, and occupancy are called sensors. These gadgets increase fuel economy by lowering power use when it is not necessary. For instance, photo sensors are used in outdoor settings to switch off appliances throughout the day. In a similar vein, timers work to reduce energy consumption by use of programs that release electricity to light appliances according to preset periods.

DISCUSSION

The many aspects of the services industry, both domestically and internationally, and how much energy each one uses. The mercantile sector of the economy is the greatest energy consumer in the services sector, accounting for 20% of overall energy consumption. Malls and strip centers that contain non-food and non-lodging retail components are known as mercantile services. Offices are the second biggest energy users in the services sector, accounting for 17% of overall energy consumption. While housing, food service, and medical care each contribute at least 8% of the overall energy consumption, education institutions use 13% of the energy.

Retailing non-food items

All structures used for the sale and exhibition of products other than food fall under the mercantile category of the services sector. This category encompasses all forms of retail buildings other than food retailing, such as enclosed malls, strip shopping centers, automobile dealerships, liquor stores, and video rental stores.24 Examining the inputs, processes, and outputs of the nonfood retail sector can help determine its potential for increased

sustainability. The two inputs of packaging and energy supply are linked to carbon emissions. Producers and distributors are looking more and more for methods to improve sustainability without raising the price of logistics related to selling to retailers. For instance, Georgia-Pacific collaborated with A. O. Smith Water Products will reorganize the water heaters' packaging. The revised package design resulted in a reduction of 1,423 tons in carbon emissions, a one-third reduction in material utilization, and lower storage and logistical expenses. The benefits of the green marketing approach are shown by this example for all parties involved in the value chain. Retailers and customers benefit from decreased prices as a consequence of production and transportation efficiency, which also reduces total carbon emissions.

Manufacturers are taking steps to reduce product packaging and floor space, as shown by Georgia-Pacific's initiatives. Additionally, retailers are starting to implement policies aimed at reducing the emissions linked to the goods they sell. Target, for instance, has removed dangerous perfluorooctanoic chemicals from goods that are used in the production of fabrics and clothing. Target makes a concerted effort to decrease the use of polyvinyl chloride plastic in its goods and packaging. At Target's internal printing plant, around 66% of the paper used is recycled. The firm also employs plastic bags with 5 to 25% recycled content, 80% recycled shoe boxes, and paper bags made entirely of recycled materials.

The kind of energy used at the retail site is the second input that is being drastically changed. Walmart, for instance, wants all of its retail locations to run entirely on renewable energy in the long run. Walmart and Duke Energy have signed a four-year power purchase agreement under which Walmart would buy wind electricity from Duke's Notrees, Texas, project at competitive prices. Walmart will be able to avoid emitting more than 139,000 metric tons of carbon dioxide annually by acquiring clean, renewable energy. The energy buy is the same as removing around 25,000 automobiles off the road[5], [6].

The control of energy use at a retail site is the process element of nonfood commerce. Target and Walmart have put in place initiatives designed to cut energy use without detracting from the shopping experience for customers. At Walmart, daylight harvesting saves an average of 800,000 kWh annually per store enough energy to power 73 households. In addition, the firm employs LED technologies, which are more efficient than earlier fluorescent lights, and dimmable fluorescent lighting systems. Target has made significant progress in improving the energy efficiency of these systems since heating and cooling account for almost 80% of the energy used in a retail space. Walmart shops have HVAC systems that are far better than those required by retail, and energy-efficient humidification systems provide comfort to the journey to the market. Additionally, Walmart has put in place a strategy to cut store water use by 17 percent. Installing new faucets and other plumbing fixtures that restrict water flow accomplishes this aim. Additionally, fly ash and slag are being used by Walmart to replace a portion of the cement. Additionally, the firm employs 100% recycled plastic for its baseboards and uses recycled materials for its cabinets and worktops.

The trash generated from a retail site is the third facet of nonfood commerce. Although retailers have been collecting paper trash for recycling for many years, in the past few years, waste reduction has received much more attention. For example, Target now recycles or reuses over 70% of garbage that was once disposed of in landfills. Retailers are required by municipal laws to recycle plastic bags. For instance, a rule requiring shops to set up in-store plastic bag recycling systems was approved by New York City in 2008. Retailers are aggressively transitioning to alternative bags in response to the growing criticism directed against plastic bags. By 2013, Walmart wants to cut down on the amount of shopping bags it throws away by 33%. By teaching employees to bag goods more effectively, introducing

reusable bags, and accepting used bags for recycling, it will be able to accomplish this aim. Walmart U.S. launched reusable bags in October 2008; they cost 50 cents for customers. The corporation has already reduced its use of plastic in Canada, Europe, Argentina, and Brazil thanks to similar programs. 46% of Walmart shoppers in Japan now bring their own bags.

Retailing Food

Buildings used for the production and sale of food and drinks are referred to as the food service component. Food retailing accounts for 10.4% of consumption in the services sector. Fast food outlets, cafeterias, and restaurants are housed in these structures. Grocery shops, food markets, convenience stores, and other establishments that sell food at retail or wholesale prices are referred to as food sales structures. 3.8% of overall energy consumption is accounted for by food sales, whereas 6.8% is attributed to food service.

While food retailing accounts for little over 10% of the services sector's total consumption, food marketing has an energy intensity that is more than double that of the average for all commercial buildings. Within the food service subsector, electricity accounts for little over 50% of energy consumption, with natural gas being the dominant source of the remaining energy. Businesses in this industry are looking for methods to save operational expenses, waste disposal costs, and fuel input prices. Food stores of all sizes have implemented energy-saving and sustainable fuel-using strategies. For example, McDonald's has saved each outlet about $2,000 by using TEEM tactics.

The skylights that enable fluorescent lighting be lowered throughout the day and the carefully treated windows that block out UV and infrared radiation from the sun are examples of the design aspects. Restaurant eating spaces are heated by infrared radiation, while UV light degrades colored materials.

Numerous other restaurant owners are seeing the benefits to their business and finances. For instance, The Austin Grill became the first multiunit restaurant in the US to run solely on wind power when it converted to wind power in 2003. The restaurant company paid around 2% more per kilowatt hour for wind power than it did for fuels derived from conventional sources. In a similar vein, Holland Inc. started using wind energy in 2005 to power all of the restaurants Burgerville and Noodlin. Holland Inc. has avoided releasing 17.4 million pounds of carbon dioxide into the atmosphere annually by switching 40 restaurants to wind power.

Food sourcing is a second aspect of sustainability related to inputs used in the restaurant and food service industries. By sourcing locally and sustainably farmed food, restaurateurs may reduce their carbon footprint. Although goods that are cultivated sustainably are often connected with reduced carbon emissions, their present cost is higher than that of their competitors. Both the restaurant owner and the neighborhood may gain greatly from local shopping. Buying locally made goods leads in reduced transportation costs overall and reduces the carbon emissions related to delivery. Additionally, the company may bolster its freshness claims by purchasing locally farmed goods. The success of the restaurants depends on the local community, which is supported by the purchase of these goods[7], [8].

Retailers are starting to realize that reducing gasoline use has several advantages. Companies are searching for savings obtained via equipment purchases and operations, as about 75% of fuel expenses in the industry are accounted for by heating/air conditioning, lighting, cooking, and refrigeration. Equipment for commercial restaurants with the Energy Star certification reduces emissions and saves a lot of fuel. Compared to conventional fryers, Energy Star fryers have an efficiency increase of over 50%. Similarly, compared to non-Energy Star items, Energy Star steamers are 25–60% more efficient, and food warming/heating

equipment is up to 137% more efficient.39 Restaurant owners may also spend money on tankless water heaters, which use less water and have an efficiency of up to 70% higher than traditional water heaters.
Retailers who manage energy for refrigeration equipment must consider global warming and ozone depletion. Investing in refrigeration equipment that provides the maximum evaporation temperature and the lowest condensing temperature while keeping the ideal storage temperature will help retailers save their energy costs.

These specifications are met by more recent commercial refrigerator models, which also have a 30% higher efficiency than earlier versions. Furthermore, these units could employ coolants that are less harmful to the environment than refrigerants based on CFCs or HFCs. For instance, the Danish manufacturer Vestfrost has created freezers that run on R-134A. But taking into account the humidity levels is just as important as maintaining a suitable temperature. Humidity control is crucial because removing moisture uses more energy than reducing air temperature. In addition to improving the shopping experience, proper dehumidification may increase the efficiency of supermarket refrigeration cases by up to 20%. Additionally, the removal of moisture plays a major role in the management of bacterial contamination, especially with regard to meat and poultry. Retailers need to take into account both the moisture removal efficiency and the energy efficiency rating at the same time. The latter deals with the quantity of condensate per kilowatt hour, whereas the former measures the kilowatt cost per hour to maintain temperature.

Crucially, energy savings from refrigerators and kitchen appliances are contingent upon appropriate maintenance of the installations. For example, in order to maintain fuel efficiency and prevent compressor wear, store-level operations need to routinely clean condensers and evaporator coils. Refrigerators should also be filled and maintained correctly to provide easy access to goods without compromising the units' ability to circulate air. The life cycle savings of commercial items may be obtained when adequate maintenance is included in the energy evaluation. The quantity of trash generated is the last consideration in energy conservation for food commerce. The Environmental Protection Agency estimates that the processing of food waste costs the US economy more than $1 billion a year. Reusing, recycling, donating, and composting goods reduce these expenses.46 Recycling facilities, for instance, may compensate merchants for aluminum, glass, and paper that are not polluted. Retailers, on the other hand, save money by recycling plastic, paper, and cardboard. By donating food, worn uniforms, furniture, and appliances to the less fortunate, they may help reduce overall expenses. Lastly, merchants understand the financial benefits of composting. More than 300 tons of debris have been composted daily by San Francisco restaurateurs since 1997. The compost is sold to nearby wineries once it has fermented for sixty days.

Administrative and Office Buildings

General office space, administrative offices, and professional offices are all housed in office buildings.48 Electricity for lighting accounts for 29% of the energy utilized at these locations, with office equipment accounting for an additional 16%. Additionally, they depend on electricity and natural gas for space heating; these two fuels together account for 25% of the energy used in office buildings. Green design and office equipment operations are two ways that commercial businesses are trying to keep their energy costs under control. The creation and upkeep of structures that are considerate of the environment, energy and resource consumption, the standard of the workplace, economy, and society at large is known as "green design." The Leadership in Energy and Environmental Design rating system was developed in the US by the nonprofit Green Building Council.

The 34 performance criteria of LEED are related to innovative and design processes, sustainable sites, water efficiency, energy and atmosphere, materials and resources, and interior environmental quality. There are four certification levels that correlate to progressively greater degrees of building sustainability. The cost-effectiveness of the sustainability-based improvements will determine whether or not to use LEED standards in buildings. Unfortunately, not much has been studied on the expenses associated with green design. The extra costs related to green design are referred to as the "green premium." Due to the relative novelty of green technology, designers, architects, and their clients tend to estimate costs conservatively when making green design decisions as opposed to nongreen ones. The advantages of green design include lower operating and maintenance expenses as well as cost savings from less energy, water, and waste. Green design also improves the health and productivity of its occupants. Additionally, green buildings have lower peak energy use and are 25–30% more energy efficient. Additionally, they are more likely to acquire electricity from renewable energy sources and produce renewable power on-site[9], [10].

The information that is now available indicates significant financial advantages over a 20-year horizon, even if survey and census data are not available to describe the trade-offs associated with implementing a green design. The state of California used net present value calculations to assess the costs and advantages of adopting a sustainable design in a 2003 assessment of 33 LEED projects. The net present value of energy savings was calculated to be $5.79, but the green premium was valued at $4 per square foot. In addition to the energy savings, the advantages of reduced emissions, improved water quality, and increased occupant productivity were calculated to bring the net present value of a certified or silver site to $52.47 per square foot. As a result, the average benefit of a green building was $48.87 per square foot. It is not appropriate to infer from these numbers that green buildings are always more affordable. These early findings highlight the need of taking into account the advantages and disadvantages of using a sustainable design. The benefits of using green construction techniques are probably going to be more obvious when the expenses are evaluated throughout the course of the property.

Office equipment is the second aspect of energy conservation that is most often linked to office buildings. This equipment consists of telephones, photocopiers, facsimile machines, personal computers, and other devices that make office work easier. The Green Electronics Council was founded in 2006 by the International Sustainable Development Foundation to promote the efficient design, production, use, and recovery of electronic equipment. GEC honours and rewards environmentally conscious goods in collaboration with the electronics sector. To determine whether electronics are better for the environment, GEC created the Electronics Products Environmental Assessment Tool. The inclusion of recycled content, the reduction or deletion of environmentally sensitive components, and the incorporation of design elements that facilitate recycling at the end of a product's life are all required by the EPEAT sourcing criterion. Concerns about energy saving, product upgradeability, and packaging are examples of operational requirements. Additionally, items are assessed in light of the company's environmental performance and whether or not a return policy for outdated products has been put in place.

Products that adhere to EPEAT criteria produce less greenhouse gases, air and water pollution, solid and hazardous waste, and greenhouse gas emissions while using less energy and more recycled materials. Less than 10% of computer monitors, including desktop and laptop models, complied with EPEAT criteria in 2006. These goods prevented the need for 24.4 million metric tons of materials and 13.7 billion kWh of power. These EPEAT-certified

products also avoided disposing of 41,100 metric tons of hazardous waste and spared 56.5 million metric tons of air pollution, 1.07 million metric tons of greenhouse gas pollution, and 118,000 metric tons of water pollution. However, it is not unexpected that companies like Apple and Dell are pushing EPEAT solutions given their advantages.

The 13-inch MacBook is marketed by Apple as the greenest MacBook to date. This computer is made of recyclable glass and aluminum, and it is devoid of arsenic, mercury, and PVC. Dell aims to attain elevated standards of sustainability and now provides 28 products that have been certified with EPEAT.

CONCLUSION

This study underscores the critical role of sustainability initiatives in the services sector for mitigating environmental impact and promoting energy efficiency. Through an in-depth analysis of energy consumption patterns across various industries within the services sector, it becomes evident that significant opportunities exist for reducing carbon emissions and improving operational efficiency.

The case study of Kimpton Hotels exemplifies the sector's commitment to sustainability, serving as a beacon for future endeavors. By embracing energy-efficient technologies, such as LED lighting and digital thermostats, and implementing sustainable practices in waste management and product sourcing, businesses can not only reduce their environmental footprint but also realize cost savings and enhance competitiveness. Moreover, the study highlights the importance of comprehensive data collection and analysis to inform policymaking and support industry-wide sustainability efforts. Moving forward, collaboration among stakeholders, including businesses, policymakers, and consumers, will be essential to drive meaningful progress towards a more sustainable future in the services sector and beyond.

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CHAPTER 4

SUSTAINABILITY INITIATIVES IN EDUCATIONAL ESTABLISHMENTS: A COMPREHENSIVE REVIEW

Dr. N. Das Mohapatra, Assistant Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id- neel@muit.in

ABSTRACT:

Educational establishments play a crucial role in the services sector, contributing significantly to economic growth while also consuming a substantial amount of energy. This study explores the energy usage patterns and sustainability initiatives within educational institutions, including schools, colleges, universities, and training centers.

The focus areas for energy conservation, such as lighting, heating, cooling, and operational practices, are examined, along with the adoption of energy-efficient technologies and practices to reduce carbon footprint and operating expenses. Additionally, the study discusses educational programs and initiatives aimed at promoting energy conservation and sustainability among students, faculty, and staff. Through a combination of technological innovations, behavioral changes, and educational initiatives, educational establishments are playing a vital role in advancing sustainability goals and shaping a more energy-efficient future.

KEYWORDS:

Economic, Energy, Educational, Health, Sector,

INTRODUCTION

Educational establishments represent a significant component of the services sector, contributing to both economic growth and energy consumption. These institutions encompass a wide range of facilities, including schools, colleges, universities, and training centers. Despite their diverse functions and operations, educational establishments share common energy usage patterns, predominantly driven by lighting, heating, cooling, and electronic equipment. In recent years, there has been a growing emphasis on sustainability within the education sector, driven by both environmental concerns and cost-saving opportunities. As a result, educational institutions have increasingly adopted energy-efficient technologies and practices to reduce their carbon footprint and operating expenses.

One of the primary areas of focus for energy conservation in educational establishments is lighting. With large buildings and extensive operating hours, lighting accounts for a significant portion of energy consumption. Institutions have been transitioning to energy-efficient lighting systems, such as LED bulbs and fluorescent lamps, which consume less energy and have longer lifespans compared to traditional incandescent bulbs. Additionally, the implementation of lighting control systems, including timers, sensors, and dimmers, enables more efficient use of electricity by adjusting lighting levels based on occupancy and daylight availability.

Heating and cooling systems also represent major energy consumers in educational establishments, particularly in regions with extreme climate conditions. To optimize energy use, institutions have been investing in advanced HVAC (heating, ventilation, and air conditioning) technologies and building automation systems. These systems enable precise

temperature control and scheduling, allowing facilities to operate more efficiently while maintaining comfort for occupants. Moreover, proper insulation, window treatments, and building design strategies, such as passive solar heating and natural ventilation, further contribute to energy savings and sustainability[1], [2].

In addition to operational improvements, educational institutions are also implementing educational programs and initiatives to promote energy conservation and sustainability among students, faculty, and staff. These efforts include awareness campaigns, energy audits, and the integration of sustainability principles into curricula and campus activities. By fostering a culture of environmental stewardship and providing resources for energy-saving practices, educational establishments not only reduce their own energy consumption but also empower future generations to become responsible global citizens. Overall, through a combination of technological innovations, behavioral changes, and educational initiatives, educational establishments are playing a vital role in advancing sustainability goals and shaping a more energy-efficient future.

Educational Establishments

Buildings used for classroom or academic teaching are known as educational institutions. These structures house classrooms on college or university campuses as well as primary, middle, or high schools. In the services sector, 13% of energy use is attributed to educational institutions. Over 80% of electricity costs in education are related to space heating, water heating, and lighting. Schools in the Northeast and Midwest are typically bigger than those in the South and West, and the majority of educational institutions are part of multibuilding campuses. The government owns around two thirds of the schools, while the local government owns three quarters of the government-owned structures. While attempts to improve the sustainability of operations at the elementary and high school levels are noteworthy, collegiate-level activity offers a means of comparing green marketing initiatives between campuses. In 2005, the Sustainable Endowments Institute was founded by the Rockefeller Philanthropy Advisors. As a charity, SEI conducts research and teaches courses to improve endowment and campus operations sustainability. SEI has been releasing the College Sustainability Report Card since 2007. One hundred top schools and institutions' policies and programs are assessed in this sustainability assessment. Approximately 75% of all investments in higher education endowments are made by these universities, which have endowments totaling more than $258 billion. The following standards are used to assess collegiate institutions:

Management

This category covers administrative or trustee-level actions taken by colleges and universities in relation to sustainability. This activity entails signing local, national, or worldwide sustainability agreements in addition to making commitments to sustainability in the institution's mission statement or master plan. Energy and climate change Initiatives addressing climate change aim to increase energy efficiency and use renewable energy sources. Conservation campaigns may motivate college students to keep an eye on their energy use, install energy-efficient appliances or power plants, carry out an emissions inventory, and make a commitment to reducing their emissions.

Consumption and recycling

The sustainable practices used by eating services are examined in this area. Higher ratings for schools are determined by the amount and accessibility of food produced sustainably, organically, and locally. Additionally considered are the usage of eco-friendly to-go

containers and reusable dishware. This category includes looks at food waste recycling and composting initiatives for the campus as a whole as well as dining-specific initiatives.

Eco-friendly construction

The degree to which schools use high-performance green building design is evaluated in the green building category. This category covers the implementation of green building rules for the whole campus, the incorporation of green building design elements into existing building retrofits, and the integration of green building practices into both new and existing structures. When colleges use the LEED grading system, their ratings improve.

Participation of Students

This category takes into account how much student participation there is in sustainability programs, as well as how supportive school officials are of these efforts. Moving. The transportation category looks at how much a school encourages other modes of transportation via its administration's and facilities management's policies and practices.

Transparency of endowments

This component deals with shareholder proxy voting records and control information about endowment investment holdings. The availability of endowment data promotes fruitful discussion on prospects for investments in sustainable energy and the voting preferences of shareholders [3], [4].

Priorities for investments

The three main areas of concentration for investment priority are community development loan funds, renewable energy funds, and return on investment. Establishing committees including members from the student body, faculty, and alumni to counsel the trustees on sustainability is one way that colleges demonstrate shareholder participation.Higher education institutions may benefit from a variety of initiatives, including the College Sustainability Report Card. The report card's particular criteria provide chances to improve significantly areas of a university's sustainability assessment that aren't performing up to par. Universities may show stakeholders how much progress has been made over time by plotting this activity across time. As an example, lists the institutions that performed the best in 2009. The relative rankings show how one college's efforts stack up against those of all other higher education establishments.

DISCUSSION

In addition to delivering insights to schools, the scorecard also serves as a resource for marketers that want to reach higher education institutions with their product offers. Businesses may create campaigns that show how their product offers assist schools in achieving sustainability objectives by examining these characteristics. Leviton, for instance, sells a range of dimmer switches designed to work with fluorescent lights.When selling these items to schools and universities, sales professionals may demonstrate how the institution can cut operating expenses and meet sustainability objectives by retrofitting these devices to existing fixtures.

Medical Care

Buildings utilized for both inpatient and outpatient diagnostic and treatment purposes are referred to as health care buildings. If a doctor or dentist uses any kind of diagnostic medical equipment, their offices are classified as health care buildings; if not, they are classified as

offices. Lodging includes skilled nursing facilities and other residential care structures. In the services sector, 9% of energy use is related to health care. The particular circumstances faced by the health care industry affect the energy-saving techniques used. Health care buildings have energy intensities that are more than twice as high as the sector average, much like food retailing. Health care facilities have to deal with round-the-clock operations, chemical usage, needs for controlling infectious diseases, and significant regulatory restrictions that make it difficult to reach greater levels of sustainability.

Since the American Society for Healthcare Engineering released its Green Healthcare Construction Guidance statement in 2002, the health care sector has been attempting to create sustainability standards. The Green Guide for Health Care project got its start the next year when a group of geographically and professionally varied business executives formed a steering committee to direct the document's creation. It is noteworthy that a diverse range of stakeholders who do not directly profit from the certification procedures or goods included in the paper are represented on this committee. From a pilot effort, the guide has developed into a comprehensive registration and certification scheme. The Green Guide for Health Care is meant to function as a resource for industry best practices in its present format. The Guide offers decision-makers, owners, and operators in the healthcare industry a voluntary, self-certifying metric toolbox to help them chart and assess their journey toward high-performance healing settings. The comprehensive handbook offers valuable insights into how healthcare institutions may increase the level of sustainability in their building operations and construction.The health care sustainability standards look at problems related to both new construction and ongoing operations. More and more hospitals are basing choices on the Green Guide for Health Care when deciding whether to add new construction or evaluate existing operations[5], [6]. The following are difficulties with health care institutions' operations and construction:

Combined design

A collaborative, multi-stakeholder goal-setting and design approach must be implemented by the healthcare institution, and human health must be the primary consideration in all aspects of design, construction, and operation. Places that are sustainable. Site development needs to minimize the negative effects that a building's placement on the environment may have. While developments in rural regions should concentrate on already developed lands, developments in urban areas should conserve green spaces and preserve natural resources. Sites where environmental pollution complicates development should also be repaired by facilities. Sites have to be controlled to reduce pollution from storm water runoff and vehicles.

Water-saving effectiveness

Healthcare establishments are required to stop using potable water for landscape irrigation or for cooling medical equipment. The healthcare institution should simultaneously analyze water usage patterns over time and optimize the amount of drinking water that is available inside the facility.

Energy and the environment

The medical institution should set minimal requirements for energy efficiency, promote performance beyond these requirements, and track this performance over time. In addition, the facility needs to promote the usage of self-supplied and renewable energy sources while lowering energy consumption. Furthermore, the establishment ought to adhere to the Montreal Protocol about ozone depletion.

Resources and materials

Reduce the discharge of harmful substances linked to construction materials that bioaccumulate and do away with the usage of building products containing mercury. Recycle materials for production, recycle reusable items to the proper locations, and dispose of hazardous trash in accordance with legal requirements.The state of the environment. To improve occupant comfort and reduce potentially hazardous indoor air pollutants, use natural ventilation. Reduce the quantity of furniture that emits air pollutants and the level of disruptive noise in the vicinity of the facility.

Create initiatives that provide incentives to design teams and projects that surpass the Green Guide for Health Care's performance benchmarks.Reduce the possibility of hazardous spills and airborne pollutants, as well as the exposure of building occupants to PCBs and the byproducts of PCB combustion. Restrict the quantity of pharmaceutical waste that is discharged into sanitary sewers. Implement recycling and minimum reduction initiatives. Through reuse, reduction, recycling, and composting, less solid waste will end up in landfills and incinerators. Cut down on medical waste by modifying work procedures and enhancing segregation.Services related to the environment. Create groundskeeping procedures that improve the property's ecological integrity. Minimize your exposure to chemical and physical risks. Restrict the quantity of vehicle traffic to mitigate the consequences of pollution and land development.

Universities who use the College Sustainability Report Card get comparable benefits from the Green Guide for Health Care. The recommendations provide hospitals specific goals to aim toward and make it possible for medical facilities to monitor their progress over time. Additionally, the Green Guide is a great resource for marketers looking to promote their products to hospitals. In the health care sector, marketers that can demonstrate how their solutions complement building and operations requirements will have an advantage in gaining market share.

Lodging & Hotels

Eight percent of the energy used in the services sector is used by the hotel and motel sector. With over 195 million employment and 10.2% of the global GDP, the hotel sector is one of the biggest employers in the world. Furthermore, the business estimates $685 billion in capital investments annually. By 2020, it is expected that the number of tourists will exceed 1.56 billion, and the hotel sector would need to increase the number of units it offers to meet this demand. Industry players understand that building new hotels has to take sustainability concerns into account. The hotel business acknowledges the need to improve sustainability, although many of the operational efforts have been made by different hoteliers on their own.63 Two initiatives that aim to reach an agreement about sustainability initiatives are the International Business Leaders Forum and Green Globe certification.

To assist developers, investors, planners, and hotel owners, the IBLF and Conservation International created a strategy in 2005 for incorporating sustainability into hotel design and development. Nine of the top hotel companies in the world Accor, Carlson, Four Seasons, Hilton, InterContinental, Marriott, Rezidor SAS, Starwood Hotels & Resorts Worldwide Inc., and Taj Hotels Resorts and Palace collaborated to design this concept. Site selection, building design, and construction are the main topics of this plan. Important elements of the strategy include:Site and design for sustainable construction. Architectural features like site location, passive solar design, day lighting, renewable energy, water conservation, and landscaping are all examined in terms of design considerations. The plan also looks at environmental factors related to windows, insulation, and other construction materials. Additionally, resource-

efficient appliances and technology are required by the design.Reuse of already-existing structures. The plan acknowledges that existing properties should be repaired and retrofitted wherever possible rather than being built from scratch. Reusing existing resources should be considered when leveling constructions[7], [8].

Environmentally friendly building practices. Ensuring that alterations to original plans do not compromise the sustainability aspects of the design or lower energy efficiency is a crucial aspect of sustainability in construction. At all costs, the site's environmental integrity must be protected. The location must also be a tidy and secure area to operate.While the IBLF plan offers direction for real estate development, it is not a certification that hotel establishments may pursue. On the other hand, IBLF logic and additional industry documents are integrated into the third-party Green Hotel Certification. The Green Globe certification is an impartial acknowledgement of environmental initiatives that compares properties to the most stringent global standards. Its goal is to instill and reinforce social and sustainable practices at all management levels in the hotel sector. Energy efficiency, greenhouse gas emissions, water conservation, waste management, facility management, policy and governance, purchasing, community, destination protection, conservation and management, and cultural and social issues are all reviewed for the Green Globe certification.

Synopsis and Introduction: Carbon Emissions Contributed by the Service Sector

An overview of energy use in the services industry is given in this chapter. Service companies, educational institutions, prisons, religious organizations, and fraternal clubs are all part of this economic sector. Globally, the service industry is responsible for 12% of carbon emissions and 9% of total final energy consumption. For services, fuel oil, natural gas, and electricity are the three main energy sources.

Selling Non-food Items

All forms of retail buildings other than food retailing are included in the mercantile segment of the services industry, which also includes enclosed malls, strip shopping centers, auto dealerships, liquor shops, and video rental businesses. Producers and suppliers of inputs are looking more and more for strategies to improve sustainability without raising the expenses of logistics related to selling to retailers. The control of energy use at a retail site is the process element of non-food commerce. Both big and small shops have put in place initiatives meant to cut energy use without detracting from the shopping experience for customers.

Retailing Food

The structures utilized for food and beverage preparation and sales are referred to as the food service component. Fast food outlets, cafeterias, and restaurants are housed in these structures. Companies competing in this industry are looking for strategies to lower operational expenses, waste management costs, and fuel input prices since food marketing has a significant energy intensity. Grocery shops, food markets, convenience stores, and other establishments that sell food at retail or wholesale prices are referred to as food sales structures. Businesses in this sector may reduce their carbon footprints by buying locally produced and sustainably farmed goods. By replacing outdated equipment with more fuel-efficient models, they may further reduce their energy emissions.

Administrative and Office Buildings

Green design and office equipment operations are two ways that commercial businesses are trying to keep their energy costs under control. The creation and upkeep of structures that are

considerate of the environment, energy and resource consumption, cost-effectiveness, workplace quality, and the wider community is known as "green design." Office equipment is the second aspect of energy conservation that is most often linked to office buildings. The Green Electronics Council was founded by the International Sustainable Development Foundation to assist in the efficient design, production, usage, and disposal of electronic equipment.

Educational Establishments

Buildings used for academic or classroom training are known as educational institutions. The College Sustainability Report Card, published by the Sustainable Endowments Institute, assesses how well colleges and universities are doing in terms of administration, energy and climate change, food and recycling, buildings and construction, endowment transparency, investment priorities, and shareholder engagement[9], [10].

Medical Care

Health care institutions may find standards about building concerns such as integrated design, sustainable sites, water efficiency, energy and atmosphere, materials, environmental quality, innovation, and design in the Green Guide for Health Care. Environmental services, chemical management, waste management, water conservation, energy efficiency, and trash management are all taken care of in the facility's continuing operations. Hotels and hotel Companies in the hotel sector may raise the bar for sustainability by employing sustainable building practices, properly planning and designing new construction sites, and renovating and repurposing old buildings.

CONCLUSION

Educational establishments, ranging from schools to universities, represent a significant segment of the services sector, both in terms of their contribution to economic growth and their energy consumption. With a growing emphasis on sustainability, these institutions have been increasingly adopting energy-efficient technologies and practices to mitigate their environmental impact and reduce operational costs. By focusing on areas such as lighting, heating, cooling, and operational improvements, educational establishments have made significant strides in enhancing energy efficiency. Moreover, through educational programs and initiatives, they are instilling a culture of environmental stewardship among students, faculty, and staff, thereby empowering future generations to become responsible global citizens. As educational institutions continue to prioritize sustainability, they are not only reducing their own energy consumption but also serving as role models for other sectors, contributing to the broader goal of shaping a more sustainable and energy-efficient future for all.

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CHAPTER 5

A GLOBAL PERSPECTIVE ON EFFICIENCY, MARKET TRENDS, AND ENERGY CONSUMPTION IN TRANSPORTATION

Dr. Girish Chhimwal, Assistant Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id- girish.chhimwal@muit.in

ABSTRACT:

This study delves into the global trends and advancements in high-speed rail transportation and its implications for energy consumption and environmental concerns. It examines the success of high-speed rail systems in various countries, highlighting their superiority over air travel in terms of cost, time efficiency, and environmental impact. Furthermore, the study explores the shifting landscape of transportation energy consumption, emphasizing the rise of road travel and its contribution to energy use and carbon emissions. It discusses the challenges and opportunities associated with alternative transportation technologies, focusing on the evolution of diesel engines and hybrid vehicles. Overall, the study provides insights into the complex interplay between transportation modes, energy consumption, and environmental sustainability on a global scale.By prioritizing energy efficiency, reducing reliance on fossil fuels, and embracing alternative transportation modes, we can pave the way towards a more sustainable and environmentally friendly transportation system for future generations.

KEYWORDS:

Countries,Energy,Market, Transportation, Vehicle.

INTRODUCTION

The Russian experience is in line with other markets where high-speed trains, at distances of up to 600 miles between large cities, have decisively outperformed airlines in terms of cost, total journey time, and convenience. Utilizing electricity also gives you the chance to employ regenerative energy sources. The advantages of this mode of transportation led to the elimination of most commercial flights between Paris and Lyons with the building of a high-speed rail connection. Comparably, the air travel market for the Madrid-to-Barcelona high-speed connection was reduced by about 50% in a single year.

The amount spent globally on railroads, tracks, and equipment is predicted to reach 122 billion in 2009, an increase of 18% from 2004. Furthermore, projections indicate that this amount will increase to 150 billion by 2016, driven by stimulus projects and environmental concerns. High-speed trains are already in use in Japan, France, Germany, Spain, Britain, Italy, Taiwan, Korea, and China. In 2010, Spain aims to surpass Japan as the country with the greatest network of high-speed links worldwide, although China and India are expected to overtake Spain soon. By 2020, France intends to expand its high-speed rail network to a distance of around 2,500 miles, while Denmark is redistributing money for public transit from roads to rail. The top four suppliers to this market are Bombardier, Siemens, Hitachi, and Alstom. In addition to developing locomotive freight trains, General Electric is dedicated to meeting the needs of the high-speed passenger train industry.

It's interesting to notice that Siemens anticipates stopping at American platforms very soon with the Sapsan. A commitment of $13 billion over five years has been made by President Barack Obama to construct high-speed train connections between key cities. The economic

stimulus proposal includes eight billion dollars. Eleven routes have been recognized by the US Department of Transportation as potential competitors for high-speed rail service between air and intercity automobile travel. Siemens Sapsan, for instance, is a contender for the 2020 opening Los Angeles-to-San Francisco route [1], [2].

The market for high-speed rail travel is always changing, which demonstrates how the transportation industry's energy consumption is shifting. An overview of the importance of transportation in global energy consumption is provided in this chapter to help readers better comprehend this energy use. We first discuss how energy is used in transportation, and then we go over how energy is used in both passenger and freight transportation. During the process, we talk about initiatives to improve alternate forms of transportation's fuel efficiency. First, we describe the personal transportation vehicles that account for the majority of fuel use in this macroeconomic sector. We next go over the projected and actual levels of public transportation. We also describe the energy use in freight transportation.

Twenty six percent of global energy consumption and out of which twenty five percent both direct and indirect carbon emissions are attributed to the transportation sector. In the last 15 years, transportation has had the strongest macroeconomic growth, with energy consumption rising by 37% to over 75 exajoules annually. Rising energy use is correlated with rising carbon emissions, which now exceed 5.3 gigatons annually. The major energy consumer and primary cause of the rise in transportation energy consumption is road travel, which accounts for 89% of energy usage for both people and freight. While the energy used for driving has climbed by 41% over the same time, the energy used for alternative forms of transportation has only increased by 13% since 1990.

There is a strong correlation between geographic location and the rise in energy use. The demand for energy usage has increased by 30% among Organization for Economic Cooperation and Development countries since 1990, whereas it has increased by more than 55% outside of the OECD. Many countries have seen significant economic expansion, which has raised personal income and increased the ownership of automobiles. Furthermore, the increased need for freight transportation is a result of the income growth. A few of these themes are shown by the Chinese economy. Even though there were essentially none at all 15 years ago, by the end of 2007, there were over 15 million privately owned cars in China.7 In 2000, the Chinese started actively promoting consumption as a means of counterbalancing their export-driven economy, and buying cars was highly encouraged.

It's interesting to note that Chinese consumers have bought a wide range of automobiles, including pickup trucks, sedans, and sport utility vehicles. Ownership of bigger automobiles is encouraged by both customer preferences and government incentives. Since these vehicles are usually outdated and filthy, several cities forbid automobiles with engines less than one liter from accessing their downtown areas. Certain towns prohibit smaller automobiles from using expressways on the grounds that their fast speeds put their occupants in danger. Larger cars are also linked to consumer preferences. Chinese cars are often a little bit longer than American cars because many drivers desire to seem affluent enough to hire a chauffeur. As a result, sport utility vehicles, passenger vans, and bigger automobiles have been successfully marketed by Volkswagen, Audi, Honda, and General Motors. Buick's largest market is China, where sales of the brand were 332,115 in 2007 as opposed to 185,791 in the US.

While energy consumption and carbon emissions worldwide must be taken into account in any endeavor to reduce energy usage, comprehensive data for the transportation industry is now unavailable. Consumption patterns are changing at a rapid pace in developing countries, as the Chinese example shows. It is projected that after 2010, the developing world's

greenhouse gas emissions will surpass those of the developed world. However, detailed information on all forms of transportation is only available for the 18 nations that are members of the International Energy Agency. These nations are: Japan, the Netherlands, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, Australia, Austria, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, and the United States.The energy used in freight and passenger transportation is included in the transportation industry. While all transportation demands and related technology share similarities, there are differences in the chances to achieve energy reductions across the transportation sectors[3], [4].

Individual Transportation Modes

The energy used for passenger transport was 30 exajoules in 2005, a 24% increase from 1990. The transportation of passengers generates more than 2.1 gigatons of carbon emissions. 87% of energy usage is attributed to transportation by vehicle. Together, passenger ships, buses, and rail make about 3% of the total energy used; the remaining 10% is attributed to domestic air travel.

These developed economies all have a high share of vehicle travel. Among the nations examined by the International Energy Agency, car travel makes up at least 75% of passenger transport, with the exception of Japan. In all the nations included in the research, 82% of passenger kilometers were accounted for by car travel in 1990 and 2005. Air travel has climbed by 2.7% year since 1990, whereas per capita gains in vehicle passenger travel have increased by an average of 1.1% annually. Even while the volume of car travel has increased, advancements in auto efficiency have also coincided with these increases. However, since 1990, there has been a 23% rise in auto-related carbon emissions linked to greater energy demand for passenger transportation. Because they drive longer distances and have bigger, heavier cars, Australia, the US, and Canada have the highest carbon emissions. Conversely, nations with denser populations and lower per capita travel rates include the Netherlands and Japan.

DISCUSSION

Political goals and the gas economy have sometimes clashed since the oil crisis of 1973–74. This embargo sent the message that nations should use oil sparingly and look for alternate energy sources. Congress mandated in the 1975 Energy Policy and Conservation Act that fuel efficiency be doubled to 27.5 miles per gallon by 1985 in the United States.10 These ratings are known as corporate average fuel economy requirements. Automobile ratings are greater than those of light trucks and sport utility vehicles.

Despite a rise in energy efficiency, President Reagan reduced it to 26 miles per gallon. Very few changes to these fuel requirements were made in the United States during the next 20 years. Congress has debated on occasion on the best way to encourage conservation initiatives. Improvements to the corporate average fuel efficiency have been considered as alternatives to increasing gasoline taxes, but the U.S. government hasn't taken much action in this regard so far.11 In 2003, Chinese fuel economy regulations surpassed those in the United States. Congress did not raise the US speed limit to 35 mph until 2007, and even then, it will not go into effect until 2020. The 35 miles per gallon US requirement is comparable to those that are now in effect in Europe and Japan.

The energy used has been rising, yet less energy is being utilized per passenger kilometer. Although there is an increase in travel, technology has made it possible for individual forms of transportation to use less fuel. Car ownership affects energy use in a similar way. Over the last 15 years, the proportion of cars owned has grown in the majority of IEA countries, and

greater per capita auto energy consumption is often linked to rising car ownership. The distance each automobile travels is referred to as its utilization. The number of families owning more than one automobile has increased, yet car utilization has decreased. Travel per vehicle decreases and trips are spread across automobiles when houses have numerous cars. Utilization and car ownership determine the overall distance traveled per person. Reductions in automobile fuel intensity were insufficient in the majority of IEA countries to counteract rising vehicle ownership and use. Thus, in the majority of IEA nations, per capita automobile energy usage grew. Canada, Finland, Germany, Norway, and the United Kingdom were the exceptions to this rule.

Recognizing that it takes time to change transportation energy consumption is essential to efforts to decrease emissions in the transportation sector. For instance, new airplanes normally remain in service for 20 to 35 years, whereas cars and light vehicles typically have a 15-year lifespan. Approximately every eight years, passenger automobiles undergo a full redesign; yet, the necessary technologies are in place three years before the car is introduced to the market. Therefore, it might take up to ten years for new technology to be completely implemented into production. Retail marketing also has to introduce new fuel technologies to the market.

Since automobile use continues to dominate the transportation industry, it is important to think about strategies to cut down on consumption. These methods include using public transit more often and making adjustments to personal transportation gadgets. Diesels, hybrids, and improved gasoline technology are examples of personal, motorized modes. Alternative technologies to gasoline have been suggested, but they are not yet accessible at a cost that would allow them to gain a significant portion of the market. Market to market, the share of each technology—diesel, gasoline, and hybrid—varies significantly. In Europe, diesel engines have a strong market share, despite the fact that the North American market is still dominated by gasoline engines[5], [6].

Diesel

Rudolph Diesel created the diesel engine in the 1880s as a replacement for gasoline and steam engines. Over time, both diesel and gasoline engines advanced, but for a long while, the choice between the two types of engines remained straightforward. Twenty years ago, diesel engines emitted a lot of soot even though they were more fuel-efficient than gasoline engines. They also provided less pickup than gasoline engines and were loud.

Examining the fundamental functions of each engine is important to understand the benefits of diesel over gasoline. Internal combustion engines, such as gasoline and diesel engines, both make use of the same cylinder engine block with pistons. For the two engines, there are differences in the combustion process. In a gasoline version, a sparkplug is used to ignite a combination of gas and air that the engine has compressed. Diesel engines don't need spark plugs since the high temperature produced during compression ignites the gasoline. Diesel fuel provides more energy per gallon than gasoline because it is a heavier and less volatile blend of hydrocarbons. Diesel engines run leaner, burn fuel more quickly, and have greater compression ratios. As a result, diesel engines use less fuel and have a higher thermodynamic efficiency than gasoline engines.

Over the last 15 years, diesel technology has advanced significantly, making these new cars a competitive option to gasoline-powered engines. The high sulfur content that the engines create has been the initial problem with diesel. Oil refiners were mandated by the U.S. Environmental Protection Agency in 2006 to manufacture clean diesel fuel with sulfur contents no more than 15 parts per billion. This requirement represents a 98% improvement

over diesel production during the 1970s. As a consequence, sulfur dioxide pollution is significantly reduced, and improved engine efficiency and less acid rain are caused by reduced sulfur levels in the atmosphere. Additionally, sulfur and other dangerous nitrogen oxide chemicals are removed by the exhaust systems.

The soot these engines emit has been a second issue with diesel. Particulate matter, or diesel soot, is a combination of solid and liquid materials consisting of inorganic, hydrocarbon, and carbon particles. According to the American Lung Association, deaths from respiratory and cardiovascular reasons, such as strokes, an increased risk of heart attacks, lung tissue inflammation, and worsened asthma episodes, have been related to brief increases in particulate matter exposure. Extended exposure has been linked to a higher risk of hospitalization for asthma, impaired lung function development in children and adolescents, lung damage to the small airways, an increased risk of heart attacks and strokes, an increased risk of lung cancer death, and a greater risk of cardiovascular disease death. According to U.S. EPA estimates, over 4,700 premature deaths take place annually in just nine cities under analysis. New diesel motor exhaust systems make sure that only permissible levels of soot are released into the atmosphere. These improvements are shown by the exhaust system for selective catalytic reduction. The exhaust is first passed through a diesel oxidation catalyst, which reduces the amount of carbon monoxide and hydrocarbons. The exhaust flow is sprayed with a urea-based solution in the next stage. The urea is converted to ammonia by the hot exhaust air, which then combines with nitrogen oxides in the SCR to produce harmless nitrogen gas and water vapor.

These improvements round out other built-in benefits of diesel power. Diesel fuel has many benefits, one of which is its ability to be refined from different sources. In addition to being produced from biowaste, crude oil may also be used to make the fuel. Methyl esters and glycerin are produced chemically during the process of turning fat or vegetable oil into biodiesel. Soybean oil is the primary ingredient used to make biodiesel in North America, but rapeseed oil is more often used in Europe. Biodiesel is primarily aromatic and sulfur-free, nontoxic, and biodegradable.

Not to be overlooked are diesel engines' performance benefits. These engines' greater compression ratios allow for a greater amount of energy to be extracted from the mixture of fuel and air, and the automobile also has comparatively superior power than one with a gasoline engine. Engines with a greater compression ratio need heavier crankshafts and connecting rods, but they also last longer because of their robust construction and low coefficient of friction. These engines can run for far over 200,000 kilometers on a regular basis. For instance, automobiles that reach the 250,000, 500,000, 750,000, one million-kilometer, and one million-mile milestones are eligible for Mercedes-Benz's High Mileage Awards. The current high mileage champion is Greek cab driver Gregorios Sachinidis, who has driven his 1976 Mercedes-Benz 240 diesel over 2.8 million kilometers.

This engine has had a renaissance due to the updated fuel systems, improved exhaust mechanisms, improved fuel injection operations, and inherent physical benefits. Western Europe has been the diesel's original market. For the first time in this area, diesel engines surpassed gasoline engines in sales in 2006. In 1998, the diesel engine constituted less than 25% of all vehicle sales; yet, within a decade, its market share quadrupled. As a result, the majority of American, Japanese, and European automakers provide a variety of diesel alternatives in Europe, and these new diesel models are spreading to a wide range of other markets[7], [8].

New diesel engine technology was being reintroduced into the US market around the beginning of 2009. California's tailpipe regulations are the strictest in the nation, and 16 other states have either adopted them or declared their intention to do so. Mercedes-Benz, BMW, Honda, and other manufacturers have introduced new diesel technologies that now comply with California regulations, allowing them to be sold across the entire American market. However, these automobiles only account for less than 3% of the market.

The Volkswagen VW Jetta TDI is a prime example of the difficulties in marketing these new cars. The TDI delivers about 50% more power, 25% fewer greenhouse gas emissions, and 30% better fuel efficiency than its gasoline version. The company may be able to capture market share in the midsize sedan product class if it can educate customers about the automobiles' financial and environmental benefits.VW has to deal with concerns about quality perceptions, availability of gasoline, and pricing. Diesel cars cost more since their components are heavier and cost more money. The Jetta TDI is eligible for a tax credit even if its list price is greater than that of the SE model.24 The purchase price of this automobile is not much different even though certain options on diesel cars are more costly than those on gas-powered equivalents. Furthermore, it is anticipated that the diesel vehicle's resale value would be high; however, there is currently no North American benchmark for comparison.

The supply and price of diesel fuel are the other major pricing challenge. Just 45 percent of the 175,000 gas stations in the US have diesel fuel. In addition, the cost of diesel fuel is greater than that of gasoline, and the market for diesel is growing faster. In the US, the average cost of gasoline was $1.69 per gallon in December 2008, while the average cost of diesel fuel was $2.45. As a result, the diesel owner pays more for gasoline, but the vehicle has superior performance and fuel economy. Additionally, the diesel engine will allow the driver to go farther on a single tank of petrol.Even while buyers certainly consider both the upfront and ongoing fuel expenses, a sizable segment of the public still has unfavorable opinions of diesel vehicles. These customers could have had Mercedes 240s or VW Golfs from an earlier diesel technology period. Changing consumers' opinions about this technology will be difficult. Producers like BMW highlight both the fuel economy and environmental benefits of their vehicles.

Blends

Despite modest sales levels, hybrid technology has garnered significant interest in North America. Diesel engines had a higher share of the market in 2007 with 2.6% than hybrids.25 Although most other manufacturers do not record substantial levels of hybrid sales, Toyota brags that 10% of their sales are related to hybrid vehicles. However, projections show that by 2020, sales of hybrid cars would make up 14% of the global automotive industry.

It is important to examine how these engines convert and store energy in order to comprehend the benefits of hybrid cars. Plug-in hybrids and conventional hybrid engines are examples of hybrid technology.An electric motor and fuel cells are two additional pieces of equipment in the hybrid system. The engine transfers energy to the drive train and electric motor at the moment of ignition. This energy is transferred to the fuel cells via the electric motor. The electric motor and gas engine provide the drive train with energy during acceleration. The fuel cells provide the energy while the car is cruising and the gasoline engine is not running. Lastly, the energy generated by using the brakes may be captured by the hybrid engine and stored in the fuel cells.

Comparing the typical hybrid versus gas-powered engines reveals both benefits and drawbacks. Firstly, compared to a standard gasoline engine, the hybrid's engine is much smaller. Larger engines consume more energy while idle, restrict acceleration, and need more

gasoline to move them. Lightweight materials are used throughout the automobile to compliment the lightweight engine, which also lowers energy use. Furthermore, the plug-ins benefit from reduced rolling resistance tires and improved aerodynamics that enhance fuel economy.

Although the hybrid engine performs better than the gasoline engine, many users are not motivated to use it. Three distinct niche markets for hybrid vehicles are identified by auto industry analysts. Those who are motivated by a product's ecological advantages are known as environmentalists. The main reason a second set of buyers purchases them is to make a fashion statement. The third segment consists of consumers who set aside money for petrol and do the necessary math to figure out whether to buy environmentally friendly or economically.

Along with the benefits of a hybrid, a plug-in hybrid lets its owner get energy from a power outlet instead of the car's gasoline engine. The hybrid may operate without using fuel for a certain amount of time when it is connected to the power outlet. For instance, the 2009 Ford Escape plug-in can go up to 30 miles solely on battery power thanks to its high-voltage lithium-ion batteries. Although plug-in technology is still in its infancy, its benefits for fuel economy are already significant. The plug-in hybrid gets 67 miles per gallon on average, compared to 42 miles per gallon for the Toyota Prius. The plug-in gets 53 miles per gallon on average when the cost of refueling batteries is taken into account[9], [10].

The present version of this technology has several significant drawbacks. First, the vehicle's weight capacity is reduced due to the increased battery use, making it possible for four or five individuals to overburden it. Secondly, the present expense of converting a hybrid vehicle to plug-in mode might surpass $10,000. The normal Prius costs around 10 cents per mile to run at $4 per gallon of petrol; the plug-in Prius costs approximately 8 cents per mile. The plug-in's break-even threshold is 500,000 miles at this 2-cent difference. For many buyers, hybrid vehicles won't be cost-effective in the absence of rebates or tax incentives.

CONCLUSION

The findings of this study underscore the growing significance of high-speed rail as a viable alternative to air travel, particularly for distances of up to 600 miles between major cities. The success stories from various countries, including Russia, Spain, and France, demonstrate the economic and environmental advantages of investing in high-speed rail infrastructure. Moreover, the study highlights the urgent need for addressing the rising energy consumption and carbon emissions associated with road travel, especially in developing countries like China. As technological advancements continue to drive improvements in transportation efficiency, there is a critical opportunity to promote the adoption of cleaner and more sustainable modes of transportation, such as diesel engines and hybrid vehicles. However, overcoming barriers such as cost and consumer perceptions will be essential for realizing the full potential of these technologies. Ultimately, concerted efforts from policymakers, industry stakeholders, and consumers will be crucial in shaping a more sustainable future for global transportation systems.

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CHAPTER 6

COMPREHENSIVE STUDY ON ENERGY CONSUMPTION AND EFFICIENCY IN TRANSPORTATION: STRATEGIES, INNOVATIONS, AND IMPACTS

Dr. Girish Chhimwal, Assistant Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id- girish.chhimwal@muit.in

ABSTRACT:

Transportation plays a pivotal role in global energy consumption, accounting for 26% of the total energy usage. This study offers a comprehensive review of energy consumption in both freight and passenger transportation sectors, highlighting their significant impact on overall energy consumption. Various initiatives aimed at enhancing fuel efficiency in alternative transportation modes are discussed, underscoring the importance of embracing green marketing strategies to promote energy-saving practices.Focusing on individual transportation modes, the study reveals a notable 24% increase in energy usage for passenger travel since 1990. Efforts to reduce energy consumption have spurred innovations in gasoline technologies, hybrids, and diesel engines, alongside regional variations in market share and initiatives to improve fuel economy through driver education and traffic management.In the broader context, mass transportation modes such as buses, trains, and airplanes are examined, emphasizing the need to address climate impacts and improve operational efficiency. Advances in technology have led to significant reductions in energy intensity and emissions, with high-speed trains and bus rapid transit systems emerging as promising solutions for efficient and sustainable transportation. In the realm of freight transportation, efficiency gains are closely tied to advancements in heavy-duty hybrids, engine systems, idle reductions, and safety measures. The study emphasizes the importance of integrating safety improvements with energy efficiency initiatives for long-term sustainability in freight transportation.Moreover, the study explores strategies to improve fuel efficiency in gas engines, including technological advancements and driver education programs. Geographic positioning and ride-sharing initiatives are also discussed as potential methods to enhance fuel economy and reduce energy consumption in the automotive industry.This study underscores the critical role of transportation in global energy consumption and the urgent need for sustainable practices to mitigate environmental impacts. By implementing innovative technologies, promoting green initiatives, and integrating safety measures, the transportation sector can move towards a more energy-efficient and environmentally sustainable future.

KEYWORDS:

Energy, Efficiency, Industry, Safety, Transportation.

INTRODUCTION

Since transportation accounts for a significant portion, 26%, of global energy consumption, any comprehensive review of energy usage must include an examination of transportation systems. In our study, we provided an overview of the energy consumption associated with both freight and passenger transportation, shedding light on the considerable impact of transportation on overall energy usage. Throughout this analysis, we discussed various

initiatives aimed at improving fuel efficiency in alternative forms of transportation, underscoring the importance of embracing green marketing initiatives that promote energy-saving practices in transportation.

Turning our focus to individual transportation modes, it's evident that since 1990, there has been a notable 24% increase in the energy used for passenger travel. This growth has spurred significant efforts to reduce energy consumption in personal transportation systems. Innovations such as enhanced gasoline technologies, hybrids, and diesel engines have emerged as viable options, each with its own set of advantages and disadvantages. Moreover, there are discernible regional and national differences in the market share of these technologies. Additionally, initiatives such as expanded instructional programs for drivers, improved traffic patterns, and advancements in energy usage technology have contributed to boosting the fuel economy of car transportation.

Within the broader context of transportation, mass transportation modes like buses, trains, and airplanes play a crucial role. However, it's important to recognize that burning fossil fuels in the atmosphere has a net effect that is twice as impactful as burning them at ground level. Addressing the impacts of climate change on air travel necessitates considering both operational activities and the technical performance of aircraft. Fortunately, advancements in technology from manufacturers have led to significant reductions in energy intensity and emissions within the transportation sector. High-speed trains, for instance, offer a more efficient and environmentally friendly alternative to conventional rail systems, running on power that can be sourced from renewable sources. Bus rapid transit systems, integrating various components into a cohesive system, have also emerged as a promising solution, offering improved service quality in terms of punctuality and speed.

In the realm of freight transportation, efficiency gains are closely linked to advancements in heavy-duty hybrids, engine systems, idle reductions, parasitic losses, and safety measures. Engine system improvements aim to enhance thermal efficiency and reduce emissions, combining the benefits of internal combustion engines and electric motor drives in hybrid electric vehicles. Efforts to mitigate parasitic energy losses, stemming from inefficiencies in auxiliary activities and aerodynamics, are also underway. Furthermore, initiatives to reduce gasoline usage, noise, and particulate matter emissions from idling are being pursued, recognizing that idling can occur for extended periods each day. Safety considerations, such as crash avoidance technology and advanced braking systems, are also paramount in freight transportation to ensure safe and efficient operations[1], [2].

Improved Fuel

It's not necessary to switch to gas engines for consumers who want to increase fuel economy. Buying automobiles with updated fuel injection systems, using ethanol, and acquiring smaller-engine cars are all cost-effective ways to increase fuel economy. Purchasing a smaller car with much higher fuel economy may seem like a no-brainer when it comes to improving fuel efficiency. The majority of automakers are releasing more fuel-efficient gasoline-powered vehicles into the market as a result of the government's growing average fuel efficiency regulations. For instance, the BMW Mini Cooper costs $19,200 on the list and gets 32 mpg in the city. With a quoted price of $33,600, the base BMW 328i series gets an average of 19 miles per gallon. Therefore, switching to a smaller car is one approach to reduce expenses and one's environmental impact.

Examining the kind of fuel that new cars utilize is a similar choice. Cars that operate on ethanol or gasoline alone are known as flex fuel vehicles.A renewable fuel derived from agricultural feedstocks is ethanol. When ethanol is used instead of gasoline, pollution and

smog-forming emissions may be cut by up to 50%. There are several restrictions on ethanol use notwithstanding the emission limits. The supply of food is decreased when maize is used for fuel rather than food, but the quantity of energy is not necessarily increased in the process. To create less than 4% of the demand for motor gasoline, for instance, the United States consumed 20% of its 2007 maize crop. Only in the Midwest region of the United States is ethanol readily accessible, and in certain places, its cost is higher than that of gasoline. Lastly, compared to a gallon of petrol, the gasoline and ethanol combination has less energy. As a result, while utilizing ethanol, these engines suffer a 20–30% reduction in fuel efficiency [3], [4].

To make gasoline engines more fuel-efficient, automakers are also improving them. With respect to equivalent conventional engines, Ford Motor Company's EcoBoost direct-injection technology promises 20% more fuel efficiency and better performance. Ford plans to reach 750,000 EcoBoost cars produced globally by 2012. Ford asserts that EcoBoost offers a better value than a hybrid or diesel vehicle, even at a premium that Ford has not revealed. Additionally, General Motors uses modern direct-injection engines in around 10% of its output worldwide. Naturally, a variety of technologies are being developed with the goal of improving vehicle fuel economy. Manufacturers such as GM, Mercedes-Benz, and others are working on gas engines that use homogeneous charge compression ignition technology. By accelerating the burning of gas at lower temperatures and minimizing part of the energy wasted during the combustion process, HCCI significantly improves fuel efficiency. The continued existence of gasoline engines will be made more feasible by this technology and other digital elements.

Educating drivers is one of the easiest and most economical ways to reduce energy use in the automotive industry. Despite the fact that numerous state programs in the United States teach new drivers about fuel economy, there is a noticeable decline in fuel efficiency, which is presumably caused by drivers' lack of interest and learning. A variety of tactics are listed in for drivers to adopt in order to minimize the quantity of gasoline their cars consume. It's important to note that government and automaker marketing campaigns may concentrate on educating drivers about fuel economy on a regular basis. According to estimates made in the 1980s, with the right vehicle selection, operation, and maintenance, fuel economy may be increased by 10%. Even while the benefits of conservation are acknowledged, many markets have not made significant efforts to provide ongoing driver education.

DISCUSSION

Geographic positioning is another tool that drivers may utilize to improve fuel economy. When a car has a GPS, the user enters the address and the device plots the route. These systems' operations and routing protocols exhibit a great deal of unpredictability, despite their capacity to plot the most economical path.However, GPS conserves energy by flagging incorrect turns and emphasizing locations that users may find interesting. Ride-sharing and carpooling initiatives are additional ways that the vehicle industry may save energy. Despite significant attempts to increase the number of shared rides, there are still over 10 trillion unoccupied seats during automobile journeys, and the average passenger count is only slightly more than one. High-occupancy vehicle lanes are one program that increases car occupancy. A number of states have reduced person-hours of travel without appreciably increasing vehicle-hours of travel by implementing these HOV on highways.

There is increasing agreement that the halfway point will be reached in the next five to twenty-five years, accounting for between one-fourth and one-half of the recoverable resources in conventional oil.Not only may individually forms of transportation reduce the

amount of oil used for transportation, but mass transit networks can as well. Nonauto transportation now makes up 13% of energy consumption across the 18 nations monitored by the International Energy Agency. Within this transportation, domestic air travel accounts for ten percent. Combined, passenger trains, buses, and passenger ships utilize around 3% of the energy produced. Mass transit system improvements are often the result of taking into account the connections between various forms of transportation rather than being solely attributable to advancements in one of them. Thus, the development of new technologies is not the only factor contributing to progress. In terms of passengers transported, ridership growth, transit speeds, and land development effects, these systems' efficacy and performance are evaluated.The process of incorporating new technology into transportation networks might take a long time. Highlight developments in rail, bus, and aviation technologies that might lower carbon emissions in the transportation sector in the section that follows. Think about plane travel first.

Air Transport

According to a recent assessment by the Intergovernmental Panel on Climate Change, aviation contributes 3.5% of all anthropogenic contributions to global warming and is expected to increase. Since 1970, air travel has grown in the US at a pace that averages more than 5% annually. On the other hand, since 1975, passenger miles per gallon for commercial aviation have increased by 150%. Improvements in energy efficiency are mostly to blame for this rise, but higher occupancy rates are also a factor. While the aviation sector is under pressure from municipal, federal, and international organizations to improve fuel economy, most efficiency improvements have been motivated more by financial gain than by legal requirements.

The peculiarities of flying add to the emissions. Oxygen and nitrogen make up more than 90% of the exhaust released by airplanes. CO_2 and H_2O make up around 7% of the exhaust, while NO_x, HC, CO, SO_x, other trace chemical species, and carbon-based soot particles make up the remaining 0.5%. It is believed that the sum of these gases is more than 1.5 times that of carbon dioxide alone. Around five to eight miles above Earth, the upper troposphere and lower stratosphere are where most airplane emissions are released. As such, burning fossil fuels at high altitudes has an effect that is about twice as great as burning the same fuels at ground level.

It is necessary to take into account both the operating activities and the technical performance of aircraft in order to reduce the consequences of climate change. Manufacturers' new technology have lowered energy intensity and emissions more than any other transportation system. These include of improved engine designs, improved structural efficiencies, and increased aerodynamic efficiency. For instance, Boeing pledges to increase the fuel economy of every new generation of commercial aircraft by a minimum of 15%. With the help of new engines, more lightweight composite material utilization, and contemporary aerodynamics. Dreamliner uses less fuel and emits less carbon dioxide [5], [6].

The carbon emissions of an airplane are also a result of its operations. Since 1950, airlines have raised the percentage of occupancy, or load factor, by 15%, and the number of seats on each aircraft by more than 35%. The relative cost of travel is reduced when there are more passengers on a plane. By cutting down on the amount of time that aircraft spend idle on the ground or in holding patterns in the air, airlines and airports may increase efficiency. Enhancements to air traffic management, according to the International Air Transport Association, have the potential to significantly lower carbon emissions and increase fuel economy. Boeing has created the Tailored Arrival concept, which reduces fuel consumption,

noise, and pollutants while increasing aircraft arrival efficiency via continual descent. According to preliminary tests conducted by Boeing, enhanced arrival procedures have the potential to reduce fuel consumption by up to 800 gallons every flight and save airlines up to $100,000 yearly on fuel expenditures per aircraft arriving at large airports. A speedy turnover at the gate is advantageous to airports and airlines alike. For instance, Southwest Airlines leverages its ability to make rapid decisions at the airport terminal to its advantage. Fast turnaround increases client satisfaction while reducing operating expenses. Technical and operational advancements are critical to the future of aviation. Air transportation has historically grown faster than energy consumption reductions, and research indicates that this tendency will hold for the foreseeable future.

Fast Trains

The Shinkansen high-speed train service, which began operating in 1964 between Tokyo and Osaka, Japan, marked the beginning of the high-speed train's global rise to prominence in the transportation industry.56 High-speed trains are a family of technologies that offer frequent, high-capacity railway services with an average speed of over 200 kilometers per hour. HSTs have been planned or put into use throughout the Middle East, as well as in South and North America, and have been extensively utilized in Asia and Europe. Trade-offs between compatibility and speed have been taken into account since the introduction of HST. The original Shinkansen HST reached speeds of over 200 km/h, but since the light rail system was narrowly designed, it needed special rails. To differing degrees, several systems created after the Shinkansen have made use of the current track. Although using the current track reduces implementation costs, it also reduces the returns from HST operations.

The cost-benefit analysis of a mode of transportation is context-specific and necessitates taking into account the interaction between modes of transportation, as we covered before in this section. However, there are a few noteworthy advantages connected to HST. These systems have been intended to improve capacity ever since they were introduced. The availability of an additional means of transportation temporarily expands the number of travel options. The long-term acceptability and capacity of HST are influenced by the prices of feasible alternative transport modes and travel circumstances. One additional noteworthy benefit is the shorter journey time in comparison to other train systems. Not only does the Shinkansen line attract tourists from trains, but it also attracts travelers from cars and airplanes. Rail travel between Osaka and Japan was cut from 7 hours and 58 minutes to 2 and a half hours. For instance, a study of the HST's potential to free up runway space at London Heathrow suggests that the HST could reduce travel times on ten of the routes that are currently served by the airport. If the airport converted to a rail station, the HST's replacement for air travel would remove roughly 20% of Heathrow's runway capacity.

The safety record of these train systems is the third major advantage of HST. These trains provide far higher safety records than any other native means of transportation in the majority of markets. For instance, in its 45 years of service, Japan's Shinkansen HST has not seen a single fatality. While earthquakes are common in Japan, these natural disasters have only sometimes caused derailments and have never claimed lives. Despite the fact that HSTs have many advantages, there are also some noteworthy environmental effects. Since the majority of HSTs are powered by electricity, emissions are tied to the sources of that energy. Noise, land conversion, air pollution, and climate change are all increased by HST activities in the area. The most dangerous pollutants associated with this are nitrogen oxides and sulfur dioxide. The environmental trade-offs between HST and other modes are still unknown, despite evidence suggesting that HST operations have less of an impact on the environment than those of cars and airplanes. This is because the environmental impact of HST and other

modes depends on infrastructure and how they interact with other transportation modes and services. The benefits of the HST rely on striking a balance between the quantity of passengers who use the tax as a replacement for driving or flying and the quantity of additional traffic that the tax creates [7], [8].

Swift Transportation

Despite a 20% rise in use since 1995, public transportation still only makes up 1% of all passenger miles. Bus rapid transit is one technological advancement that has received a lot of recent attention. Rubber-tired rapid transit, or BRT, integrates running ways, vehicles, stations, services, and intelligent transportation system components into a cohesive system. It has been adopted in South America, Europe, Australia, and more than 20 US and Canadian cities' urban planning plans have included BRT features and systems. BRT has many advantages. Firstly, there is flexibility in integrating these bus-based systems into the current transit lines. Rapid bus lines may be incorporated in crowded locations for comparatively less money than other transportation options like light rail. Second, BRT systems' digital operating systems improve service quality by delivering faster and more reliable performance on time.

For instance, the BRT line on Wilshire Boulevard in Los Angeles runs at a pace that is seventy-five percent quicker than local service. The deployment of BRT systems has also been linked to higher ridership. For example, bus usage increased by 40% in Brisbane, Australia, in the six months after the installation of a BRT system. Designers of rapid transit systems have also profited from incorporating some of the visually appealing elements of light rail systems into bus routes. BRT systems prioritize straightforward and uncomplicated routes. They also stress how user-friendly and permanent the routing is. It should come as no surprise that these attributes boost BRT's appeal to customers combined with its speed of transfer. When combined, these advantages help communities reduce their carbon footprints. Compared to driving an automobile, using the bus has a far less carbon impact per person. The footprint is reduced every time a person chooses to ride instead than driving.

The term "BRT" has been adopted by several applications with differing benefits due to its popularity. One such application is the Orange Line in Los Angeles, which combines all the features of a full-scale BRT system, such as dedicated bus lanes with intelligent transportation systems, full-scale stations, low floor/level boarding, branded vehicles, and off-vehicle ticket vending. Partial BRT systems, on the other hand, operate some of their routes in designated transit lanes and some of them on municipal streets. They provide the majority of the features and benefits seen in complete BRT systems. For instance, single-bidirectional dedicated lanes are combined with in-traffic operations on Cleveland's Euclid Busway. Other rapid bus systems are essentially express buses and do not leverage the majority of BRT's advantages. They may use sophisticated transportation technology, but they don't use designated lanes for traffic.

To guarantee patronage, BRT introductions need to be supported by relevant marketing campaigns. These BRT systems must to have a distinct and recognizable brand identity. As an example, the Lymmo system in downtown Orlando is a BRT system that runs under the Linx transportation initiative of the city. The visually appealing and unique wording on the Lymmo signage sets the system apart from other transportation systems. Consistent use of logos, color schemes, and visuals on cars, stations, and printed materials may also help BRT systems increase passenger recognition and utilization. As a result, the Orlando Lymmo buses continuously employ the Lymmo emblem and unique colors across their routes. Public education, innovative services, and price incentives should all be a part of promotional

initiatives. Orlando's Lymmo offers information that connects the BRT system to destinations and other forms of transportation. Furthermore, advertising materials stress that this system is free for customers.

BRT's entrance to Orlando has brought about a number of advantages. The downtown area has less traffic and parking demand, which benefits the city. In addition to promoting more transit usage, Lymmo has improved accessibility and mobility to important downtown locations. Additionally, BRT has improved the way the general public views Orlando's downtown and made more room for downtown development possible.

Transportation of Freight

Among the eighteen nations within the International Energy Agency's purview, freight accounts for thirty percent of energy use in the transportation sector. The amount of energy used for freight transport was 18 exajoules, which was 27% more than in 1990.70 Transportation of goods by pipeline, rail, air, sea, and highway is included in freight. Oil is by far the most popular fuel for conveying freight, accounting for 99% of the total final energy use. Diesel fuel makes up the majority of this fuel. 87% of trucks and 88% of rail transit use diesel fuel. Fuel oil and diesel fuel are used by ships to transport goods across waterways. Since freight transportation by pipeline, rail, and water is comparatively energy-efficient, our research concentrates on the highway industry.

Light, medium, and heavy-duty trucks are used to move freight over roadways. Utility vans and step vans are examples of light trucks, whereas walk-in trucks, city delivery trucks, school buses, and beverage delivery vehicles are examples of medium-sized trucks. Light truck energy usage increased more quickly between 1990 and 2000 than any other mode. The combined annual fuel consumption of light and medium-sized trucks is about 26.8 billion gallons. Refuse trucks, dump trucks, cement trucks, and regular semi-trailers are examples of heavy-duty automobiles. An estimated 10.6 billion gallons of gasoline are used annually by these vehicles. The energy needed to convey one ton of freight has decreased by half since 1975. Engine systems, heavy-duty hybrids, parasitic losses, idle reductions, and safety concerns all contribute to increased freight transportation efficiency. Engine systems are closely linked to emissions, safety, pollution, and reliance on oil. Reducing pollutants and increasing engine operating efficiency are the two main objectives of engine systems. NOx and particulate matter have dropped by 85% and 95%, respectively, during the last 20 years. Modern highway vehicles have a 42% thermal efficiency, which means that 58% of the energy used does not go into mechanical labor. By 2010, the United States wants to reduce NOx and particulate matter by a further 83% while also boosting thermal efficiency by 20%.

The second engine-related project is the use of hybrid electric cars. Two power sources are integrated in heavy-duty hybrid trucks to provide the necessary power to move the vehicle. HEVs use an internal combustion engine and an electric motor drive to combine the benefits of both propulsion systems. A battery pack that functions as a supplementary energy storage device power the electric tractor. Additionally, the HEV is capable of absorbing brake-related energy and storing it in the fuel cells. Only 10 to 15% of the energy in gasoline is transferred to traction in a normal car; this figure might reach 30 to 40% in a hybrid. This efficiency gain lowers pollutants and improves fuel economy. Unfortunately, heavy hybrid technology has not kept up with improvements in passenger cars, and more study is necessary before commercialization [9], [10].

The capacity to cut energy usage is influenced by the operational activities related to a vehicle. Not only can large trucks serve as a mode of transportation, but they also serve as the residences of drivers who travel the country. Energy losses resulting from aerodynamics,

auxiliary processes, and other activities are together referred to as parasitic energy losses. When combined, these restrictions represent 40% of the energy that large vehicles use. Reductions in parasitic energy loss are facilitated by improved technology that set energy consumption limits. Although trucks' aerodynamics and rolling resistance may be improved, the cargo area's rectangular form poses a major limitation. The on-board amenities, lighting, and heating are examples of auxiliary operations. These auxiliary actions support the reduction of idle time as well. Long-haul trucks sometimes spend more than six hours a day in the idle position. During this idle period, gasoline is used, particulate matter is produced, and noise levels are increased. Technologies that lower the power needs for these procedures may lower the energy cost of auxiliary functions. Furthermore, idling time may be decreased with improved freight scheduling, innovative idling technologies, and vehicle shutdowns.

Alongside other measures to improve energy efficiency, safety improvements are crucial to attracting and keeping skilled drivers. Advanced braking technologies, stability controls, lane-tracking systems, and video-based visibility systems all improve the chances of avoiding crashes and surviving them. Considering that many safety improvements make vehicles heavier and less aerodynamic, their implementation may conflict with other efficiency objectives. For this reason, long-term sustainability issues depend heavily on effective coordination between safety and energy efficiency.

CONCLUSION

This study provides a comprehensive analysis of energy consumption and efficiency measures in transportation sectors, emphasizing the need for sustainable practices to address environmental concerns and reduce energy consumption. From individual transportation modes to mass transit systems and freight transportation, various initiatives and advancements have been explored to enhance fuel efficiency and minimize environmental impacts.Efforts to improve fuel economy in gas engines through technological innovations and driver education programs offer promising avenues for reducing energy consumption in the automotive industry. Similarly, initiatives such as geographic positioning and ride-sharing can contribute to lowering energy usage and promoting sustainable transportation practices.Moreover, advancements in mass transportation modes, including high-speed trains and bus rapid transit systems, demonstrate significant potential for reducing energy intensity and emissions. Integration of safety measures with energy efficiency initiatives is crucial for ensuring long-term sustainability in freight transportation.Overall, by embracing green marketing strategies, promoting technological innovations, and implementing effective policies, the transportation sector can play a pivotal role in achieving global energy sustainability goals. It is imperative for stakeholders to collaborate and invest in sustainable transportation solutions to mitigate environmental impacts and create a more resilient and energy-efficient transportation system for future generations.

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CHAPTER 7

GREEN MARKETING INITIATIVES AND SUSTAINABILITY MEASURES IN THE INDUSTRIAL SECTOR

Dr. Girish Chhimwal, Assistant Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id- girish.chhimwal@muit.in

ABSTRACT:

The Steel Day initiative underscores major transformations within the industrial sector, particularly focusing on green marketing initiatives and sustainability efforts. This study provides an overview of energy consumption and carbon emissions in key industries, with a specific focus on the steel sector. The analysis identifies sectors with the highest energy consumption and potential for carbon emission reduction, emphasizing global initiatives aimed at enhancing industrial sustainability. Detailed insights are provided into the production processes of steel, nonmetallic minerals, and chemicals, highlighting energy-intensive stages and opportunities for efficiency improvements. The study also examines initiatives to reduce carbon emissions, improve material efficiency, and promote recycling within these industries. Overall, the research underscores the importance of adopting eco-efficient practices to mitigate environmental impacts and enhance sustainability in the industrial sector.

KEYWORDS:

Carbon, Steel, Industry, Industrial, Production.

INTRODUCTION

The Steel Day initiative highlights a few of the major transformations occurring within the industrial sector. We provide a summary of the green marketing initiatives related to this sector of the economy in this chapter. Effective control of energy consumption and carbon emissions may provide significant benefits, since this sector constitutes one-third of the total energy use. As a result, we start by summarizing a few of the sectors in this sector that exhibit the highest energy consumption and the greatest potential for carbon emission reduction. We then go on to discuss global initiatives aimed at improving industrial sustainability. Let's start by thinking about the major industrial contributions to climate change.The International Energy Agency found significant opportunity to cut emissions in a recent assessment of energy use in the industrial sector. Globally, industry is responsible for 33% of energy use and 36% of carbon emissions. Even while industrial efficiency has increased significantly, the IEA forecasts that the industrial sector may still save between 600 and 900 million tons of oil equivalent. Furthermore, 7 to 12% of world emissions, or 1.9 to 3.2 gigatons of carbon dioxide, have been eliminated in carbon emissions.

Industries differ significantly in terms of energy use and carbon emissions. Shows that the petrochemical and chemical sectors utilize more energy than any other industry. Chemical products need a significant quantity of energy as feedstock, despite the fact that chemicals are linked to the greatest energy use. For instance, gasoline contains a significant amount of the oil needed to refine vehicle fuel. Moreover, significant energy consumers include the chemical industry, the iron and steel sector, and the nonmetallic mineral industries.The chemical and petrochemical, nonmetallic mineral, and iron and steel sectors account for 70% of the sector's carbon emissions. Apart from these industries, there are significant prospects to

decrease the quantity of carbon emissions linked to the paper and non-ferrous metal domains. There isn't a single metric linked to emissions across all businesses, unlike the home sector. There are several industry-specific aspects that need to be taken into account while trying to cut emissions. As a result, we emphasize elements linked to increased carbon emissions and energy efficiency in each of these businesses[1], [2].

Carbon Emissions Linked to the Production of Steel

The globe produced around 1.3 billion tons of steel in 2007. Steel is a material that seems to be used in a lot of finished goods. The main market for steel is construction, which is followed by manufacturing, metal goods, and the automobile industry.The two industries in this economic sector that produce the most carbon emissions are the steel and nonmetallic mineral sectors. Ten markets account for almost 90% of the global steel output. Over the previous 20 years, the industry has seen significant efficiency increases, yet the global average has not grown. China has seen the majority of development over the last 20 years, despite its relatively inefficient steel production. Furthermore, there isn't a lot of scrap accessible for recycling steel on the Chinese market. Nearly half of the world's steel production and over half of the carbon dioxide emissions related to the iron and steel industry come from China, Russia, India, and the Ukraine.

Although the techniques used in the manufacture of iron and steel are complicated and vary from nation to nation, they are comparable in other geographical areas. The processes inherent in the manufacture of steel must be outlined in order to comprehend energy usage. Roughly 97% of all steel production is done in two ways: electric arc furnaces and simple oxygen furnaces. Electric arc furnaces are utilized to generate low-tonnage specialty steels, whereas basic oxygen is often employed for high-tonnage carbon steel manufacturing.Six basic oxygen processes account for almost 66% of output, whereas electric arc operations account for 31%. Following the use of one of these processing techniques, the metal is prepared for metallurgy and finishing.

Elementary Oxygen Furnaces

The first step in the steel-making process is turning raw materials into iron, which is then turned into steel. After then, steel is changed by metallurgy and finishing to make it usable for the automotive, building, and other sectors.The fundamental oxygen furnace method yields goods including packaging, refrigerator encasements, and car fenders. Coke, iron ore, and oxygen are added to a furnace in order to produce iron in simple oxygen furnaces. Bituminous coal is fed into a succession of ovens to be burned to a high temperature without the presence of oxygen for a duration of 14 to 36 hours in order to produce coke.8 Compounds are driven off and collected during this procedure. As a byproduct, ammonia liquor is sent to wastewater treatment plants, and the tar that is extracted is kept in storage. Light oil recovered from the coke furnaces is converted into valuable chemicals including xylene, toluene, and benzene. The residual carbon is converted to coke, and as a byproduct, naphthalene is also produced. The coke is then moved to a quenching tower, where it undergoes a process known as dry quenching, in which it is cooled by either an inert gas circulated or a water spray. Sintering needs two to three GJ per ton of crude steel, whereas coke manufacturing needs 0.75 to 2.0 GJ.

Coke manufacture generates a variety of waste products. Particulate particles, volatile organic compounds, methane, sulfur oxides, and other pollutants are released into the air by coke ovens. The cooling of coke oven gas and the by-product processing produce wastewater. During the quenching process, coke manufacturing produces coke breeze. This substance is either sold as a by-product or utilized to create sinter. Apart from breeze, coke generates solid

waste that includes dangerous substances like benzene.In a blast furnace, coke, oxygen, flux, and iron ore are mixed to generate iron. Compressed air is combined with extra oxygen and heated to 1100°C in hot burners. After then, the blast furnaces bottom is filled with oxygen. Since 10 to 20% of an integrated steel mill's energy needs are met by hot stoves, efficient hot stoves may result in significant energy savings.

Sinter or pellets are often used to bring iron ore into the blast furnace. The most effective method of producing direct feed for blast furnaces is sintering; over half of all iron ore is used to make sinter. Fine ore is heated during the sintering process to get it to aggregate into bigger granules. Approximately one-third of the total heat input into a steel factory is used for the sintering process. Recovering waste heat from this energy is essential for increased efficiency since about half of it is dumped into the atmosphere. Sintering produces more dust per ton of steel produced even though it is more efficient than pellet manufacturing.In the blast furnace, coke, oxygen, iron ore, and flux are combined to create iron. In order to get rid of sulfur and other contaminants, limestone is added in the form of flux. Slag from the blast furnace rises to the top of the furnace due to impurities. The basic oxygen furnace is then filled with iron that has been generated in blast furnaces. Steel scrap and molten iron from the blast furnace are transformed into steel via the oxygen steelmaking process. Flux is provided to decrease the amounts of sulfur and phosphorus, while high-purity oxygen is injected to lower the iron's car-bon, silicon, manganese, and phosphorous content. The slag that floats on the heated metal's surface carries off these impurities. Between one and thirteen GJ are needed for every ton of crude steel produced in a basic oxygen furnace, which includes a hot stove, blast furnace, and oxygen furnace[3], [4].

Arc Electric Furnaces

Strength is the main criterion for the items produced by the electric arc furnace. For instance, electric arc furnaces are used to create steel plates, reinforcing bars, and structural beams.This method of processing steel from ore involves using electric arc furnace operations and direct reduced iron output. In the process of producing direct reduced iron, lump iron oxide pellets are stripped of their oxygen. This direct reduced iron and scrap are used in the electric arc furnace to make steel. Since scrap makes up over 80% of the inputs, it is the most significant component. As a result, it is challenging to maintain quality and purity controls over the steel produced. Steel mills that produce EAF steel often target markets where steel quality is not as important.Some of the unwanted components in the bath oxidize and turn into electric arc slag during the smelting and refining process. For every ton of crude steel, 12 GJ are needed in the natural gas-based process of producing direct reduced iron. For every ton of crude steel produced, electric arc furnaces use one to 1.5 GJ of energy.

Metalworking and Coating

Crude steel is produced using an electric arc furnace or a simple oxygen furnace, although refining is not finished. Metallurgy is the term for the set of procedures used to further refine the liquid steel that comes out of the furnaces. Removing contaminants like sulfur, hydrogen, oxygen, and other elements is the aim of these operations. Following the elimination of these impurities, the steel is cast into semifinished forms called ingots. Compared to ingot casting, continuous casting into semifinished forms uses less time, labor, energy, and money. During this last stage, steel is also coated with additional finishing, such galvanization.

Durability

Through initiatives related to climate change, environmental preservation, and natural resource management, the steel sector is making an effort to improve environmental

sustainability. Reductions in the quantity of carbon dioxide generated for each ton of steel produced are a focal point of several climate change initiatives. Investing in technology that increase production's eco-efficiency is a part of this endeavor. According to the International Energy Agency, increased industrial process efficiency and greater by-product recovery may offset almost 3% of total secondary energy usage and 3% of CO_2 emissions. The use of dry coke quenching in the coke-making process, improvements to blast furnaces and electric arc furnaces, and improvements to steel finishing are examples of improved manufacturing processes. When businesses adapt to the newest technology available, the reductions linked to changes in these processes become apparent.

The steel industry is primarily concerned with life cycle inventory management and production monitoring when it comes to environmental protection. The majority of steel companies use ISO 14001-certified facilities since operation monitoring is crucial to this sector. The International Standards Organization established a series of management standards known as ISO 14000. Businesses may use the ISO 14001 standard to evaluate how their operations affect the environment, enhance their environmental performance, and put in place a methodical plan for accomplishing their environmental goals. At ISO-registered facilities, about 85% of all workers and contractors in the steel sector are employed.

DISCUSSION

The management of natural resources is the third aspect of environmental sustainability in the steel industry. The quantity of material that is not disposed of permanently in a landfill or burned is referred to as material efficiency. This efficiency is achieved by the well-known concept of reduce, reuse, and recycle. Utilizing coke less steel manufacturing techniques, which do not depend on the generation of coke, results in material savings. Energy costs and total carbon emissions for the industrial sector are decreased by marketing the slag from blast furnaces and electric arc furnaces to the cement and road building sectors.An industry with a 97% material efficiency level serves as an example of material reuse. In order to reach this 100% efficiency target, collaboration with other sectors is necessary. Efforts to recover gas from basic oxygen furnaces and coke ovens, utilize blast furnace gas, and make cement out of steel and slag are examples of ways to use steel manufacturing byproducts more effectively. Significantly, slag sold to the cement sector has the ability to cut CO_2 emissions associated with cement by 50%.The steel sector is a major recycler as well. Since steel is one of the few magnetic metals, it can be readily separated from other metals and rubbish. Almost all steel can be recycled. The most recyclable material in the world is steel. For instance, 459 metric megatons, or 37% of the crude steel produced in that year, were recycled by the industry in 2006. By recycling, 827 mmt of carbon emissions were avoided, and 868 mmt of iron ore were saved.

Nonmetallic Minerals Industry's Carbon Emissions

Nonmetallic minerals make about 27% of carbon emissions but just 9% of industrial energy usage. The manufacturing of concrete, of which cement is a key component, accounts for the majority of energy consumption in the nonmetallic minerals industry. Concrete is the second most consumed product worldwide, behind water. Global sales of concrete topped $97 billion in 2000.30 Cement manufacture is a major source of CO_2 emissions and accounts for around 80% of the energy used to produce nonmetallic metals. Over the last 15 years, there have been significant improvements in this industry's energy usage; nevertheless, adoption of the best available technology may result in further reductions.

Over 850,000 people work in the 150 nations that make up the worldwide concrete industry. China is the world's biggest cement producer, accounting for 46% of the world's cement

output in 2005. Over 71% of the world's output is accounted for by the top 10 producers. Cement has high transportation expenses, and it is seldom carried above 300 kilometers. The majority of the nation's imports come from China, Thailand, Canada, Thailand, and Greece, while the US sells concrete to Mexico and Canada.The method of producing concrete consists of four very easy steps. The procurement of raw materials is the initial step. These resources, which usually originate from quarries close to the cement producing facility, include limestone, sand, and clay. These constituents provide the four main constituents of cement: silica, iron, alumina, and lime. These materials are examined, combined, and ground in the second step in preparation for further processing. The final step involves heating the materials in a massive kiln that is over 200 meters long and 3 to 7.5 meters in diameter.

When the material reaches 1,450°C in the kiln, it transforms into clinker, a substance the size of marble. Heat causes a chemical reaction in limestone that releases carbon dioxide and forms calcium oxide. It's significant to note that this process accounts for nearly half of concrete's carbon emissions, and that emissions are unaffected by fuel switching or other efficiency-boosting measures. Gypsum is added in the fourth step, and the combination is processed into Portland cement, a fine powder. While other types of cement exist, Portland cement is the most widely used and accounts for more than 98% of cement sales in the US. Portland cement is sold in eight distinct compounds that differ according to physical and chemical specifications including strength and durability.Both wet and dry methods may be used to produce cement. Because water must be evaporated before calcium dioxide can be produced, the wet method requires more energy but allows for greater control over chemical activity. The dry technique reduces the energy expenses involved in producing cement since it doesn't need evaporation. As a result, wet processes are gradually being replaced by dry processes globally[5], [6].

Durability

Concrete has been linked to global warming because of the volume of carbon emissions produced by the sector. The majority of carbon emissions in the production of concrete, however, are related to the creation of calcium oxide, and most sustainability initiatives are unable to address this major source of emissions in the sector. However, a number of tactics have been used to lessen the industry's contribution to climate change. The goal of using less energy throughout the manufacturing process has received a lot of attention. Energy expenses are influenced by the size of the kiln used to produce cement. With roughly 50% of global output, China is the world's biggest producer, and bigger, more efficient kilns are replacing smaller ones there. In an effort to lower manufacturing costs, manage waste, cut carbon emissions, and minimize the use of fossil fuels, concrete makers are now experimenting with alternative fuels. Tires, wood, plastics, chemicals, animal carcasses, sewage sludge, and building debris are a few examples of these fuels. Each nation uses alternative energy differently. On one extreme, South Korea uses less than 5% of alternative fuels in its clinker production, while Germany uses them for over 37% of its total.

In the cement business, material grinding is the step that uses the most power. About 100 kilowatt hours are required for every metric ton of cement produced in the grinding processes related to raw material processing and cement grinding. However, according to best industry practices, there is still room to cut power use by an additional 20%. Despite this possibility, over 90% of the energy consumed in grinding is transformed into heat that is not used to make cement. It is obvious that there are chances to create novel procedures that enable the manufacturing of cement at efficiency levels higher than 10%.

Reuse is key to the concrete industry's strategy of reducing carbon emissions. Referred to as supplemental cementitious materials, industrial by-products are used in various production processes to replace or supplement part of the Portland cement. Slag from the steel industry may be used in lieu of limestone. It takes not much more fuel to transform steel slag into cement clinker. As a consequence of less energy requirements, carbon emissions are decreased. In addition, fly ash; a byproduct of burning coaland silica fume, a byproduct of making silicon, are recycled as slag in the making of cement. By recovering industrial by-products, cement production may avoid using virgin resources and landfill disposal of material is reduced. Furthermore, substituting some Portland cement with SCMs may result in a decrease in greenhouse gas emissions. Portland cement making uses a lot of energy, which is reduced when SCMs are used in its stead. Reusing SCMs may also increase the concrete mixture's workability, reduce its permeability, increase its longevity, and boost its strength.

One of the materials that may be recycled the most on Earth is concrete. Concrete pavement recycling is breaking, removing, and crushing concrete from an existing pavement. Then, crushed concrete is utilized as an aggregate in fresh Portland cement or other concrete processes. Concrete crusher technology and steel removal techniques have advanced recently. When combined with other concrete and asphalt products, this recycled concrete fulfills the majority of requirements and performs better than similar virgin concrete. Because of its smaller weight than conventional concrete, material handling and transportation costs are reduced. Recycling also reduces the quantity of concrete that is dumped in landfills. Concrete sustainability analyses must take into account the long-term advantages of using concrete as a building material in addition to the reduction, reuse, and recycling logic.The most common raw material for cement in concrete is limestone, which is also the most abundant mineral on Earth. Concrete may be produced locally and processed close to a project since the supplies are easily accessible.

The amount of gasoline needed for processing and transportation is reduced when exporting locally. Additionally, concrete produces strong, long-lasting buildings with lifespans that may double or treble that of other typical construction materials. Last but not least, concrete constructions save energy by using the material's natural capacity to absorb and hold heat. As a result, homeowners may install HVAC equipment with a lower capacity and drastically reduce their heating and cooling expenses[7], [8].

Carbon Emissions Inherent in the Production of Chemicals

Plastics, synthetics, resins, detergents, fertilizers, and a host of other everyday necessities are produced by the chemical industry. The chemical industry is responsible for 16% of the industrial sector's carbon emissions and accounts for 30% of the energy used in the industry, which is expanding at a pace of 2.2% each year. Raw materials and consumer goods are divided into three categories of intermediate items. Olefins, aromatics, and other intermediates are some of these intermediary products. Propylene, xylene, and ethylene are examples of olefins. Trash bags and bottles are only two of the many goods made with these compounds. Aromatics are substances used to manufacture tires for automobiles and shoes, such as benzene, toluene, and xylene. The synthetic gas used to produce methanol and ammonia is one of the other mediators. Natural gas is the main feedstock used in the manufacturing of synthetic gas, whereas crude oil is the main feedstock used in the synthesis of olefins and aromatics.Crude oil makes over 75% of the feedstock used in this business. In the industry, nine chemical processes are responsible for about 65% of the energy used globally. These procedures have to do with fertilizers, inorganic chemicals, and petrochemicals.

Petrochemicals

Cracking of steam. Saturated hydrocarbons are broken down into smaller hydrocarbons by a process called steam cracking. Steam cracking is the process of breaking down feedstocks in the presence of steam in ovens.Byproducts such hydrocarbons, water, and acid gas are eliminated during this process. Over 39% of the total energy used in the chemical sector is used in steam cracking. It is the main process used to make olefins. Since the 1970s, this process has used 50% less energy; nevertheless, higher energy efficiency may be achieved by using new technology for the elimination of by-products.

Aromatic Extraction Process

Benzene, toluene, and xylene are produced during aromatic extraction and are utilized in the manufacturing of various items such as DVDs and medications. There is not much room for energy consumption reduction since feedstock uses up most of the energy used in this process.Methanol is a substance that is produced by microbes, plants, and other living things via biological processes. Using natural gas as the feedstock, the catalytic steam method is used to create it synthetically. In 2006, formaldehyde accounted for 40% of methanol use, with the remaining 19% coming from fuel additives. Methanol is produced from natural gas, coal, municipal wastes, landfill gas, wood wastes, and seaweed. It finds application in the production of plastics, paints, construction materials, and windshield washer fluid. More than 90% of methanol is produced in seventeen nations. China is the only country that utilizes coal as a feedstock and the greatest producer. Compared to facilities that rely on coal, natural gas plants have lower carbon emission costs.

Processing of olefin and aromatics. Synthetic rubber and plastics are produced using olefins. The Unipol reactor technique, which Union Carbide began selling in 1977, was developed to produce polyethylene, and the announcement of the polypropylene production process dates back to 1983.

The most popular plastic in the world is polypropylene, and the most popular method for producing it is Unipol. Another commonly used technique is Innovene, which was invented by BP. Ineos currently owns the marketing rights for Innovene.

Chemicals That Are Not Organic

Sodium hydroxide with chlorine. When salt is electrochemically broken down into chlorine and sodium hydroxide, chlorine is obtained. While sodium chloride is utilized by the paper, textile, and other sectors, chlorine is further processed to create polyvinyl chloride, which is used in plumbing. The United States leads the globe in production, accounting for more over 25% of worldwide production. Three procedures that differ in the amount of sodium hydroxide they contain are used to manufacture both chlorine and sodium hydroxide. The membrane, diaphragm, and mercury processes are some of these techniques. Using membrane technology to replace mercury and diaphragm process plants offers the most chance for energy savings.

Black Carbon

One of the main uses for carbon is as reinforcement in vulcanized rubber goods, namely in the form of carbon black. Roughly 85% of this inorganic compound's production is used by the tire industry. There have been attempts in the last ten years to use silica in lieu of part of the carbon black. Better traction, longer tire life, and increased fuel economy are all benefits of silica tires. Nevertheless, silica is twice as expensive to produce as carbon black.

Soda Ash

Although glass is the main product of soda ash, also known as sodium carbonate, it is also used in the production of detergents, water softeners, bricks, and photography processes. The world's biggest producer, the United States, obtains its soda ash from natural resources and recovers soda from lakes. In contrast, every other nation produces soda ash by synthetic methods. Compared to natural soda, this synthetic procedure is more expensive and energy-intensive.

Industrial Gases

Common sources of industrial gases include other gases and the air. Nitrogen is the most widely sold gas and is utilized in many industrial operations as well as the food and beverage sector. The second-most popular gas, oxygen, is used in both industry and medical fields. In addition to the food business, the refrigeration and medical fields also employ carbon dioxide. The fourth most popular gas, acetylene, is utilized in welding.

Applying fertilizers

When oxygen and hydrogen are combined, fertilizer becomes ammonia, a vital component. While the hydrogen comes from fossil fuels, the nitrogen comes from the air. The majority of the globe produces hydrogen using natural gas. Approximately 77% of ammonia is produced using natural gas. The procurement of hydrogen using coal gasification is an alternative technique that accounts for 14% of the global market. In China, ammonia is mostly produced using coal. For the remaining 9% of the market, hydrogen is produced by partially oxidizing oil. The two countries that generate the most ammonia, China and India, use this method of manufacturing[9], [10].

Durability

Significant technological advancements have made it possible for the chemical industry to use less energy. For instance, since 1970, the specific energy required for steam cracking has decreased by 50%. The emergence of improved technology, such process-to-process heat recovery systems, has led to these advancements. Similarly, olefin and aromatic manufacturing processes using best practice technology might see an increase in energy efficiency of over 30%. Enhanced polymerization processes and the utilization of proven reactors are examples of best practice technology.The membrane process uses the least amount of energy out of the three methods utilized to produce chlorine. Steam usage and the power needed for the salt's breakdown are included in the overall energy needs. Compared to the other two processes, the membrane process has an efficiency advantage of at least 16%. The energy consumption of the industrial sector is decreased when chemical facilities are converted to this method.Despite the fact that many chemicals cannot be reused, significant attempts are made to recycle by-products from the chemical production process. Significant volumes of by-products from steam cracking are recycled, and the by-products' forms change depending on the fuel. For instance, 803 kg of ethylene are created for every metric ton of ethane that undergoes steam cracking. Numerous goods, including detergents, antifreeze, and packaging, are made from ethylene. The by-products include methane and hydrogen, which power the steam cracking furnace, as well as propylene and butadiene, which are used to make plastics.

CONCLUSION

This study sheds light on the significant energy consumption and carbon emissions associated with key industries such as steel, nonmetallic minerals, and chemicals. By analyzing

production processes and identifying energy-intensive stages, the study emphasizes the potential for efficiency improvements and carbon emission reductions. Initiatives aimed at enhancing sustainability, including material efficiency, recycling, and adoption of eco-efficient technologies, are crucial for mitigating environmental impacts in these industries. Collaboration among stakeholders, adoption of best practices, and investment in innovative technologies are essential for achieving long-term sustainability goals. Overall, this study highlights the importance of addressing environmental challenges in the industrial sector to ensure a greener and more sustainable future.

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CHAPTER 8

COMPREHENSIVE ANALYSIS OF INDUSTRIAL CARBON EMISSIONS AND ENVIRONMENTAL MANAGEMENT STANDARDS: A FOCUS ON STEEL, PAPER, AND CHEMICAL INDUSTRIES

Dr. Girish Chhimwal, Assistant Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id- girish.chhimwal@muit.in

ABSTRACT:

This study examines the principal industrial sources of carbon emissions, focusing on the energy production, manufacturing, transportation, agriculture, and forestry sectors. It explores the carbon emissions associated with the production of steel, chemicals, and paper and pulp, highlighting the significant environmental impact of these industries. Specifically, the paper delves into the complex processes involved in steelmaking, cement production, and paper manufacturing, elucidating the various stages of production that contribute to carbon emissions. Additionally, the study discusses industry-related standards and management systems aimed at reducing carbon emissions and promoting environmental sustainability, with a focus on ISO 14000 standards. By analyzing these industrial sectors and their carbon emissions, the study aims to provide insights into the challenges and opportunities for mitigating carbon emissions in industrial processes.

KEYWORDS:

Carbon, Steel, Industry, Industrial, Production.

INTRODUCTION

The principal industrial sources of carbon emissions encompass a wide array of sectors and activities, each contributing significantly to the overall carbon footprint of industrial processes. One major contributor is the energy production sector, particularly power plants that rely on fossil fuels such as coal, oil, and natural gas. These power plants emit substantial amounts of carbon dioxide (CO_2) during combustion as they generate electricity to meet the demands of various industries and households.Additionally, the manufacturing sector is a substantial source of carbon emissions due to its reliance on energy-intensive processes and the use of fossil fuels as feedstocks for chemical reactions. Industries such as cement production, iron and steel manufacturing, and petrochemical refining release substantial amounts of CO_2 as byproducts of their operations. Cement production, for instance, involves the calcination of limestone, which releases CO_2 as a result of the chemical decomposition of calcium carbonate.

Transportation also plays a significant role in industrial carbon emissions, with the movement of goods and people relying heavily on fossil fuel-powered vehicles. Freight transportation, including shipping, trucking, and aviation, emits CO_2 through the combustion of diesel fuel and other petroleum products. Similarly, passenger vehicles contribute to carbon emissions through the combustion of gasoline and diesel fuel, especially in regions where public transportation infrastructure is limited.Furthermore, the agriculture and forestry sectors are important sources of carbon emissions, albeit through indirect means. Deforestation and land-use changes release carbon stored in vegetation and soil into the atmosphere, while agricultural practices such as livestock farming and rice cultivation emit methane (CH_4) and nitrous oxide (N_2O), both potent greenhouse gases. The principal industrial sources of carbon

emissions encompass energy production, manufacturing, transportation, agriculture, and forestry. Addressing these emissions requires concerted efforts to transition to cleaner energy sources, improve industrial processes and efficiency, and implement sustainable practices across various sectors of the economy[1], [2].

Carbon Emissions Linked to the Production of Steel

In the realm of carbon emissions, two prominent industries within the economic sector stand out: the nonmetallic minerals industry and the steel industry. Among these, the steel industry holds a significant position as one of the largest contributors to carbon emissions globally. The production of steel involves intricate processes that vary in complexity and methodology across different nations and regions. However, regardless of the specific techniques employed, the majority of steel worldwide is manufactured using primarily two methods: the blast furnace-basic oxygen furnace (BF-BOF) route and the electric arc furnace (EAF) route.

The BF-BOF route, a traditional method widely used for mass production of carbon steels, involves the conversion of iron ore into molten iron in a blast furnace through a reaction facilitated by coke (a derivative of coal) as a reducing agent. This molten iron is then further refined into steel through the basic oxygen furnace, where oxygen is blown through the molten iron to reduce impurities and adjust the carbon content, resulting in the production of carbon steels. This process is particularly suited for large-scale production of carbon steels due to its efficiency and cost-effectiveness.

On the other hand, the EAF route, often employed for the production of specialty steels and smaller tonnages, utilizes electric arc furnaces as the primary means of steelmaking. In this method, scrap steel is melted using electric arcs generated by graphite electrodes, with the addition of other raw materials and alloys as needed to achieve the desired steel composition. The EAF route is favored for its flexibility, allowing for the production of a wide range of steel grades and alloys, as well as its relatively lower environmental impact compared to the BF-BOF route, especially when powered by electricity from renewable sources.

While the BF-BOF route remains dominant for the mass production of carbon steels due to its efficiency and established infrastructure, the EAF route is gaining traction, particularly in regions with access to abundant scrap steel and renewable energy sources. Additionally, advancements in technology and increasing environmental regulations are driving efforts within the steel industry to reduce carbon emissions and transition towards more sustainable steelmaking processes. This includes initiatives such as carbon capture and utilization, utilization of hydrogen as a reducing agent, and increasing the use of renewable energy in steel production, all aimed at mitigating the environmental impact of steelmaking while meeting the growing global demand for steel.

Steel production is a significant contributor to carbon emissions, playing a substantial role in the overall environmental footprint of industrial processes. The production of steel involves several steps, each of which has its own associated carbon emissions. The primary method of steel production, known as the blast furnace-basic oxygen furnace (BF-BOF) route, relies heavily on coal as a source of energy and carbon. In the blast furnace, iron ore is converted into molten iron using coke (derived from coal) as a reducing agent. This process releases carbon dioxide (CO_2) both from the combustion of coal and from the chemical reactions involved in reducing iron ore to iron.Additionally, the basic oxygen furnace, where molten iron is converted into steel by blowing oxygen through it, also requires significant energy inputs, typically derived from fossil fuels. This further contributes to carbon emissions through the combustion of fuels and the release of CO_2.

Furthermore, the steel industry often utilizes other processes, such as electric arc furnaces (EAF), which rely on electricity as the primary energy source. While EAFs are generally considered more energy-efficient and less carbon-intensive compared to the BF-BOF route, the carbon footprint of steel production through EAFs still depends on the source of electricity. If the electricity used is generated from fossil fuels, such as coal or natural gas, it will result in carbon emissions.Moreover, ancillary processes involved in steel production, such as the mining and transportation of raw materials (iron ore, coal, and limestone), also contribute to carbon emissions. The extraction of these materials, particularly through mining, often involves heavy machinery and energy-intensive operations, leading to additional CO_2 emissions. The carbon emissions associated with steel production are substantial and multifaceted, stemming from various stages of the production process, including the use of fossil fuels for energy, chemical reactions, and ancillary activities. Addressing these emissions requires a holistic approach that encompasses technological innovations, process improvements, and the adoption of cleaner energy sources to mitigate the environmental impact of steel production[3], [4].

Nonmetallic Minerals Industry's Carbon Emissions

The manufacturing of concrete, a ubiquitous material in construction, plays a pivotal role in the global non-metallic minerals industry, with a significant share of energy consumption attributed to its production. Central to the process is cement, a key component of concrete, which is manufactured through a series of steps that collectively contribute to energy-intensive operations and carbon emissions.The production of cement involves a straightforward yet energy-intensive process comprising four main steps. Firstly, raw materials such as limestone, clay, silica, and iron ore are procured from natural sources or quarries. These raw materials serve as the foundational elements for cement production, each contributing unique properties to the final product.

The acquired raw materials undergo meticulous examination, mixing, and grinding to achieve the desired chemical composition and particle size distribution. This preparatory stage is crucial for ensuring the quality and consistency of the cement produced, as well as optimizing its performance characteristics in concrete applications.Subsequently, the prepared raw materials are subjected to high temperatures in a large kiln in the third step of the manufacturing process. This thermal treatment, often referred to as calcination, involves heating the materials to temperatures exceeding 1,400 degrees Celsius, causing chemical reactions that result in the formation of clinker—a nodular material resembling small marble-sized balls. This involves the addition of gypsum to the clinker, followed by further grinding to produce Portland cement, a fine powder with hydraulic properties. Gypsum is added to regulate the setting time of the cement and prevent flash setting, ensuring workability and consistency during concrete placement and curing.

Throughout each stage of cement production, significant energy inputs are required, primarily for the operation of kilns, grinding mills, and other machinery involved in material processing and handling. Additionally, the reliance on high-temperature processes fueled by fossil fuels, such as coal, natural gas, or petroleum coke, contributes to carbon emissions and environmental impacts associated with cement manufacturing.Despite advancements in technology aimed at improving energy efficiency and reducing emissions, cement production remains inherently energy-intensive and carbon-intensive. As such, efforts to mitigate the environmental footprint of concrete production necessitate a comprehensive approach that incorporates alternative fuel sources, process optimization, and the development of low-carbon cements to achieve sustainable and environmentally responsible construction practices.

Carbon emissions are a significant concern in various industrial sectors, with the chemical industry being a notable contributor, accounting for approximately 16% of carbon emissions within the industrial sector. This sector encompasses a wide range of processes and products, including petrochemicals, inorganic chemicals, and fertilizers. Among these, nine key chemical processes related to petrochemicals are responsible for over 65% of the energy consumed globally in the chemical industry. These processes often rely on fossil fuels such as coal, natural gas, and crude oil as feedstocks or energy sources, leading to substantial carbon emissions.

The pulp and paper industry also plays a significant role in carbon emissions within the industrial sector, ranking as the fourth largest energy user. This industry encompasses the production of various paper and pulp products, including paperboard, packaging, wrapping, printing, and writing paper. Notably, the demand for writing and printing paper has seen consistent growth since 1960, attributed in part to the widespread adoption of computers and photocopiers. This trend reflects evolving consumer needs and technological advancements, contributing to the industry's overall energy consumption and carbon emissions.

To address the challenge of carbon emissions in industrial processes, industry-related standards and management systems have been developed to promote environmental sustainability and reduce negative environmental impacts. One such system is the ISO 14000 series, which provides a framework for organizations to implement environmental management practices and improve environmental performance continually. ISO 14000 emphasizes resource conservation, waste management, and pollution prevention, helping enterprises achieve cost savings through efficiency improvements and waste reduction.

DISCUSSION

By adhering to ISO 14000 standards, companies can mitigate the risk of non-compliance with environmental regulations and enhance their reputation for environmental responsibility. Moreover, certification to ISO 14000 standards can open up marketing opportunities and demonstrate a commitment to environmental stewardship, thereby enhancing the company's credibility and competitiveness in the market. Overall, industry-related standards like ISO 14000 play a crucial role in driving environmental sustainability efforts within the chemical and pulp and paper industries, promoting responsible business practices and contributing to global efforts to reduce carbon emissions.

Carbon Emissions from the Pulp and Paper Industries

The paper and pulp industry is the fourth biggest energy consumer in the industrial sector, accounting for 5.7% of all industry energy consumption. With a quarter of the global production, the United States is the top producer. The production is nearly entirely accounted for by the top 10 producers. Paper and paperboard output in China has more than quadrupled since 1990.Paperboard, packaging, and wrapping account for around half of industry output, while printing and writing paper make up the other third. Since 1960, the demand for writing and printing paper has grown at an annual pace faster than that of other industrial segments; this development has been linked to an increase in the usage of computers and photocopiers. The remaining output consists of newsprint, sanitary paper, and domestic paper.The need for newspapers and periodicals has declined as the Internet and other electronic media have grown in popularity. The organization for Economic Cooperation and Development's membership is correlated with the need for different types of output. Paper used for printing and writing is in higher demand inside the OECD, whereas paper and paperboard used for packaging drives demand outside of the OECD.

The capacity to draw broad conclusions on the manufacture of paper is influenced by a number of factors. First, the producers' access to recycled resources and virgin lumber varies. Furthermore, there are significant differences in plant sizes and energy needs across different markets. The fact that the paper and pulp sector uses and produces a lot of biomass sets it apart from other businesses. Biomass accounts for about one-third of the energy used in the sector. This biomass mostly consists of black liquor, which is created during the pulp-making process. The main purpose of this biomass and other energy sources is to provide heat for the manufacturing process. Heat production accounts for two thirds of the energy required, with the remaining third going toward the production of electricity. Because this business uses biomass, its carbon emissions are comparatively low, which implies that there aren't many options to improve energy efficiency. However, estimates provided by the International Energy Agency show that there are substantial chances to improve energy efficiency.

It's essential to comprehend how resources move through the manufacturing process in order to assess the possibility for savings. Logs and other raw materials are chopped into wood pulp, which is then treated to separate the wood fibers from the lignin that binds the fibers to the solid wood. This pulp processing may be done chemically or mechanically. High yields are obtained with mechanical pulping, which is utilized for lower-grade sheets. Chemical pulping is a thermochemical technique that involves using heat and a mixture of solvents to extract lignin from wood fibers. Sulfite and sulfate pulping are the two most used methods. Sodium sulfate is used in the Kraft process, which produces a pulp with high bulk and physical strength but rather poor sheet formation, to create sulfate pulp. Sulfurous acid and an alkali are used in sulfite pulping to create pulps with less volume and physical strength that have superior sheet formation. These pulps are used in tissue, bond papers, printing, and newsprint.

Pulping accounts for around 18% of energy usage, with mechanical pulping accounting for the majority of this use. Large volumes of black liquid are produced by chemical pulping and are used to create power. Consequently, almost one-third of the energy consumed in the sector is produced by the pulping process. The pulp is bleached and dried to make it ready for papermaking when the pulping process and energy recovery are complete. The mixing of pulps and additives, sheet creation, and finishing are steps in the process of creating paper. Fourteen percent of the energy used in the sector is used in the papermaking process[5], [6].

Durability

Although the sector has made great progress toward sustainability, there are still steps that may be taken to cut down on energy use and carbon emissions. These extra precautions include better heat recovery systems, improved black liquor recovery technologies, and sophisticated pulp drying technology. According to the International Energy Agency, using the best technology currently on the market may cut final energy use by 14%. The paper sector has already seen considerable dividends from the repurposing of resources throughout the manufacturing process. Reusing black liquor as fuel reduces the need for fossil fuels. Furthermore, the use of this technology may allow chemical pulp factories to function as net suppliers to the electrical grid.

Here is the paper product recycling value chain. The theoretical limit for recycling paper is 81% as things like building materials, archive records, and other items cannot be recycled. Japan is the biggest recycler, with 60%, followed by the European Union with 52%. The average worldwide recycling rate is 45%, indicating a significant possibility for recycling. A goal of 66% by 2010 has been established by the Confederation of European Paper Industries, a consortium including EU nations, Norway, and Switzerland.One of the

fascinating problems with green marketing is shown by the initiatives taken by the paper sector to encourage recycling. There are circumstances when one must choose between relatively contradictory environmental aims. As an example, nowadays, forty five percent of inputs into global production come from the reclamation of recycled paper. It should be noted that although recycling reduces the need for natural resources, the process of collecting and processing recycled materials produces carbon emissions. On the other hand, virgin timber-using chemical pulping facilities can be carbon neutral. One must consider managing natural resources like wood at the same time as striving for reduced carbon emissions.

Industry-Related Standards aimed at Reducing Carbon Emissions

The analysis of industrial energy consumers and carbon dioxide producers that came before it shows the difficulties involved in trying to behave in an ecologically responsible way. The standards for attaining sustainability change from industry to industry, however it is sometimes difficult to evaluate sustainability levels within or across sectors because of variances in surroundings and technology. Establishing benchmarks for comparison helps businesses assess sustainability in relation to products both within and across sectors. The International Organization for Standardization is one institution that supports this work.

ISO is a network of 157 national standards institutions located in Geneva, Switzerland. ISO was established in 1946 with the aim of promoting global standards. Currently, the organization has over 17,000 international standards covering a wide range of industries, such as information and communication technologies, medical devices, agriculture, construction, mechanical engineering, manufacturing, distribution, and transportation. For instance, ISO created a universal format for ATM cards, allowing them to be used anywhere in the world. Additionally, ISO has created standards for services and good management practices. The majority of ISO standards are industry-specific, but the organization has also created two families of generic strategies that can be applied to any industry. Unlike the majority of other ISO standards, these families of standards place more emphasis on process than on particular industrial measures. A general set of guidelines for putting in place a quality management system is ISO 9000. These guidelines formalize continuous quality improvement initiatives while concurrently handling legal, regulatory, and customer satisfaction requirements.

The second generic managerial system, ISO 14000, supports organizational actions aimed at reducing adverse environmental effects and achieving continuous improvement of environmental performance. An organization can reap numerous benefits from implementing ISO 14000, starting with cost savings from a focus on resource consumption and waste management. Reduced energy and material consumption as well as total product distribution costs are achieved. Risk management also offers another advantage. Establishing ISO 14000 standards helps identify present and future regulations and requirements, so the organizations who do so have less financial and legal risk. The chance of noncompliance is reduced by adhering to ISO 14000 standards.

The marketing possibilities that ISO certification provides to the company make up a third aspect of the process. Nowadays, sustainability concerns affect almost every business, thus becoming certified offers a chance to highlight the environmental aspects of product offerings. Opportunities for the environment arise not only in the distribution and logistics processes but also in the manufacturing process. Creating an environmental management system with ISO 14000 certification boosts the chances of determining client needs and putting in place environmentally sound systems for projects created in collaboration with clients and suppliers. As a result, ISO accreditation enhances the company's reputation for environmental consciousness.

The impact that ISO certification has on interested parties both within and outside the company is another advantage. Employees and other internal stakeholders may cultivate environmental sensitivity in ways that strengthen their commitment to the company. Additionally, accreditation provides reassurance to communities, regulatory bodies, and other external stakeholders about how the company is handling its environmental relationship. It offers a framework for proving compliance with environmental regulations and bolsters the organization's assertions about its own environmental policies [7], [8].

ISO 14001:2004, one of the members of the ISO 14000 family, offers the general specifications for an environmental management system. EMS is a methodical approach to managing an organization's environmental affairs that tackles the short- and long-term effects of its processes and products on the environment. It gives organizations structure in how they address environmental issues by allocating resources, delegating tasks, and continuously assessing their practices.

ISO 14001:2004 makes it easier to create a suitable environmental strategy. The organization's activities also include a planning phase that addresses identifying the environmental aspects of those activities, identifying and adhering to legal requirements, establishing and documenting targets and objectives that are consistent with the policy, and creating a program to achieve those targets and objectives. It also describes an EMS implementation plan, including how roles and duties for environmentally responsible activities should be communicated and documented. In addition, ISO 14001:2004 offers a plan for the EMS's recurring evaluations as well as processes for tracking important aspects of operations and activities. Management and staff are guaranteed by ISO 14001:2004 that they are in charge of organizational procedures and environmental-related activities. The standard that certifies the company's dedication to upholding an environmental management system is ISO 14001:2004. Either via third-party registration or self-compliance initiatives, this system will be established.

ISO 14004:2004 provides generic EMS recommendations, as opposed to ISO 14001:2004, which describes standards for an EMS. There are guidelines available for the creation, application, and upkeep of an EMS in ISO 14004:2004. An overview of EMS's commitment and policy is given by ISO14004:2004, which also includes instructions on how to create a strategy to carry out the policy. This standard also describes how to implement the strategy by allocating material, monetary, and human resources. Additionally, ISO 14004:2004 offers protocols for EMS improvement and monitoring.

In addition, ISO 14000 includes many more environmental management guidelines. The auditing systems define the requirements for auditors and provide auditing protocols and standards. A similar collection of guidelines for include environmental factors in product standards is called the environmental aspects of product standards. Product designers are more likely to be aware of how their designs affect the environment if they follow this guideline. In a similar vein, ISO 14062 empowers companies to recognize the potential environmental impacts of their upcoming goods and make wise choices throughout the design and development phases to enhance their environmental performance. Direct attention is given to greenhouse gas emissions in ISO 14064. By putting ISO 14064 into practice, companies may better identify and manage risks, assets, and liabilities connected to greenhouse gas emissions while also promoting openness in GHG measurement. Additionally, it promotes the creation of emission-limiting systems and makes the trading of GHG credits easier.

The 14000 family of standards also includes a set of requirements that allow a business to claim that its goods are environmentally conscious. The goal of ISO 14020-24 is to provide uniformity in labeling practices and protocols by defining standards for self-declaration, green reporting, and labeling. Claims about a firm's production and distribution processes gain credibility when these requirements are satisfied. The assurance that a business is making an effort to address ecological problems across its activities is the overall effect of ISO 14000 standards[9], [10]. Customers are becoming more and more interested in a company's environmental responsibility, and adopting these standards helps companies show their dedication to the environment.

CONCLUSION

This study underscores the critical role of various industrial sectors in contributing to carbon emissions and the pressing need for sustainable practices to mitigate environmental impact. Industries such as steel, chemicals, and paper and pulp are significant contributors to carbon emissions, driven by energy-intensive processes and reliance on fossil fuels. Efforts to address these emissions require a multi-faceted approach, including technological innovation, process optimization, and the adoption of cleaner energy sources. Industry-related standards, such as ISO 14000, offer a framework for organizations to improve environmental performance and reduce carbon emissions through resource conservation, waste management, and pollution prevention. By adhering to these standards and implementing sustainable practices, industries can not only reduce their environmental footprint but also achieve cost savings and enhance their competitiveness in the market. The study highlights the importance of transitioning towards more sustainable industrial processes to mitigate carbon emissions and promote environmental stewardship in the face of climate change.

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CHAPTER 9

COMPREHENSIVE ANALYSIS OF ECONOMIC AND ENVIRONMENTAL VALUE REPORTING FOR SUSTAINABLE BUSINESS PRACTICES

Prof. (Dr.) Smita Mishra, Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id-smita.mishra@muit.in

ABSTRACT:

This study examines the significance of economic and environmental value reporting, as well as the disclosure of social value, in promoting transparency, accountability, and sustainability in corporate operations. Economic value reporting encompasses analyses of financial performance, market presence, and indirect market impacts, providing stakeholders with insights into a company's economic contributions and sustainability. Market presence reflects the company's success within its local market, highlighting its ability to create value and competitiveness. Indirect market impacts encompass broader economic effects, demonstrating the company's role in driving economic growth and fostering innovation.Environmental value reporting is crucial for understanding a company's environmental performance and efforts to minimize its ecological footprint. It covers various aspects such as material efficiency, energy usage, water consumption, waste management, biodiversity, transportation, and product impacts. The study also explores the disclosure of social value, including discussions on human rights, labor practices, product responsibility, and societal interactions. By reporting on these elements, companies demonstrate their commitment to ethical and socially responsible business practices, fostering trust and accountability with stakeholders. Through transparent reporting on economic, environmental, and social performance, companies can enhance stakeholder trust, drive continuous improvement, and create long-term value for both shareholders and society. The study highlights the importance of sustainability reporting in promoting transparency, accountability, and sustainability across corporate operations.

KEYWORDS:

Company, Economic, Financial,Stakeholder, Society.

INTRODUCTION

Economic value reporting encompasses analyses of financial performance, market presence, and indirect market impacts, providing stakeholders with insights into the company's economic contributions and sustainability. Market presence reflects the company's success within its local market compared to other employers, indicating its influence and competitiveness. This aspect of economic value reporting highlights the company's ability to create value within its operating environment and its standing relative to peers.Financial performance analysis delves into the transfer of cash between the company and its stakeholders, shedding light on profitability, liquidity, solvency, and efficiency. By examining financial metrics such as revenue, profit margins, return on investment, and cash flow, stakeholders gain an understanding of the company's fiscal health and its ability to generate sustainable returns over time. Moreover, financial performance reporting enables

stakeholders to assess the company's adherence to financial regulations and accounting standards, ensuring transparency and accountability in financial reporting practices.

Indirect market impacts encompass the broader economic effects of the company's operations, including its contributions to employment, economic development, and community prosperity. This aspect of economic value reporting goes beyond traditional financial metrics to capture the company's role in driving economic growth, fostering innovation, and creating value for society at large. By quantifying its indirect market impacts, the company demonstrates its commitment to responsible business practices and its contribution to the overall well-being of the economy and society. Economic value reporting provides stakeholders with a comprehensive understanding of the company's economic performance, market position, and broader socio-economic contributions. By transparently reporting on financial performance, market presence, and indirect market impacts, the company enhances its credibility, builds trust with stakeholders, and demonstrates its commitment to long-term value creation and sustainability[1], [2].

Environmental value reporting is a critical component of sustainability reporting, providing stakeholders with insights into the company's environmental performance and its efforts to minimize its ecological footprint. The firm's environmental performance encompasses various aspects of its operations, including the use of materials, energy, water, biodiversity, waste and byproducts, goods and services, and transportation.Material efficiency and expenses are monitored to assess the company's resource utilization and the overall cost-effectiveness of its operations. By tracking material usage and expenses, the company can identify opportunities for waste reduction, process optimization, and cost savings, thereby enhancing operational efficiency and sustainability.

Energy usage monitoring involves tracking both direct and indirect energy use, providing insights into the company's energy consumption patterns and its efforts to improve energy efficiency. By disclosing energy usage data and initiatives to reduce energy consumption, the company demonstrates its commitment to environmental stewardship and resource conservation. Water usage reporting involves quantifying the company's water consumption and identifying sources that are most affected by water removal. By transparently reporting on water usage and conservation efforts, the company highlights its efforts to minimize water-related risks and promote water stewardship.

By-product reporting focuses on the company's processes for handling waste and other non-product outputs of production, highlighting its efforts to minimize waste generation, promote recycling and reuse, and reduce environmental impacts.Biodiversity reporting assesses the company's impact on local flora and fauna, including efforts to protect and preserve biodiversity in its operating areas. Transportation reporting reveals the company's strategies for managing transportation-related expenses and reducing its carbon footprint through efficient logistics and supply chain management.

Product reporting provides insights into the environmental impacts of the company's products, including materials used, water consumption, emissions, and other environmental aspects. By transparently reporting on product-related environmental impacts, the company enables stakeholders to make informed decisions and encourages responsible consumption.Environmental value reporting plays a crucial role in promoting transparency, accountability, and sustainability in corporate operations. By systematically measuring, disclosing, and communicating environmental performance, companies can enhance stakeholder trust, drive continuous improvement, and create long-term value for both shareholders and society.

Disclosure of Social Value

Discussions of human rights, labor practices, product responsibility, and society are all included in reporting on social value. The company provides reports on the use of collective bargaining as well as its fundamental human rights principles. The extent and diversity of the workforce as well as the occupational health and safety requirements of the company are disclosed via labor reporting. Product responsibility reporting deals with how goods and services affect consumers, whereas societal reporting deals with how the company interacts with the society at large.The Apple case study demonstrates how businesses plan, carry out, and document their sustainability initiatives using closed-loop processes. Cradle-to-cradle reasoning is used to reduce energy consumption across a product's lifetime. Compared to their rivals, businesses that report on this activity are more likely to produce outcomes that last. We'll take a detailed look at how businesses report on sustainability in this chapter. We start by looking at the goals and advantages of reporting on sustainability. We then go on to discuss the elements of sustainability reports and look at how financial, environmental, and social performance is reported[3], [4].

Sustainability Reporting's Objectives

Due to the severity and immediacy of the sustainability risks that businesses confront, companies must disclose all relevant information about their financial, environmental, and social performance. All kinds of stakeholders may use this information to decide how to relate to and commit to the company. Stakeholders may make better judgments if the company provides full information of its sustainability-related initiatives.Stakeholders' capacity to see the firm's activities is a prerequisite to their ability to evaluate the company. The degree to which an organization discloses all information pertaining to its performance in terms of the economy, the environment, and relationships is referred to as its transparency.9. Businesses that fully disclose every contact they have with stakeholders that has an impact on their triple bottom line performance demonstrate how transparent their business practices are. To evaluate the degree of transparency, it is important to find out what sustainability metrics and subjects a company uses. Businesses are increasingly reporting on financial and social performance indicators in addition to environmental results, even though they are not obligated to report on every aspect of triple bottom line performance. Furthermore, it is essential that the company guarantee the accuracy of the data included in the report.

DISCUSSION

Three uses are possible for sustainability reports thanks to transparent disclosure:Giving an example. Businesses show their dedication to sustainability by illustrating how they both contribute to and are affected by sustainable development. For instance, the Best Buy 2009 sustainability report highlights the steps the company has done to improve recycling rates in the US and Canada and recognizes the vital relevance of electronics recycling. Comparative analysis. Comparing a company's performance to regulations, standards, conventions, and volunteer efforts is known as benchmarking. For instance, according to the 2008 sustainability report of the Bayer Corporation, around one-third of its manufacturing locations have obtained ISO 14001 or EMAS (European environmental management regulation) certification.

Making a comparison

A company may show how performance has changed over time by comparing. These comparisons show how a firm has improved its sustainability efforts and show how it has performed over time in relation to its competitors. For example, the Ford 2008 sustainability

report compares the performance of current car models to those that have already been sold. Businesses who consider themselves to be leaders in their field and implement best practices may validate their perceptions via comparison. For instance, Apple differentiates itself from the competition by stating that it no longer utilizes PVC or BFR in its goods.

Sustainability reports provide stakeholders information, therefore it's important to think about what should and shouldn't be included in them. The following four standards are used by the Global Reporting Initiative to direct the creation of sustainability reports: Materiality: It's important to determine what information is relevant since businesses deal with a variety of issues that may be included in these reports. The company has to identify the aspects of the social, environmental, and economic setting that have a significant impact on stakeholders' assessments. Businesses employ both external and internal variables to assess the materiality of information. These elements include stakeholder concerns as well as the company's competitive strategy and objective[5], [6].

Inclusion of stakeholders

The report's insight is dependent on how it is received by all parties who are materially impacted by the firm's conduct. Employees, vendors, clients, governments, non-governmental organizations, and other parties having a stake in the company's sustainability initiatives are some of these groups. In order to be inclusive of all stakeholders, the company must list each of these interest groups and provide a report detailing how it has addressed the expectations and concerns of each group. For instance, Sun Microsystems' 2008 sustainability report highlights the need of gathering feedback from partners, consumers, staff members, NGOs, CSR specialists, and investors.

Context of sustainability

The criteria for sustainability context guarantee that the organization provides an explanation of how it is fulfilling the requirements for attaining sustainability. The environment in which the company works must be taken into consideration rather than the firm's actions alone. As a result, the company should not only provide an overview of its sustainability initiatives, but also explain how these initiatives help to improve social, economic, and environmental circumstances locally, regionally, and globally.

Wholeness

The corporation has a difficult challenge in deciding how much information to offer because of the variety of factors related to triple bottom line performance. The supply of enough data about social, environmental, and economic performance to allow stakeholders to make educated choices is referred to as completeness. Time, scope, and boundary dimensions are all included in completeness. The time period linked with the report must be specified in order to monitor progress. The report's breadth ought to be sufficiently expansive to include noteworthy factors that impact triple bottom line achievement. The report's boundaries relate to the variety of groups the research looked at. In this respect, businesses must take into account their extensive supply chains and examine the effects of upstream suppliers, workers, and downstream consumers. For instance, Apple acknowledges that downstream product consumption accounts for 53% of the energy effect of their goods. The report's border is a challenging issue to evaluate as several businesses within the same sector may have different opinions about what constitutes their consumption limits. Although the rules for sustainability reporting recommend that corporations report on every entity that they control or have influence over, various organizations may use divergent decision logics to evaluate the extent of their influence.

Advantages of Reporting on Sustainability

The practice of sustainability reporting is a relatively recent development that is being used by businesses across all economic sectors. It is difficult to pinpoint the beginnings of this kind of reporting. For example, business involvement with the environment has been included in certain annual reports for decades. Since 1989, when the first distinct environmental reports were created, the quantity of these reports has significantly increased. There are other labels for this kind of reporting that include sustainability, social, and environmental terms.

The widest perspective on sustainability and its significance to the company may be gained from sustainability reports that discuss the firm's role in regard to the triple bottom line of financial, relational, and environmental performance. Nevertheless, a lot of reporting styles ignore other aspects of triple bottom line performance in favor of emphasizing the environmental or social aspects of sustainability.

The United Nations started examining the reasons for developing sustainability more than a decade ago. According to their study, there are many reasons why some companies choose not to create sustainability reports.

Certain organizations doubt the benefits that come with this kind of reporting, while other businesses think there are other methods to tell customers about environmental issues. Market differences can affect the reasons for creating a sustainability report. While the majority of companies in the computer and chemical industries release these reports, many fewer sustainability studies are produced by companies in the retail and banking sectors.

While a growing number of sustainability reports are being produced in various economic sectors, some businesses still choose not to produce them. The following are some advantages of sustainability reporting: heightened awareness of environmental performance. Many businesses now understand that carbon restriction and trading have an impact on an organization's business strategy and financial performance as a result of the Kyoto Protocol and other international initiatives aimed at reducing greenhouse gas emissions. Businesses that report on their efforts to reduce carbon emissions also have to deal with controlling how their business interacts with the environment.

For example, strategic cost management systems enable the assessment of a product or service's carbon emissions costs across the course of its life cycle. Businesses that provide this information offer insights into marketing, supply chain management, financial performance, and human resource management. A company that creates sustainability reports makes everyone in the business more aware of environmental concerns, which should reduce the company's carbon footprint.

Conveysto all parties involved a message about the environment. The potential of sustainability reporting to foster communication with stakeholders is one of its main advantages. Remember that consumers, suppliers, workers, rival businesses, the legal system, financial institutions, the government, the media, shareholders and owners, the scientific community, non-governmental groups, and the general public are among the firm's stakeholders. Businesses understand that by being transparent, they may increase their reputation with each of these groups. For instance, in 2007 Apple Computer Company started to speak out about their sustainability practices. CEO Steve Jobs said at the time that while Apple typically keeps its future plans under wraps, the company's present practices have been keeping key stakeholders in the dark. Apple and other companies may significantly impact their perception in the markets they operate in by adopting a proactive approach towards

sustainability reporting. Therefore, sustainability reporting offers a framework that lets the company simulate changes in workers' values, opinions, and fundamental presumptions about the company[7], [8].

Monitor your progress in relation to your goals. A company may track its progress toward goals over time by compiling sustainability reports on an annual or frequent basis. For instance, since 1998, Electrolux has been creating sustainability reports. The firm lists its goals over the last several years along with the degree to which it has accomplished them in its 2008 report.

The report outlines precise targets for the future in addition to identifying previous accomplishments. The performance tracking over time shows all stakeholders how far the company has come and highlights how important sustainability is to the company.

Diminish the danger to the environment. Risks associated with sustainability are different from other types of risk. Enterprises are required to tackle the hazards linked to climate change, boycotts, ecological services, social justice, and hazardous chemicals. These risks may provide particular obligations for the firm's officers and directors. Companies may lessen their environmental liability by analyzing the hazards involved in the acquisition, processing, use, and disposal of goods.Determine cost-savings and efficiency. When organizations start tracking their energy use, they eventually start to see how much energy costs are and how different demands are distributed. Businesses that submit yearly sustainability reports measure their energy use and start looking for methods to cut down. For instance, IBM was able to cut usage across the board by more than 3.5% in 2008 by analyzing energy use over the course of many years.

Find fresh commercial prospects. An organization must inevitably examine every aspect of its company operations in order to create a sustainability report. Businesses sometimes discover resources in this evaluation that aren't advertised. Shell Oil, for instance, transfers carbon dioxide to greenhouses from Dutch refineries. Prior to Shell evaluating the refinery's sustainability, this carbon dioxide was discharged into the atmosphere.

A Synopsis of Reporting on Sustainability

Many businesses use different forms and designs to showcase their attempts to attain a certain degree of sustainability. In spite of these different approaches, the company has to address a few crucial points in order to provide a relevant discussion of its performance and sustainability initiatives. The company first describes its approach to sustainability and then offers particular metrics related to its efforts in the areas of the economy, environment, and society. Many businesses show how their sustainability analyses align with the GRI Sustainability Reporting Guidelines, even though the company may use a variety of presentation styles to do so. General Electric, for instance, aligns its 2008 sustainability report with the GRI's point-by-point criteria.

A company strategy and management approach to sustainability are summarized in the first section of a sustainability report. Regarding economic, environmental, and social conditions, the connection between the company and its stakeholders should be the main topic of debate when it comes to corporate strategy. Crucially, a letter from the organization's senior decision-maker regarding the importance of sustainability to the organization and its strategy should be included in the strategic overview. In addition, this first conversation should cover the firm's major influences as well as its opportunities and risks in the markets it serves. For instance, a letter from Chairman Jeff Immelt emphasizing the company's dedication to sustainability may be seen in the General Electric 2008 sustainability report. In addition, the

report reviews the firm's promises, accomplishments from the previous year's report, and progress achieved in 2008 toward accomplishing those goals. It also outlines predictions for 2009[9], [10].

Profile of the organization

The corporate name, ownership structure, and headquarters are all included in the organizational profile. The firm also lists its main goods, brands, and services, along with the nations and markets it serves. The corporation also discloses the extent of its engagement in the manufacturing as well as the amount of outsourcing that was done.

Reporting specifications

The specifications of the report pertain to the timeframe covered by the investigation and the company's reporting frequency. At this stage, the company also defines the parameters of the research, including its boundaries and scope, and acknowledges any known limits. In addition, the company offers an overview of its measuring methods and outlines the procedures and guidelines for obtaining outside confirmation on the report.Engagement, pledges, and governance.

The company's approach to achieving its goals is summarized in the governance system. The committees in charge of the company's strategy and organizational supervision, as well as the organizational structure, are all included in governance.

The company also describes its values and purpose in relation to social, environmental, and economic performance. The company also describes the incentive plans of its top officials and specifies how suggestions may be made by staff members and other stakeholders.

The company lists its external obligations as well. An essential aspect of a company's commitment is its involvement in the creation of industry standards. Lists of affiliates and industrial groupings are provided by companies. They also report on triple bottom line concepts that were established outside of their organization and that they support. For instance, the Environmental Defense Fund, the Pew Center, the Natural Resources Defense Council, the World Resources Institute, and the Nature Conservancy are members of the nonpartisan United States Climate Action Partnership, which consists of 26 corporations. GE's 2008 sustainability report acknowledges the company's support for this coalition and its efforts to draft legislation establishing a national cap-and-trade system.

Stakeholder involvement is the last part of the strategic overview. It is crucial to determine these groups' degree of engagement since all of the data in the report comes from them. The company outlines the reasons for the identification and selection of stakeholders as well as the frequency of interaction with each kind of stakeholder. In addition, the business offers an overview of the subjects discussed and attired in stakeholder meetings.

External Verification

Following the completion of its corporate sustainability plan summary, the company reports on its social, environmental, and economic performance, which are delineated in the following parts. After providing these performance indicators, businesses increasingly use a third party to verify their assurance. While many businesses have established processes for identifying sustainable action, assurance is greatly increased when this evaluation is done by an outside party. When a business reports on a third-party review, it says that the evaluation was carried out by an outside party using people whose access to the firm is unrestricted. Individuals with the necessary expertise in the subject area and relevant practices should

complete the third-party review. A publicly accessible assessment of the company's sustainability performance should also be generated as a consequence of the report's methodical, documented creation process.

Economic Value Reporting

Accounting and financial reporting are neither replaced nor substituted by the economic value that a company provides. In contrast, the purpose of this section of the sustainability report is to show how capital moves among stakeholders and to depict the firm's economic influence on society as a whole. Economic reporting comprises analyses of the company's financial performance as well as its local market presence and indirect economic influences.

Financial Outcomes

The way a company presents its worth in terms of accounting and financial standards is referred to as its financial performance. The direct economic value created and delivered to capital providers and the government is identified by the value-added statement. The report's income, employee pay, operational expenses, contributions and other community investments, retained profits, and payments are all compiled in this part. Henkel, for instance, is one of the top manufacturers of adhesives, toiletries and cosmetics, and laundry and home care products worldwide.

The disclosure of the financial effects of climate change on the company is a second financial factor. Businesses suffer regulatory risk as a result of rising expenses as the amount of regulation related to climate change rises. Through new markets and technology, these laws also provide opportunity. Businesses report on these factors to show how they prepare and manage risks. Timberland, for instance, provides information on their attempts to become carbon neutral by 2010. This tactic mostly entails lowering energy use, obtaining renewable energy, and funding renewable energy via the purchase of carbon offsets.Two further pieces of information that are relevant to workers, investors, and other stakeholders are provided by the company. Businesses make the financial obligations related to benefit schemes public. They also state if the government provides them with a sizable amount of cash aid[11], [12].

Regional Market Share

The relevance of the company in the local marketplaces where it is well-established is covered by the second set of economic indicators. The corporation shows how corporate pay relate to local minimum wages in order to report on the relative wage rate. It also provides information on the rules and procedures surrounding the employment of local residents. In a similar vein, businesses disclose the processes involved in locating locally based suppliers. For instance, Unilever's 2008 sustainability report describes the company's initiatives for corporate diversity and leadership development. It also describes the business partner code, which lays out guidelines for sourcing that include labor standards, environmental concerns, health and safety, and corporate ethics.

Indirect effects of the economy. The company's initiatives to improve public welfare have indirect economic effects. The group provides updates on how services and infrastructure are developing. For instance, Unilever states that in 2008, it contributed over $136 million to the community, allowing it to assist about 16,500 community organizations. Businesses also disclose additional forms of economic activity that arise from their sustainability initiatives, in addition to infrastructure investments. For instance, the Unilever 2008 report details the company's continued efforts to address Kenya's political turmoil.

CONCLUSION

This study emphasizes the critical role of sustainability reporting in promoting transparency, accountability, and sustainability in corporate operations. Economic value reporting provides stakeholders with insights into a company's financial performance, market presence, and indirect economic impacts, demonstrating its economic contributions and sustainability. Environmental value reporting sheds light on a company's environmental performance and efforts to minimize its ecological footprint, fostering environmental stewardship and resource conservation.Moreover, the disclosure of social value demonstrates a company's commitment to ethical and socially responsible business practices, enhancing trust and accountability with stakeholders. By transparently reporting on economic, environmental, and social performance, companies can build stakeholder trust, drive continuous improvement, and create long-term value for both shareholders and society.Sustainability reporting serves as a crucial tool for companies to communicate their commitment to sustainability and responsible business practices, contributing to a more sustainable and equitable future for all stakeholders. Through transparent reporting and accountability, companies can align their business objectives with societal and environmental goals, driving positive change and fostering long-term value creation.

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CHAPTER 10

COMPREHENSIVE ROLE OF SUSTAINABILITY REPORTING: DEMONSTRATING COMMITMENT, ASSESSING PERFORMANCE, AND DRIVING LONG-TERM VALUE

Prof. (Dr.) Smita Mishra, Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id-smita.mishra@muit.in

ABSTRACT:

Sustainability reporting is a multifaceted tool for companies, serving three primary purposes. Firstly, it allows companies to demonstrate their commitment to sustainability, which is increasingly valued by consumers, investors, and regulators. Secondly, sustainability reporting enables companies to evaluate their performance against various benchmarks, fostering a culture of continuous improvement and accountability. Thirdly, sustainability reports provide businesses with the opportunity to showcase their long-term performance compared to competitors, thereby enhancing transparency and stakeholder engagement. This study examines the advantages and procedures of sustainability reporting, with a focus on environmental value reporting. Environmental value reporting plays a crucial role in corporate sustainability initiatives, encompassing the transparent communication of a company's environmental performance, impacts, and contributions to mitigating climate change and preserving natural resources. This paper provides a comprehensive overview of environmental value reporting, highlighting its importance in promoting transparency, accountability, and informed decision-making in corporate sustainability efforts.

KEYWORDS:

Company, Economic, Financial,Stakeholder, Society, Sustainability.

INTRODUCTION

Sustainability reporting serves as a multifaceted tool for companies, fulfilling three primary purposes. Firstly, such reports enable companies to demonstrate their commitment to sustainability. In an era where environmental and social responsibility are increasingly valued by consumers, investors, and regulators alike, sustainability reporting provides a platform for companies to showcase their efforts towards mitigating their environmental footprint, promoting social equity, and fostering economic resilience. By transparently disclosing their sustainability initiatives, goals, and outcomes, companies can build trust and credibility with stakeholders, enhancing their reputation as responsible corporate citizens.

Secondly, sustainability reporting facilitates companies in evaluating their performance against a myriad of benchmarks, including legal requirements, industry standards, international conventions, and voluntary initiatives. Through comprehensive reporting on key sustainability indicators, companies can assess their adherence to regulatory frameworks, compliance with environmental and social standards, and alignment with global sustainability goals such as the United Nations Sustainable Development Goals (SDGs). This enables companies to identify areas of strength and weakness, set targets for improvement, and benchmark their performance against industry peers, thus fostering a culture of continuous improvement and accountability.

Thirdly, sustainability reports provide businesses with the opportunity to demonstrate their long-term performance vis-à-vis their competitors. By analyzing and disclosing relevant sustainability metrics over successive reporting periods, companies can showcase their progress, resilience, and adaptability in addressing environmental, social, and economic challenges. This longitudinal perspective not only enhances transparency but also enables stakeholders to gauge the sustainability maturity and leadership of a company within its industry. Moreover, comparative analysis against industry benchmarks and peer performance can highlight areas of competitive advantage and areas for strategic differentiation, thus informing decision-making and stakeholder engagement strategies[1], [2].

In essence, sustainability reporting serves as a strategic imperative for businesses seeking to navigate the complexities of the modern marketplace while simultaneously contributing to global sustainability objectives. By embracing transparency, accountability, and long-term thinking, companies can leverage sustainability reporting to enhance their brand reputation, drive operational efficiency, mitigate risks, and unlock new opportunities for innovation and growth. As sustainability continues to emerge as a critical driver of business success, the importance of robust and credible sustainability reporting cannot be overstated, serving as a cornerstone for building resilient and sustainable business models for the future.

Advantages of Reporting on Sustainability

Sustainability reporting offers numerous advantages for businesses, encompassing environmental awareness, risk mitigation, goal tracking, and the identification of new opportunities. Firstly, through sustainability reporting, businesses can heighten their awareness of their environmental performance and disseminate pertinent environmental information to all relevant stakeholders. By systematically gathering and analyzing data on their environmental impact, companies can gain insights into areas where improvements can be made, thereby fostering a culture of environmental responsibility across their operations.

Moreover, sustainability reporting enables businesses to monitor their progress in relation to predefined sustainability goals. By establishing clear objectives and regularly tracking performance against these targets, companies can effectively gauge their sustainability efforts and make informed decisions to drive continuous improvement. This proactive approach to monitoring progress not only enhances accountability but also empowers organizations to address sustainability challenges in a timely and strategic manner.In addition to monitoring progress, sustainability reporting facilitates the identification of potential risks and opportunities for businesses. By conducting comprehensive assessments of their environmental, social, and governance (ESG) performance, companies can proactively identify and mitigate risks related to regulatory compliance, supply chain disruptions, and reputational damage. Furthermore, by leveraging sustainability data, businesses can uncover new market opportunities, enhance operational efficiency, and realize cost savings through resource optimization and waste reduction initiatives.

Furthermore, sustainability reporting can uncover new business prospects and efficiency and savings potential. By analyzing sustainability data and identifying areas for improvement, businesses can unlock new revenue streams, enhance their competitive edge, and strengthen their brand reputation as socially and environmentally responsible entities. Additionally, by optimizing resource utilization and implementing sustainable practices, companies can achieve cost savings through reduced energy consumption, waste management efficiencies, and enhanced productivity.In essence, sustainability reporting serves as a valuable tool for businesses seeking to enhance their environmental performance, manage risks, achieve strategic goals, and capitalize on new business opportunities. By embracing transparency and

accountability in reporting their ESG performance, companies can not only meet the expectations of stakeholders but also drive positive societal and environmental impacts while securing long-term business success[3], [4].

Overview of Reporting on Sustainability

A company's sustainability strategy serves as a cornerstone of its operations, encapsulating its commitment to environmental stewardship, social responsibility, and economic viability. This strategy is meticulously outlined and elucidated in its sustainability report, which serves as a comprehensive document detailing the company's overarching sustainability objectives and initiatives. Moreover, the sustainability report delves into various facets of the organization, providing insights into its corporate strategy, governance structure, and the strategic approach adopted towards the markets it serves. Through this holistic examination, stakeholders gain a deeper understanding of how sustainability principles are integrated into the company's overarching vision and mission.

In addition to elucidating the company's strategic direction, the sustainability report meticulously analyzes and evaluates its social, environmental, and economic performance. This entails a thorough examination of key performance indicators (KPIs) related to sustainability metrics, such as carbon footprint reduction, energy efficiency measures, diversity and inclusion initiatives, community engagement programs, and adherence to ethical labor practices. By transparently reporting on these aspects, the company demonstrates its commitment to accountability and provides stakeholders with valuable insights into its sustainability efforts and progress.

Crucially, the quality and integrity of sustainability reports are upheld through independent verification processes. Independent verification involves the rigorous assessment and validation of the data and information presented in the sustainability report by external auditors or third-party verification agencies. This ensures the accuracy, reliability, and credibility of the information disclosed, instilling confidence among stakeholders, including investors, customers, employees, and regulatory bodies. Furthermore, independent verification serves as a mechanism for identifying areas for improvement and enhancing the overall transparency and credibility of the company's sustainability reporting practices.

Overall, sustainability reporting plays a pivotal role in promoting transparency, accountability, and stakeholder engagement in corporate sustainability initiatives. By providing comprehensive insights into a company's sustainability strategy, performance, and impacts, sustainability reports enable stakeholders to make informed decisions and hold the organization accountable for its actions. Through independent verification, companies can further enhance the credibility and reliability of their sustainability reports, ultimately driving positive social, environmental, and economic outcomes.

DISCUSSION

The firm's actions in relation to material use, energy, water, biodiversity, waste and by-products, goods and services, and transportation are all included in the environmental performance reporting. Let's start with the firm's material use.

Environmental Value Reporting

Environmental value reporting is a critical component of corporate sustainability initiatives, encompassing the transparent communication of a company's environmental performance, impacts, and contributions to mitigating climate change and preserving natural resources. This form of reporting goes beyond mere compliance with regulatory requirements and

delves into the holistic assessment of environmental risks and opportunities, as well as the integration of environmental considerations into business strategies and decision-making processes.At the core of environmental value reporting is the quantification and disclosure of key environmental metrics and indicators, such as greenhouse gas emissions, water consumption, waste generation, and biodiversity conservation efforts. By systematically measuring and reporting on these metrics, companies can assess their environmental footprint, identify areas for improvement, and track progress towards sustainability goals. This data-driven approach enables stakeholders to gain insights into the company's environmental performance and its efforts to minimize adverse impacts on ecosystems and natural habitats.

Moreover, environmental value reporting serves as a platform for companies to showcase their commitment to environmental stewardship and corporate responsibility. Through narrative disclosures, case studies, and best practice examples, companies can communicate their sustainability initiatives, innovations, and achievements in addressing environmental challenges. This transparent communication fosters trust and credibility among stakeholders, including investors, customers, employees, and communities, and enhances the company's reputation as a responsible corporate citizen.In addition to showcasing achievements, environmental value reporting also highlights areas for improvement and sets targets for future environmental performance. By establishing ambitious goals related to emission reductions, resource efficiency, and sustainable sourcing, companies demonstrate their commitment to continuous improvement and driving positive environmental outcomes. Moreover, setting clear targets allows stakeholders to hold the company accountable for its environmental commitments and track progress over time[5], [6].

Furthermore, environmental value reporting provides valuable insights into the business case for sustainability and the financial implications of environmental management practices. By quantifying the costs and benefits associated with environmental initiatives, companies can demonstrate the tangible value generated through investments in sustainability, such as cost savings from energy efficiency measures, enhanced brand reputation, and access to new markets or business opportunities. This financial perspective reinforces the importance of integrating environmental considerations into overall business strategies and decision-making processes. Environmental value reporting is an essential tool for promoting transparency, accountability, and informed decision-making in corporate sustainability efforts. By systematically measuring, disclosing, and communicating environmental performance and impacts, companies can enhance stakeholder trust, drive continuous improvement, and create long-term value for both shareholders and society.

Materials

The monitoring of this element allows the company to evaluate material efficiency and expenses related to the flow of material. Material consumption directly addresses the total cost of operations. Businesses report on semi manufactured items, raw materials, processed materials, and packaging materials. They also disclose how much of recycled materials they utilize as inputs. For example, the 2008–2009 Ford Motor Company sustainability report states that over 20% of the content of automobiles sold in North America is made up of recycled materials. The study also states that Ford uses a life-cycle design approach.

Vitality

To achieve fuel efficiency, energy consumption monitoring is essential. Businesses keep an eye on both direct and indirect energy use. While indirect energy refers to the usage of energy that has undergone some kind of transformation, direct energy refers to the use of energy

without conversion. For instance, coal is directly used by an electrical plant to generate its output of energy. Indirect energy consumption is what happens when an auto plant uses this electricity. Businesses report on the usage of nonrenewable energy sources, such as coal, natural gas, gasoline, and others, under the direct energy category. Renewable energy sources like biofuels, ethanol, and hydrogen are also considered forms of direct energy. Similar distinctions are made between renewable energy sources like solar, geothermal, and wind energy and non-renewable energy sources like steam, electricity, heating/cooling, and nuclear power in reporting on indirect energy usage.

By providing reports on energy use over time, businesses may demonstrate the outcomes of their attempts to reduce energy use. The procurement of coal, fuel oil, and electricity is tracked over a five-year period, for instance, in the Merck 2008 Sustainability Report. Companies provide proof of the extent to which conservation efforts boost energy efficiency and lower direct and indirect energy consumption. Additionally, they specify the degree to which their goods use renewable energy sources or energy-efficient technology. For instance, Ford's 2008-2009 sustainability report details the company's initiatives to lower its energy use, both direct and indirect. The study also emphasizes Ford's efforts to create vehicles that use electrification, alternative fuels, and new drive train technologies in an effort to improve efficiency [7], [8].

Aqua

Due to the decreasing availability of clean freshwater, companies' water uses reports shed light on the financial and social risks that the organization faces. Companies disclose the volume of water they take out of surface sources, ground water, rainwater, municipal sources, and waste water. They also pinpoint water sources that are greatly impacted by water loss. They also show the total amount of recycled or reused water. For instance, Abbott Laboratories' 2008 sustainability report details the company's initiatives to cut water use by 40% in comparison to 2004 norms.The diversity of life. Environmental evaluations must evaluate the firm's efforts to improve habitat, especially in light of the impending threats to flora and wildlife. Businesses report on their activities, plans, and effects on wildlife in protected areas and high biodiversity regions. The reporting also lists the number of endangered species that the company's activities have impacted, as well as the ecosystems that the company has restored or preserved. For instance, Shell Oil describes how it preserves tundra habitats in the Arctic via collaborations with Wetlands International and the International Union for the Conservation of Nature. They may also preserve wetlands that are in the route of migrating birds thanks to their partnership.

Leftovers and by-products

The gaseous, liquid, and solid outputs that are thrown away in the supply chain are known as waste and by-products. Both ozone-depleting compounds and greenhouse gas emissions are examples of gaseous by-products. Businesses disclose their efforts to reduce emissions as well as the methodology used to establish the amount of these outputs. Voda-phone, for example, reports its total greenhouse gas emissions both directly and indirectly in its energy performance report. Liquid by-product reporting, on the other hand, reports on all water discharges as well as spills of chemicals, oil, and other materials. For example, Shell claims that in 2008, it transported over 40 million tons of cargo without experiencing a single leak. However, it goes on to say that around 300 tons of diesel fuel were spilled into the German Elbe River by a single-hull ship that was hired out for a brief period of time. According to Shell's sustainability report, the company is gradually introducing double-hull ships in an effort to lower the risk of spills Businesses also report on the overall amount of garbage and

the techniques used to dispose of it. Waste that is liquid, solid, hazardous, and nonhazardous is included in this item. For instance, Abbot Laboratories reports that, compared to 2007, its hazardous waste output decreased by 21% in 2008. Companies disclose the extent to which they dispose of their byproducts through composting, reuse, recycling, recovery, deep well injection, on-site storage, incineration, or landfills.

Goods and Services

Product-related conservation initiatives focus on the inputs used in development and manufacturing. Companies include descriptions of the material, water, emissions, and other aspects related to their goods. For instance, Apple's yearly sustainability report details the life cycle costs associated with each of its products. Product reporting also takes the company's level of product reclamation into consideration. It's important to create programs to recover and properly dispose of the hazardous compounds that were formerly used in the production of various items, such as brominated flame retardants. For example, the Lexmark sustainability program details the company's initiatives to salvage printers, inkjet cartridges, and laser toner cartridges, among other items.

Observance

This aspect of reporting pertains to the degree of complianceor noncompliancethat an organization has with environmental rules. In general, compliant businesses have lower financial risk and are in a better position to obtain licenses or carry out other business expansions. Some sustainability reports from businesses include an assessment of their environmental policy together with proof that they adhere to industry norms. Merck's 2008 sustainability report, for instance, describes the company's commitment to safety and environmental performance and demonstrates its adherence to current environmental laws pertaining to spills. Businesses can provide an explanation for their noncompliance with current standards by disclosing monetary fines and nonmonetary penalties related to environmental rules. For instance, the Merck 2008 report shows that the business spent more than $1 million in penalties for infractions and was subject to 178 environmental inspections in 2008.

Moving

It is crucial for businesses to disclose the impact of transportation as many organizations derive their primary source of value from their product supply chains and distribution networks. Businesses choose how they plan to reduce transportation expenses. Crucially, they cover the energy used in transportation, the emissions brought on by it, as well as the trash, noise, and spills related to it. For example, the United Parcel Service environmental stewardship report offers a summary of energy use for air, train, and road transportation. According to the research, transitions from air to ground and ground to rail save 3 million metric tons of CO_2 in absolute terms[9], [10].

Reporting Social Value

The third part of sustainability reporting is social value reporting. Reports on labor practices, human rights, product responsibility, and society are included in this section.

Human Rights

In the area of human rights, the company describes how it upholds and honors people's fundamental rights. The company discloses the degree to which trade partners and investment agreements have been examined for compliance with human rights standards. In its 2008

sustainability report, Ford Motor Company, for instance, talks about working with its supply chain partners to address human rights concerns. Businesses report on the amount of money they have spent on educating employees about human rights problems as well as the quantity of discriminatory occurrences that have occurred.

A few rules pertaining to working conditions are also included under the human rights section. Businesses disclose any activities that have a substantial chance of restricting the freedom of collective bargaining and association. They also provide information on operations that might include forced labor or underage labor. For instance, Starbucks' 2009 sustainability report details the company's efforts to reach its objective of having 100% of its coffee produced ethically and responsibly. Growing coffee according to these guidelines is unlikely to go against requirements for labor conditions.

Labor Standards

The idea of decent employment is central to the examination of labor practices. The company highlights elements of age and gender distribution and divulges the number and diversity of its staff. In addition, the company reports the benefits it offers to employees and the degree to which it makes use of collective bargaining agreements. Furthermore, it offers financial and demographic statistics on employee data to demonstrate equity and diversity. For instance, Shell's 2008 sustainability report details the company's progress toward its objective of reaching a minimum of 20% representation of women in senior management.

Standards for occupational health and safety, as well as the company's regular training, safeguard workers' physical and mental wellbeing. These occupational health and safety indicators help businesses track statistical performance and tell staff members about their health and safety initiatives. Businesses disclose how much counseling and training is devoted to educating the public about major illnesses and diseases. Coca-Cola, for instance, provides information about its treatment and preventive initiatives aimed at halting the HIV/AIDS epidemic.

Product accountability

Reports on product responsibility examine how goods and services affect consumers and users. It is required of organizations to use due care in ensuring that their goods are safe for their intended use and do not present any unexpected risks to the health and safety of users. Businesses report on the effects of their goods on health and safety as well as instances of noncompliance with regulations. IBM, for instance, provides information on the evaluation of product safety and health in the following areas: idea creation, R&D, product certification, manufacturing, marketing, distribution, usage, and disposal. Businesses also specify the kind of product labelling.

Reporting on product responsibility also takes customer information security and marketing communications into account. Programs for adhering to regulations and standards pertaining to sponsorship, advertising, promotion, and other marketing communications must be outlined by businesses. The Ford 2008 Sustainability Report, for instance, details the company's compliance with the Federal Trade Commission Act and its modifications.

Reporting companies are also required to disclose the quantity of instances in which rules are broken and to disclose any penalties that result from such violations. Product responsibility reporting also addresses the issue of customer privacy. The organization displays the amount of verified complaints about data breaches and privacy violations.

Community. Human rights, labor, and product concerns center on a particular set of stakeholders, whereas societal performance metrics show how the community as a whole interacts with the business. The company gives a summary of the initiatives it has designed to control and evaluate the impact of its activities on the neighborhood. Shell Oil, for instance, provides information about its initiatives to lessen the impact of its activities on nearby communities. Shell and the Living Earth Foundation collaborate to foster communication between the company and Alaskan communities who are affected by the extraction, processing, and delivery of oil and gas.

The reporting corporation gives an account of its donations to political parties, legislators, and associated institutions in all the markets it serves, along with a summary of its involvement in lobbying and public policy formulation.

The company also discloses information on how well it complies with legal requirements and judgments pertaining to anticompetitive or corrupt practices. For example, Shell provides a code of conduct that covers standards related to political activity, gifts and hospitality, insider selling, bribery and corruption, and conflicts of interest. The reporting company additionally specifies how many business divisions were examined for corruption risk and how much staff had been educated in the company's anticorruption procedures.

CONCLUSION

Sustainability reporting serves as a strategic imperative for businesses navigating the complexities of the modern marketplace while contributing to global sustainability objectives. Through transparency, accountability, and long-term thinking, companies can leverage sustainability reporting to enhance brand reputation, drive operational efficiency, mitigate risks, and unlock new opportunities for innovation and growth. Environmental value reporting, as a critical component of sustainability reporting, provides valuable insights into a company's environmental performance, impacts, and contributions to mitigating climate change and preserving natural resources. By embracing transparency and accountability in reporting environmental performance, companies can foster trust and credibility among stakeholders while driving positive social, environmental, and economic outcomes. As sustainability continues to emerge as a critical driver of business success, robust and credible sustainability reporting will remain essential for building resilient and sustainable business models for the future.

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CHAPTER 11

SUSTAINABLE VALUE DELIVERY: A COMPREHENSIVE ANALYSIS OF SUPPLY CYCLES AND ECOLOGICAL SUPPLY CHAINS IN MARKETING AND LOGISTICS

Prof. (Dr.) Smita Mishra, Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id-smita.mishra@muit.in

ABSTRACT:

This study delves into the intricate network of supply cycles that underpin almost all product deliveries in various sectors, with a particular focus on the textbook supply chain. By examining the roles and interactions of organizations involved in producing a product, the study aims to enhance understanding of supply cycles and their significance in achieving sustainability goals. The concept of supply cycles integrates principles from logistics, marketing strategy, and Porter's value chain model, emphasizing the interconnectedness of environmental, social, and economic value creation. Through an analysis of input-output processes and the management of by-products, the study elucidates how organizations can optimize supply cycles to maximize benefits while minimizing environmental impact. Additionally, the study explores the advantages of ethical supply chain management, such as improved product quality, decreased turnover, enhanced profitability, and efficiency gains. Furthermore, it discusses the role of logistics, including reverse logistics and the adoption of cutting-edge technologies, in achieving sustainability objectives and reducing operational costs. Overall, the study underscores the importance of viewing value delivery as a supply cycle and provides insights into strategies for building environmentally friendly and economically viable supply chains.

KEYWORDS:

Economic, Logistics, Marketing,Supply Cycle, Supply Chain.

INTRODUCTION

Almost all marketing product deliveries across sectors are supported by supply cycles. Teachers, students, book binders, distributors, retailers, soybean farmers, paper makers, ink manufacturers, forestry companies, and recycling facilities are all part of the textbook supply chain. In order to comprehend supply cycles, one must have an appreciation for the organizations that go into producing a product and the roles that these organizations play in the process. Enhancing sustainability requires a thorough grasp of the roles that each cycle performs. These roles help certain supply chain participants in effective supply cycles. These advantages could be linked to improved financial, social, and economic performance, as was covered in Chapter 1's discussion of the triple bottom line. On the other hand, the triple bottom line's pursuit of several alternative performance components concurrently is what makes the company sustainable. Knowing the advantages of each function allows one to work toward creating environmentally friendly supply chains that maximize benefits at every stage of the value chain.

The tasks carried out within the channel are assigned to certain companies in several sectors. For instance, accounting companies are somewhat connected to the auditing function. While it is possible to remove an organization from the supply chain in many situations, the value

that an organization creates cannot be removed. Therefore, if a textbook publisher chooses not to work with stores, books must still be sold to students online or via other channels. The actions carried out in a supply cycle are described in the section that follows, and these entities are treated as distinct organizations. Although we treat them as distinct tasks, we acknowledge that an organization may choose to handle many supply cycle tasks. Starbucks Coffee, for instance, is a retailer that controls the majority of the supply chain, from the production of coffee beans to retail sales.

There are many definitions of value delivery offered by academic research. A channel is defined in marketing terms as a group of companies that work together to make a product accessible for purchase. Similar to this, logistics defines the supply chain as a collection of companies that are actively involved in the movement of goods and information from a source to a customer. Although the particular organizations that route items to customers are included in both of these definitions, the value that results from product offers is not highlighted. Porter, on the other hand, defines a value chain as the collection of the company's core and auxiliary operations that provide it a competitive edge. Knowing how to deliver value to the customer via a channel gives a business a competitive edge. This viewpoint does not really address the connection between value and the environment, although offering sharp insight into attempts to supply value to consumers.

Supply cycles are the systems that result in environmental, social, and economic value from the acquisition, processing, consumption, and post-consumption of resources. The logic of supply chains and distribution channels in logistics and marketing strategy, as well as the logic of the value chain as defined by Porter, are all included into our concept. This concept requires knowledge of the value chain in addition to the input-output process at each supply cycle level. The input-output process assumes that processing occurs at every stage of the supply cycle. Processing results in both inputs and outputs[1], [2].

There are two types of input and output for each entity in the supply chain. Inputs include resources derived from the environment as well as those factors handled by a higher-ranking organization in the supply chain. There are two kinds of output products and by-products for each entity in the supply chain. The main results of processing are called products, while all other results are referred to as by-products. For instance, iron ore and compressed air are listed as inputs to steel production in the steel manufacturing process. Combining these inputs results in a series of procedures that produce carbon dioxide and slag as byproducts along with steel coils as the final product. The steel producers may reduce operating expenses and boost income to the degree that they can discover applications for these by-products. Therefore, the steel company may avoid the expenses associated with slag disposal while increasing income if they are successful in marketing the slag to the concrete sector. Furthermore, the road manufacturing industry's carbon footprint is reduced by the slag by-product of steel manufacture.

Because of how the environment and the process of product creation are related, we call the process of providing value a supply cycle. In the end, the environment provides the inputs, and the environment provides the outputs. The incentive to participate in the supply cycle comes from the product outputs, which also serve as inputs for the subsequent phase of the cycle. The by-products are either recycled back into the environment or used as inputs in other supply chains.

The environment must be taken into account throughout the whole value chain cycle as it influences supply chain operations both directly and indirectly. The parties engaged in the supply cycle provide product inputs for the subsequent stage of the cycle at each step of the

process. These entities get their value from the environment or from processing that occurs earlier in the supply chain. Therefore, the maker of bicycles purchases steel from a producer of metal, but the making of bicycles also need water that is obtained from the environment. An entity interacts with the environment at every step of the supply cycle, sending and receiving resources. A company like a retailer generates byproducts that are recycled back into the environment or used in other supply chains. The firm may profit from the by-product to the extent that these outputs are integrated into other supply chains. By-products, on the other hand, that are worthless in supply chains have to be returned to the environment. Although these outputs don't bring in money, they do raise operating expenses.

By seeing value delivery as a supply cycle, it becomes possible to analyze individual outputs and the costs and advantages that come with them. Walmart created a sustainability scorecard in 2007 that recognizes 14 categories of goods or procedures with the most environmental effect in accordance with this viewpoint. The company's objectives to utilize only sustainable energy, attain zero waste, and sell sustainable goods are linked to these 14 areas. As a result, the company has expanded its usage of sustainable energy sources including solar panels and natural lighting. In an attempt to save waste, it has also led the way in material handling improvements. The company has also embraced a number of environmentally friendly innovations, such as selling detergents that are ultraconcentrated only.

Advantages of Ecological Supply Chains

The triple bottom line approach offers the chance to discuss many benefits that result from sustainable supply chains. Take into account the following advantages of practicing ethical supply chain management. Improved Product Quality, Decreased Turnover, and Better Working Conditions an enterprise may determine the circumstances under which raw materials are converted into consumer goods by taking the time to research the businesses and operations within its supply chain. For instance, the British car industry's Mayflower Vehicle System PLC is a subcomponent assembler situated in Birmingham, England. It examined the waste resulting from shop floor activities in its examination of the sustainability of operations. Defective components, individual productivity, stock turnover frequency, meeting delivery deadlines, equipment efficiency, value contributed per person, and floor space utilization were all taken into account when calculating waste. Change agents discovered that giving workers a feeling of ownership over the tools and procedures related to their occupations made these waste reduction targets more agreeable to them. Better working conditions resulted from the evaluation of operations to reach higher levels of sustainability, which is one social aspect of the triple bottom line. Economic benefits from improved working conditions include less staff turnover and improved product quality.

Enhanced Profitability and Efficiency

The goal of delivering value in a sustainable manner draws attention to the inputs and outputs connected to each stage of the supply chain. The company has a great chance to increase profitability by concentrating on initiatives to minimize inputs and optimize output productivity. Packaging serves as an example of how sustainability may impact professors in several ways. The company lowers warehousing, distribution, and transportation expenses by using effective packaging. Reducing the quantity of fiber in packaging may be accomplished by the use of lighter and less corrugated board in package designs. Reusable packaging, automated case formation, and stretch wrapping of material pallets are more ways to achieve efficiency[3], [4].

Club businesses like Sam's Club provide yet another creative illustration of sustainable packaging. These shops often use packaging that serves as both a display package and a

delivery container. These shops' optimal packaging guarantees flawless delivery, improved shelf appeal, and less waste. When combined, these advantages increase retail space productivity while lowering overhead.Improved Risk Management Businesses that are aware of their responsibilities are in a better position to reduce the risk they face. Variations in potential outcomes and their likelihoods are referred to as risks.An examination of supply chain disruptions and their detrimental effects is part of the liability assessment process. Reduced risk may be linked to cheaper insurance premiums, less expensive legal and regulatory fees, and better loan interest rates.

DISCUSSION

Risk in the supply chain arises from the value stream, interfirm networks, asset concerns, and macroenvironmental problems. The movement of materials, knowledge, and funds across the supply cycle are all taken into account when analyzing risk in the value stream. Businesses assess how goods and by-products are sourced and processed by value cycle upstream partners. Organizations also evaluate how consumers of their goods consume and dispose of their leftovers. The circumstances in which a business invests in certain technologies that have limited applications outside of their original function are referred to as asset considerations. Organizations that use global supply specialization of processes run a higher risk of problems with component supply security and quality control. Interfirm networks highlight how reliant one individual is on other companies along the supply chain. Businesses that rely heavily on other organizations run the danger of experiencing higher levels of risk, which should be managed via contracts or solid stakeholder relations. The total amount of risk present in the social, economic, and environmental contexts is referred to as the macroenvironmental concerns.Even while each of these four risk categories may be seen separately, these contingencies interact with one another. For instance, software firms' investments in Apple and Microsoft's specialized operating systems have an impact on cash flow in the personal computer market. The software companies rely increasingly on the operating system architects as these investments increase in value.

Improved Image of the Brand Businesses that engage in sustainable supply chain processes build favorable brand perceptions that benefit several relationships. As an example, Cisco Systems has established a solid reputation as a leader in the supply chain. Almost 90% of the output in this company's supply network is supplied by non-Cisco personnel. Strong working ties are fostered with a select few suppliers by Cisco's proactive approach to the supply chain. In addition, they keep a close eye on technology developments, pay close attention to consumer needs, and provide a variety of solutions as part of their supply strategy.

Increased Stakeholder Returns Businesses that prioritize the triple bottom line are better equipped to foresee and keep an eye on the risks related to returns on the economy, society, and environment. Through active communication with both partners upstream and customers downstream, Cisco has built robust inter-firm relationships. Furthermore, in highly volatile technological marketplaces, it may sustain a very low turnover rate. As a result, investors find this company and others that foster robust supply cycles more appealing as they are more suited to handle these various risk aspects than their rivals. Maintaining a sustainable supply chain also lessens the chance that a company would face backlash or other complaints from communities and NGOs[5], [6].

Ecological Transportation

The planning, distributing, and managing of financial and human resources for the purposes of physical distribution, manufacturing support, and purchasing processes is known as logistics. Activities related to the logistics function include distribution communications,

inventory control, materials handling, order processing, parts and service support, procurement, packaging, return goods handling, disposal of salvage and scrap, traffic and transportation, warehousing and storage, customer service, and demand forecasting. Considering that in 2006, logistics accounted for almost 10% of the US GDP may help you understand the importance of this job. Logistics accounts for 9.9% of the company's costs on average, with the main expenses being related to transportation, warehousing, order entry/customer service, administration, and inventory carrying. Companies get a competitive edge via the resources they own and the skills that allow them to use these resources most effectively. Assessing these assets and their deployment from point of origin to consumption is made possible by an analysis of the logistics function.

Reverse logistics, or tracking things back from the point of consumption, are becoming more and more important in supply chains, even though logistics has historically been connected to the movement of commodities toward consumption. Returned items, appropriate disposal of end-of-life products, production scheduling, inventory control, and supply chain management have all raised interest in reverse logistics.Roughly 70% of the stuff that was returned in 2005 had no defects and had been returned for some other reason, with the total cost of returns estimated to be $100 billion. Walmart established a target in 2008 to eliminate returns of faulty products among its top 1,000 suppliers in less than four years after realizing the significant cost of returns.

To assist efforts to achieve this aim, the corporation intends to deploy on-site audits, enforcement of social and environmental standards, and the prospect of lost business. A viewpoint on reverse logistics offers the chance to investigate the impact of returned items and also to ascertain how much supply chain choices are influenced by retail inventory levels, product life cycle concerns, and promotional initiatives.

The company must see logistics as a source of long-term competitive advantage because of the scope of logistics and how logistics management affects operating costs. Businesses looking to improve triple bottom line performance are increasingly looking at the following aspects of logistics:Fleet Efficiency Product transportation entails substantial expenses, and as fossil fuels are the primary source of energy for most modes of transportation, this aspect of logistics is closely related to sustainability issues.

Companies are putting a lot of work toward reducing this function, which is done via internal company resources or outside vendors. Crucially, restricting both the quantity of travel these vehicles do and the cost of transportation is how fleet cost optimization is accomplished. For instance, Staples fitted governors to every car in their fleet in 2007. Delivery truck speeds were limited by these governors to sixty miles per hour. Following the installation of these devices, the firm saw a 25% reduction in fuel consumption and a 500,000–750,000 gallons decrease in diesel fuel expenses.

In a similar vein, UPS instituted a program a few years back that instructed drivers to plan their routes so that they turn right whenever feasible. This straightforward tactic results in safety benefits, lower emissions, and fuel savings since cars do not have to stop for oncoming traffic. In addition, right-on-red laws save gasoline whereas left turns need longer idle times while waiting for incoming traffic. According to UPS, the right-turn policy helped the firm save 32,000 metric tons of pollutants and 3.1 million gallons of gasoline in 2007.

The distribution function's planning is linked to a second way to reduce transportation expenses. Organizations may get aggressive about the costs associated with delivering goods to customers when they analyze the relative locations of the company's distribution hubs and the final consumer. Procter & Gamble, for instance, reduced the number of distribution

centers by 200 sites and reevaluated the expenses associated with staging and distribution. As a result, the company was able to provide customers with items more quickly.

Efficiency in Energy Use In addition to reducing transportation expenses, businesses may also increase efficiency by managing energy use at production and distribution facilities. The use of cutting-edge construction materials results in increased efficiency. By concentrating on the design of airtight buildings, new construction allows businesses to reduce waste related to heat and cooling losses.

For instance, ProLogis built a warehouse in the UK for Sainsbury's, one of the biggest grocery stores in England. This facility includes energy-efficient lighting, airtight construction to reduce energy loss, solar walls that produce heat from sunlight, wall-mounted photovoltaic panels that generate electricity, an on-site power plant that repurposes the heat produced by air conditioning, and an on-site recycling facility[7], [8].

Cutting-edge technology

Numerous cutting-edge technologies provide a wealth of opportunities for handling the logistics function. Inventory management software, RFID, GPS, and computer systems for routing and tracking are the four technologies that have an impact on operations.Time-definite services are becoming more and more necessary in the worldwide courier and shipping sector, which UPS operates in. UPS has grown to be recognized as a top package delivery service provider by establishing a strong electronic information transportation division. To provide it a competitive edge in this difficult industry, the organization has created an information processing system. Using bespoke handheld computers with pen input, UPS delivery personnel take the signature of each receiver of a product or document. Every day, the system gathers electronic information on almost 9.5 million parcels. The world's biggest IBM D-baseII installation supports this system. The architecture of the system makes it easy to integrate new technologies into the network. Furthermore, reporting features provide UPS customers the chance to get personalized data about their goods and clients. The company's productivity and pricing competitiveness have increased thanks to the routing and tracking computer system, which has also enhanced information management and customer support.

Software for inventory management is the second cutting-edge technology that offers a competitive edge. For many firms, inventory is a significant financial commitment. When money is invested in inventory, it does not provide the same return as when it is put in a financial institution. As a result, businesses want to keep inventory as low as possible while still providing the quality of service that consumers demand. The market for cosmetics is a prime example of very erratic demand, coupled with the possibility of obsolescence in inventory and consequent out-of-stock situations. In this context, Procter & Gamble offers a variety of items, including Aussie shampoo, CoverGirl cosmetics, Olay skin care products, and many more. The company started using multi-echelon inventory technologies, which are intended to optimize inventory throughout the supply chain, five years ago. The dynamic product life cycles, contract manufacturing, multichannel distribution systems, and increasingly worldwide supply chains have all been taken into consideration in the creation of this MEI software. With the use of mathematical models included in this program, managers may make plans for intricate market situations.

The program makes better judgments regarding inventory policy and strategy by identifying demand and supply fluctuation using probabilistic optimization approaches. P&G can now engage with suppliers to minimize material stocks and with customers to reduce retail inventory thanks to the software. The company's manufacturing and distribution processes

have been made more responsive, better materials and production planning have been done, and these reductions have all been made. It's important to note that this method prioritizes inventory optimization above inventory reduction. The Beauty Care segment at P&G reduced overall inventory by 3 to 7% during the first installation while keeping service levels over 99%. Sales went up 7%, net profits went up 13%, and the number of inventory days on hand decreased by 8 days. P&G has decided to roll out the inventory management software to all of its key business divisions as a consequence of these outcomes.

Radio frequency identification, or RFID, is a cutting-edge technology with important uses in retail and logistics. A radio frequency emitter/reader and a radio frequency tag with a printed antenna make up RFID technology. The tag's signal yields a unique 96-bit product identification code. Unlike bar codes, which require line-of-sight scanning, RFID tags may be read.At the Auto-ID Center at MIT, a group including the Uniform Product Code, P&G, Gillette, Coca-Cola, the Department of Defense, and Walmart conducted some of the most insightful preliminary research on RFID. These readers have many advantages in the industrial sector. These tags guarantee that every component connected to an assembly is really there. Similar to this, RFID scanners make it easier to verify the correctness of plant deliveries by removing the need to use a driver's bill of lading to verify the product's physical delivery. The management may also choose the best location for items in storage thanks to these solutions. To boost production throughput, for instance, out-of-stock products might be placed straight into the assembly line as soon as they arrive at the loading dock. Inventory warehousing may be done rather flexible since the devices don't need to be in line of sight to read what's inside a container. RFID technology also enables warehouse workers to store some items in different places by detecting compatibility problems between two chemical reagents. RFID's tracking capacity lowers the risk of employee theft by allowing the identification of each item that leaves a distribution center.

Retailers may also profit from a number of other significant advantages provided by RFID readers; Walmart recognized this in 2005 when it mandated that its top 100 suppliers use RFID chips. Thanks to this technology, businesses may price things differently depending on where they are in the shop and can effectively manage inventory across different locations. Soft drinks that are chilled may thus cost more than those that are displayed on regular shelves. Retailers may also concentrate more on rotating stock in their shops since each product has information that connects the date of sale and the date of delivery. One further benefit of product tracking is the potential to reduce retail shrinkage.

The supply chain is significantly impacted by the use of RFID technology. Retailers' access to information probably gives them more clout than suppliers. Without the assistance of manufacturers, the shop may create its own category management system using RFID technology. This information may also be utilized by the retailer to pressure manufacturers to create displays that are suitable for retail settings and to bargain for more compensation for waste and obsolescence. These displays reduce the cost of product inventory for retailers while driving up expenses for producers.

Another technology that has the potential to revolutionize logistics is global positioning systems. The GPS is a radio-navigation system developed in the United States that offers continuous, free location, navigation, and timing services around the globe. The components of GPS include user-owned GPS receivers, control and monitoring stations on Earth, and satellites in orbit around the planet. GPS receivers take up and identify signals that the satellites transmit from space. Every receiver gives both the time and the location [9], [10].Monitoring delivery drivers and their cars is one of GPS's two main advantages in the supply chain. Managers can monitor every car in their fleet at all times thanks to GPS. A

motorist's conduct may be observed to ascertain if the driver is traveling at an unsafe speed, off-route, or at the proper pace. Furthermore, GPS makes sure that the best route is chosen, which leads to a more economical use of fuel and gasoline. Managers may also evaluate the performance of the vehicles using the tracking equipment. The best speed, tire pressure, and other variables that impact fuel consumption may be determined by management.

CONCLUSION

This study highlights the critical role of supply cycles in shaping sustainable and efficient supply chains across various sectors. By recognizing the interconnectedness of organizations and processes involved in product delivery, businesses can identify opportunities to enhance environmental, social, and economic value creation.

The integration of sustainability principles into supply chain management practices not only contributes to improved product quality, decreased turnover, and better working conditions but also enhances profitability and operational efficiency. Moreover, the adoption of innovative logistics strategies and technologies, such as reverse logistics, RFID, GPS, and inventory management software, offers avenues for reducing costs and minimizing environmental impact. As organizations strive to meet triple bottom line objectives and build resilient supply chains, understanding and optimizing supply cycles will be essential for driving long-term success and competitiveness in the marketplace.

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CHAPTER 12

ADVANCING SUSTAINABILITY IN SUPPLY CHAIN MANAGEMENT: INSIGHTS, INITIATIVES, AND IMPLICATIONS

Prof. (Dr.) Smita Mishra, Professor,
Maharishi School of Business Management, Maharishi University of Information Technology, Uttar Pradesh, India.
Email Id-smita.mishra@muit.in

ABSTRACT:

This study delves into the intricacies of supply chain management, with a specific focus on distribution as a critical component. Through a comprehensive analysis, the study explores the various elements that constitute the supply chain, emphasizing the complex network of organizations and processes involved in delivering products to consumers. Additionally, the study highlights the advantages of integrating sustainability into supply chain practices, such as reducing waste, minimizing resource consumption, and adopting eco-friendly technologies. Furthermore, the role of green marketing initiatives and ISO 14000 certification in promoting environmental responsibility within supply chains is examined. Overall, the study underscores the importance of prioritizing sustainability in logistics and supply chain management to achieve long-term success and competitiveness in the marketplace.

KEYWORDS:

Economic, Logistics, Marketing,Supply Cycle, Supply Chain.

INTRODUCTION

Since distribution serves as the critical firm-level operation responsible for delivering value to consumers, our study concentrated on this aspect of the supply chain. Through our analysis, we identified and examined the various components that constitute the supply chain, emphasizing the intricate network of organizations and processes involved in bringing products to market. By delineating these components, we aimed to provide a comprehensive understanding of the complexities inherent in supply chain management and the interdependencies that exist among different entities.

Moreover, our study delved into the advantages that businesses stand to gain when they prioritize sustainability efforts within their supply chains. By implementing sustainable practices, such as reducing waste, minimizing resource consumption, and adopting environmentally friendly technologies, organizations can experience numerous benefits. These advantages include improved brand reputation, enhanced customer loyalty, cost savings through operational efficiencies, and compliance with regulatory requirements. By highlighting these benefits, we underscored the importance of integrating sustainability into supply chain strategies as a means to achieve both environmental and economic objectives.

In addition to exploring the advantages of sustainability in supply chain management, we examined the role of green marketing initiatives within the realm of logistics. Green marketing encompasses strategies aimed at promoting environmentally friendly products and practices, thereby appealing to consumers' growing concerns about sustainability. By incorporating green marketing into logistics operations, businesses can not only differentiate themselves in the marketplace but also align their brand image with consumer preferences for eco-conscious products and services. Through our discussion of green marketing initiatives,

we emphasized the importance of leveraging sustainability as a competitive advantage in today's increasingly environmentally conscious market landscape. Furthermore, our study addressed the significance of ISO 14000 certification in the context of environmental management systems (EMS) across various industries. ISO 14000 is a series of international standards that provide guidelines for establishing and implementing effective EMS, with the aim of reducing environmental impact and improving environmental performance. By obtaining ISO 14000 certification, organizations demonstrate their commitment to environmental responsibility and sustainability, which can enhance their credibility, reputation, and market competitiveness.

We highlighted the benefits of ISO 14000 certification in helping organizations achieve environmental objectives, comply with regulatory requirements, and meet the expectations of environmentally conscious consumers.Our study elucidated the importance of distribution in delivering value to consumers and provided insights into the components, advantages, and initiatives related to sustainable supply chain management. By emphasizing the significance of sustainability in logistics and the benefits of ISO 14000 certification, we underscored the need for organizations to prioritize environmental responsibility and integrate sustainability principles into their supply chain strategies to achieve long-term success and competitiveness in the marketplace[1], [2].

Components of Ecological Supply Chains

In our study, we delineated supply cycles as the intricate processes that lead to the creation of economic, social, and environmental value throughout the entire lifecycle of resources. This comprehensive strategy involves a deep understanding of the value chain, encompassing all activities from raw material acquisition to product disposal, as well as the input-output dynamics occurring at each stage of the supply cycle. Central to this concept is the recognition that processing, in various forms, occurs at every juncture of the supply cycle, generating both primary products and secondary by-products.

At its core, the input-output process within supply cycles embodies a dynamic exchange wherein raw materials are transformed through various operations to yield finished products. This transformational journey involves the utilization of resources acquired from the environment, coupled with inputs sourced from upstream entities within the supply chain. Through a series of manufacturing, assembly, and distribution activities, these inputs are converted into tangible products that meet consumer needs and desires.

However, it is crucial to acknowledge that alongside the primary products, a spectrum of by-products is also generated as a consequence of these operations.

Moreover, the input-output process underscores the interconnectedness of supply cycle activities, wherein outputs from one stage serve as inputs for subsequent stages, thereby perpetuating the cycle of value creation. This cyclical nature highlights the sustainability imperative embedded within supply chains, wherein the efficient utilization and repurposing of resources become paramount.

By optimizing the input-output dynamics, organizations can minimize waste generation, enhance resource efficiency, and maximize the value extracted from each stage of the supply cycle.

Furthermore, the notion of by-products within the supply cycle introduces opportunities for value optimization and resource recovery. These secondary outputs, which may initially be perceived as waste, can often be repurposed or recycled to create additional value. For

instance, waste materials from one manufacturing process can serve as inputs for another, thus closing the loop and reducing environmental impact. By embracing circular economy principles and leveraging the potential of by-products, organizations can unlock new revenue streams, reduce operational costs, and minimize their ecological footprint.

In essence, the input-output process within supply cycles encapsulates the multifaceted journey of resource utilization, transformation, and value creation. By understanding and optimizing this process, organizations can foster sustainability, resilience, and competitiveness within their supply chains. Through innovative approaches to resource management, waste reduction, and value optimization, businesses can navigate the complexities of modern supply networks while advancing towards a more sustainable future.

Advantages of Ecological Supply Chains

Increased product quality, less employee turnover, and better working conditions are some of the significant advantages that emerge from the implementation of sustainable supply cycles. When enterprises prioritize sustainability in their supply chain management practices, they often find that their products exhibit higher levels of quality and reliability. By ensuring that raw materials are sourced ethically and processed efficiently, businesses can minimize defects and inconsistencies in their products, ultimately leading to greater customer satisfaction and loyalty. Moreover, sustainable supply cycles often involve closer collaboration with suppliers and partners, fostering a culture of accountability and continuous improvement that further enhances product quality.

In addition to improving product quality, sustainable supply cycles contribute to reducing employee turnover rates and fostering better working conditions within organizations. By prioritizing ethical labor practices and investing in employee well-being, businesses can create a more positive and supportive work environment. Employees who feel valued and respected are more likely to remain with the company, reducing recruitment and training costs associated with high turnover rates. Furthermore, promoting better working conditions can lead to higher levels of productivity and engagement among employees, ultimately benefiting the organization as a whole.

Beyond the direct benefits to product quality and employee satisfaction, sustainable supply cycles also yield greater profitability and efficiency for businesses. By optimizing processes and minimizing waste throughout the supply chain, companies can reduce operational costs and improve overall efficiency.Sustainable practices such as waste reduction, energy conservation, and resource optimization not only contribute to cost savings but also align with broader environmental and social goals. Additionally, sustainable supply chains are often more resilient to external disruptions and risks, allowing businesses to better manage uncertainties and maintain continuity in their operations.

Furthermore, businesses that prioritize sustainability in their supply chain management strategies often enjoy stronger brand reputations and higher stakeholder returns. Consumers today are increasingly conscious of environmental and social issues, and they are more likely to support companies that demonstrate a commitment to sustainability. By aligning with values such as environmental stewardship, social responsibility, and ethical business practices, companies can enhance their brand image and differentiate themselves in the marketplace. Moreover, investors and other stakeholders are increasingly prioritizing sustainability metrics when evaluating companies, recognizing the long-term value and resilience of businesses with sustainable supply chains[3], [4].

Sustainable supply cycles offer a wide range of advantages for businesses, including increased product quality, reduced turnover, better working conditions, improved profitability and efficiency, enhanced risk management, stronger brand reputations, and higher stakeholder returns. By integrating sustainability principles into their supply chain management practices, companies can not only achieve financial success but also contribute to positive environmental and social outcomes, creating value for both themselves and society as a whole.

Logistic Sustainability

The systematic administration of the financial and human resources involved in physical distribution, manufacturing support, and purchasing processes is referred to as logistics. In essence, logistics encompasses the intricate web of activities that facilitate the movement of goods from suppliers to consumers, ensuring timely delivery and efficient utilization of resources throughout the supply chain. From managing inventory and order processing to coordinating transportation and warehousing, logistics plays a pivotal role in streamlining operations and optimizing the flow of products. Without effective logistics management, companies risk inefficiencies, delays, and increased costs, ultimately impacting their competitiveness in the market.

However, the true potential of logistics is realized when this crucial approach is handled with sustainability as a goal. Sustainable logistics practices involve minimizing environmental impact, promoting social responsibility, and ensuring economic viability across all stages of the supply chain.

By incorporating sustainability principles into logistics operations, companies can reduce carbon emissions, conserve natural resources, and mitigate environmental degradation. For instance, adopting fuel-efficient transportation methods, optimizing delivery routes, and implementing eco-friendly packaging solutions are all strategies that contribute to a greener and more sustainable logistics infrastructure.

Moreover, sustainable logistics also encompasses ethical considerations such as fair labor practices, community engagement, and ethical sourcing. Companies that prioritize social responsibility in their logistics operations strive to uphold labor rights, support local communities, and ensure the well-being of workers throughout the supply chain. This may involve partnering with suppliers who adhere to ethical labor standards, providing training and development opportunities for employees, and actively engaging with local stakeholders to address social issues.

Furthermore, sustainability in logistics extends beyond environmental and social dimensions to encompass economic viability. By optimizing resource utilization, minimizing waste, and reducing operating costs, companies can achieve greater efficiency and profitability in their logistics operations. For example, investing in technology solutions such as inventory management software, RFID tracking systems, and route optimization algorithms can help companies streamline processes, reduce inventory holding costs, and improve overall productivity.

DISCUSSION

The effective administration of logistics is essential for ensuring smooth and efficient supply chain operations. However, the true potential of logistics is unlocked when sustainability becomes a guiding principle. By integrating environmental, social, and economic considerations into logistics practices, companies can not only reduce their environmental

footprint and enhance social impact but also improve profitability and competitiveness in the long run. Embracing sustainable logistics is not only a moral imperative but also a strategic imperative for businesses seeking to thrive in an increasingly complex and interconnected global marketplace.

Putting together

Packaging serves as the fundamental mechanism to guarantee that goods are delivered in usable forms, making it a crucial component of logistics. Significant changes have been made to packaging practices by manufacturers and merchants, which lower package prices and decrease the quantity of damaged items in the supply chain. Dow Chemical redesigned their packaging between 1995 and 2005, saving over $3 billion and cutting its energy use by 22%. In a similar vein, Walmart established a 2008 target of 5% less packaging. Walmart calculates that this reduction saves 213,000 vehicles off the road, 667,000 metric tons of carbon dioxide from the atmosphere, 66.7 million gallons of diesel fuel, and $3.4 in savings for the store per year.

An examination of packaging's function that is crucial in nature must take into account the whole supply chain, not just one level of the distribution channel. Products have different packing requirements depending on whether they are being transported by truck or rail. Pallets that are balanced, stackable, and optimize trailer capacity are necessary for truck-based transportation.

On the other hand, robust and safe packaging is necessary for the demands of rail transportation. Compared to stretch wrap that simply binds a pallet's sides, stretch hoods that cover a product on five sides provide a better degree of protection.

Supply chain managers understand that minimum packing is required to deliver products undamaged, thanks to methods like carton optimization and other freight packaging strategies. Applying these tactics may result in savings ranging from 10% to 50% of the overall cost associated with packing and shipping. Furthermore, material reuse throughout the supply chain is becoming more and more common among supply chain managers. For instance, by recycling vendor supply boxes to transport orders, Amerisource Bergen, a medical supply firm, was able to save over $22,000 annually and reduce the amount of paper boxes used by 30,000 pounds.

Interdepartmental Collaborations Owing to the rapid and unpredictable changes in logistics, businesses are realizing more and more the benefits and knowledge that can be gained by collaborating with other supply chain players. Manufacturers and retailers may improve their supply chain sustainability via third-party logistics companies in a number of ways.

Boost the efficiency of the car. Independent vendors possess the know-how to stabilize transportation routes and lower stock levels. They may also monitor and instruct drivers on how to utilize fuel-efficient habits, which improve the efficiency of the vehicle. These improvements in vehicle performance save labor costs, increase the cars' usable lives, save fuel expenses, and lessen the company's carbon impact.

Cut the overall expenses of the supply chain. Cost is a delicate topic in the supply chain as it necessitates an instant assessment of the value that the third-party provider adds. Companies that handle third-party logistics use a number of tactics to maximize fuel efficiency and improve environmental performance. For instance, replacing the typical two-tire setups on long-haul trucks with a single wide-base tire is a new trend among third-party suppliers. These tires reduce carbon emissions by more than four metric tons yearly and save over 400

gallons of gasoline annually. Furthermore, by monitoring trailer performance using tractor-trailer aerodynamic devices, third-party logistics organizations may reduce yearly carbon emissions by almost 5 metric tons.

Improved assistance to customers. Third-party logistics agents are able to improve distribution networks and condense routes because of their expertise with a wide range of users and applications. It is noteworthy that third-party suppliers may provide distribution synergy by emphasizing sustainability across the supply chain, as opposed to treating it as a series of isolated activities. Manufacturers benefit from higher rates of product availability, better order accuracy, and a decrease in consumer complaints. By doing these things, the company may provide better customer service and avoid making inefficient accommodations like special delivery. All of these improvements in customer service reduce the supply chain's overall environmental impact[5], [6].

It is crucial to understand that the incentives and oversight procedures implemented by retailers and manufacturers have an impact on these third-party suppliers' capacity to improve sustainability. As suppliers explore these sustainable initiatives, businesses are more likely to reward them with more business. Joint process improvements, whereby the manufacturer and supplier collaborate to solve the sustainability concerns in the supply chain, are replacing previous arms-length agreements. Suppliers are being asked to provide sustainability measures and monitor this performance over time by manufacturers and retailers.

ISO 14000 standard

Supply chain managers are putting more and more pressure on suppliers to submit sustainability indicators and to certify their main suppliers independently. All sizes of businesses have put environmental management systems into place in response to these requests for a systematic examination of a firm's impact on the environment. An EMS is a body of laws designed to accomplish environmental objectives. The International Organization for Standardization created the optional ISO 14000 standards. The ISO standard family has become a collection of standards used by many businesses to track and manage environmental interaction. Government and business standards organizations primarily represent the more than 100 member nations that make up ISO. Over 1,100 new ISO standards are created annually, and the organization has created over 17,500 international standards covering a wide range of topics. These standards have been implemented by several businesses due to the possibility of improved performance. Since its introduction in 1998, the Ford Motor Company, the pioneering carmaker to adopt ISO 14000—claims that the standard has saved millions of dollars.

The ISO 14000 family of standards includes two main standards, 14004 and 14001. In 2004, these criteria were revised. An organization may regulate the environmental impact of its activities, goods, and services and continuously improve its environmental performance with the help of the framework provided by ISO 14001:2004. The organization's approach to sustainability is outlined in ISO 14001:2004, which also offers a strategic framework for the organization's environmental policy. Because of its wide scope, the standard may be used in a number of settings, such as restaurants, hotels, construction companies, manufacturers and their suppliers, and airports. Furthermore, small and medium-sized businesses are realizing the advantages of being certified to ISO 14001:2004. Guidelines on an EMS's components, application, and main concerns are provided by ISO 14004:2004[7], [8].

Organizations often want their pursuit of ISO management standards to be publicly documented. While ISO does not provide certification, it does set standards by which certification should be determined. The process of ISO 14001:2004 certification is carried out

by impartial environmental auditors. These auditors' accreditation is determined by their professional background, educational background, character traits, and auditor training. External auditors provide advice about the company's sustainability initiatives. The auditor's written guarantee that it has examined an EMS and confirmed that it complies with the standard is known as certification. On the other hand, registration happens when the auditor enters the certification in the business register. The ISO 14001:2004 certification is valid for three years.

Adopting ISO 14001:2004 has certain external advantages as well. Evidence demonstrates that businesses who use it get a competitive edge over other businesses in a market, compared to businesses with comparable assets and performance. The benefit is linked to comparatively reduced harmful emissions in companies that have adopted the standard. The company benefits from reduced resource consumption, increased energy efficiency, and decreased waste disposal expenses due to its ISO 14001:2004 accreditation. The benefits of certification reassure stakeholders about the company's dedication to sustainability. The local community may see via certification that the company is a leader in environmental issues. Businesses who implement the ISO 14000 standards are more likely to be well-liked by the public, nongovernmental groups, and individual customers. Adoption of the standards lends credence to the company's assertion on its environmental policy. Additionally, it lists and displays plans and activities that show compliance with environmental regulations.

When a company adopts this standard, it may respond forcefully to demands made by suppliers and consumers about the environment. Businesses in the United States, for instance, are more likely to implement ISO 14001:2004 if they have significant capital investments or close relationships with European or Japanese businesses. American companies with significant ties to companies in these areas are more likely to implement the standards since sustainability-related attitudes are more prevalent in these geographic markets. Furthermore, the adoption procedure, which includes a third-party auditor's assessment of conformance, lessens the need for trade partners to verify[9], [10].

The certification of ISO 14001:2004 has significant benefits for the company's stakeholders. Top management is more confident that it is keeping an eye on and regulating business practices that have an impact on the environment. As a result, the company can back up sustainability claims and provide a compelling refutation of criticisms centered on greenwashing. Workers become more assured that their companies are ecologically conscious. Businesses that demonstrate empathy for environmental issues provide extra incentives to attract and retain personnel, considering the expenses associated with staff recruiting and turnover.

CONCLUSION

This study sheds light on the critical role of distribution in supply chain management and the importance of integrating sustainability into logistics practices. By prioritizing sustainability efforts, businesses can not only reduce their environmental footprint but also enhance brand reputation, improve customer loyalty, and achieve cost savings through operational efficiencies. Green marketing initiatives offer a valuable opportunity for companies to differentiate themselves in the marketplace and align with consumer preferences for eco-conscious products. Furthermore, ISO 14000 certification serves as a testament to an organization's commitment to environmental responsibility and can enhance credibility, reputation, and market competitiveness. Overall, the findings emphasize the need for businesses to embrace sustainable logistics and supply chain strategies to navigate the complexities of the modern marketplace and contribute to a more sustainable future.

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