



REVIEW ARTICLE

APPLICATIONS OF SUSTAINABLE DEVELOPMENT GOALS IN PHARMACEUTICAL INDUSTRY: CHALLENGES AND OPPORTUNITIES

Shruti Rawal

Department of Pharmaceutics, Institute of Pharmacy, Nirma University, Ahmedabad, Gujarat-382481.

shruti.rawal@nirmauni.ac.in

ABSTRACT

‘Sustainability’ has become a prime focus of every organization and Institute after the declaration of the UNSDG goals in 2016. However, the Pharmaceutical sector has yet to contribute a lot towards the sustenance of these goals at Industrial level and is far from ideal scenario to meet the UNSDG expectations. It becomes obligatory for the pharma Industry to practice sustainability as they are quite resource-intensive. With reports claiming the Pharmaceutical sector to be contributing 13% greater than the automotive sector to the pollution, and meagre measures taken by the companies and to control the greenhouse emissions, it becomes crucial to establish regulations for the same. As Health-care promoters, it becomes our prime responsibility to adapt sustainable practices while catering the business and not adversely affecting the health and well-being of the people. This document discusses the challenges, opportunities and perspectives where the pharmaceutical industry can contribute. With extreme rise and deterioration of the climate and environment, the need to adapt sustainability and embedding it into Pharma’s genome has become inevitable so as to cater to the need of the present and the future too.

Keywords: Process mass intensity, Solvent Intensity, Zero emission, Green Chemistry.

1. INTRODUCTION:

A set of seventeen interconnected goals known as the Sustainable Development Goals (SDGs) or Global Goals were devised by The United Nations (UN) High-Level Political

Forum on Sustainable Development (HLPF) in 2015 with an aim to build a peaceful and prosperous planet for now and future (Fig. 1) [Adapted from 1]. UN-

HLPF is convened yearly under the direction of the UN Economic and Social Council, and is in charge of overseeing the SDGs [1].



Figure 1: 17 Unique Sustainable Development Goals as Defined by the UN.

These master-crafted SDGs are intended to act as a shared blueprint that can guide futuristic partnerships for achieving the intended moto. These include overlaps and areas where the SDGs complement one another. For instance, the Intergovernmental Panel on Climate Change (IPCC) notes that SDG 13 on climate action has strong overlaps with SDGs 3 (health), 7 (clean energy), 11 (cities and communities), 12 (responsible consumption and production), and 14 (oceans)[2]. However, detractors and analysts have also pointed out trade-offs between the SDG objectives, such as those between eradicating hunger and advancing environmental sustainability. Concerns have also been raised about the excessive

number of goals (in comparison to the eight Millennium Development Goals i.e. MDGs), which can result in complicated trade-offs, a lackluster emphasis on environmental sustainability, and challenges monitoring qualitative indicators.

The pharmaceutical industry is dedicated to creating medications to treat illnesses and is vital to global health and life preservation efforts. It has demonstrated outstanding success in treating debilitating conditions like infectious diseases and possesses a remarkable capacity to produce extremely inventive medications for extremely complex illnesses like cancer and neurodegenerative disorders. The pharmaceutical industry is most notable for

having established a global ecosystem that includes every stage of the difficult process of developing, manufacturing, and distributing new medications. This ecosystem's adaptability and resilience allowed the Covid-19 vaccinations to be produced in record time.

Given a chance and the right direction, there are lot many ways in which the pharmaceutical sector can contribute to the progress of the SDG goals which also may be divided as per their contributions to Environmental, social, governance (ESG) aspects of this business (Fig. 2) [1].



Figure 2: UNSDGs and ESGs they link with.

Some of the prime SDGs that intersect with the Pharmaceutical sector's expectations are:

SDG 3; Easy and affordable medicine: This is one of the major areas where the pharmaceutical industry plays a direct role. Immunization drives for fighting the infectious diseases, orphan and neglected health conditions, disorders and diseases are some of the most important expectations. Affordability of medicine is one of the most important pharmacoeconomic factors that affect the patient prognosis and hence is one of the prime

responsibilities on the shoulders of Pharma companies. Public health awareness programs, initiatives and infrastructure development for conducting healthcare promoting activities etc. may be contributing towards achieving the goal.

SDG 4; Training and Capacity Building: Local healthcare, especially in rural areas needs trained healthcare professionals.

SDG 9; Innovation and Research: Innovations in healthcare may devise novel strategies and interventions that may offer better health to the patients and improve

their condition. Approvals for novel medical devices, medications, vaccines and other therapeutic interventions may help tackle health issues more effectively. Funding research and innovations is directly going to foster the achievement of SDG goals to a significant extent.

SDG 10; Addressing Health Inequalities: Right to good health requires equal access to healthcare facilities while excluding the socio-economic, geographic, demographic disparities.

SDG 12; Responsible consumption and production are facilitated by the application of sustainable techniques for manufacturing, reduction in waste, reduction in environmental deteriorants and optimization of resource utilization.

SDG 17; Partnerships and Collaboration: In order to expand the scopes and facilitate achieving the goals, it becomes imperative to collaborate with governmental, NGOs, and other stakeholders. This may facilitate technology transfer, and knowledge-sharing and catalyze the individual efforts through synergistic mechanisms.

However, the sector at present has not much changed in terms of achieving these goals.

Arguably, this might be attributed to the fact that Implementation of the Sustainable Development Goals (SDGs) in the pharmaceutical industry comes with several challenges due to the industry's complexity, where businesses are expected to provide patients with secure, cutting-

edge, and efficacious treatments at affordable rates.

Pharma companies are now adopting measurable and ambitious goals and laying out a plan of action, but there is frequently a critical gap between aspiration and action when it comes to target selection, achievement measurement, and pace of progress. In order to meet their goals, businesses must be proactive in fostering greater collaboration and transparency, build and analyze sizable data sets to produce useful insights, and think about drastically altering current procedures in order to bring about a dramatic, long-lasting change. Given the lengthy development cycles, the pharmaceutical industry will need to completely rethink its current supply chains, digital infrastructure, business models, and drug development and manufacturing processes in order to fulfill its obligations. Pharma is developing products, but they are not intended for the current market; rather, they are intended for the next ten years or more. Nevertheless, the environmental impact of the products that are currently on the market must also be carefully considered.

Overcoming the challenges faced in implementing the SDGs into Pharmaceutical sector requires a concerted effort from governments, regulatory bodies, pharmaceutical companies, consumers, and other stakeholders. Collaboration, innovation, financial incentives, and clearer guidelines are essential to successfully integrate SDGs

into the pharmaceutical industry while addressing these obstacles. It may be impossible to combine the following two factors into this equation without collated efforts of the sector's giants: 1. carbon-neutral research and development, production, and distribution chains; and 2. a business model that enables access to extremely innovative drugs at a reasonable cost on a global basis. This result requires practices that balances the needs of the market, science, finance, competition, and serendipity with those of regulatory bodies.

A complete reorganization of procedures is required throughout the whole pharmaceutical product life cycle and value chain for the pharmaceutical business to meet its net-zero targets, decrease waste, and restrict its use of natural resources. As new, disruptive strategies are implemented, momentum throughout multiyear business cycles must

be preserved. Parallel to this, businesses must scrutinize the current production methods and goods.

Six interconnected topics are depicted in **Fig. 3** (Adapted from [3]) that will affect how quickly and how far the pharmaceutical industry may go toward its sustainability goals.

This article primarily focuses on the major aspects of ESG, such as industry approaches to lowering Scope 1, 2, and 3 greenhouse gas (GHG) emissions and more efficient use of the planet's limited resources. It looks at the significant obstacles the pharmaceutical industry faces in meeting its lofty environmental sustainability goals as well as the potential characteristics of an environmentally conscious pharmaceutical company and its supply chain. The paper assesses new investment, culture shifts, and simple wins throughout the value chain as means of advancing sustainability.

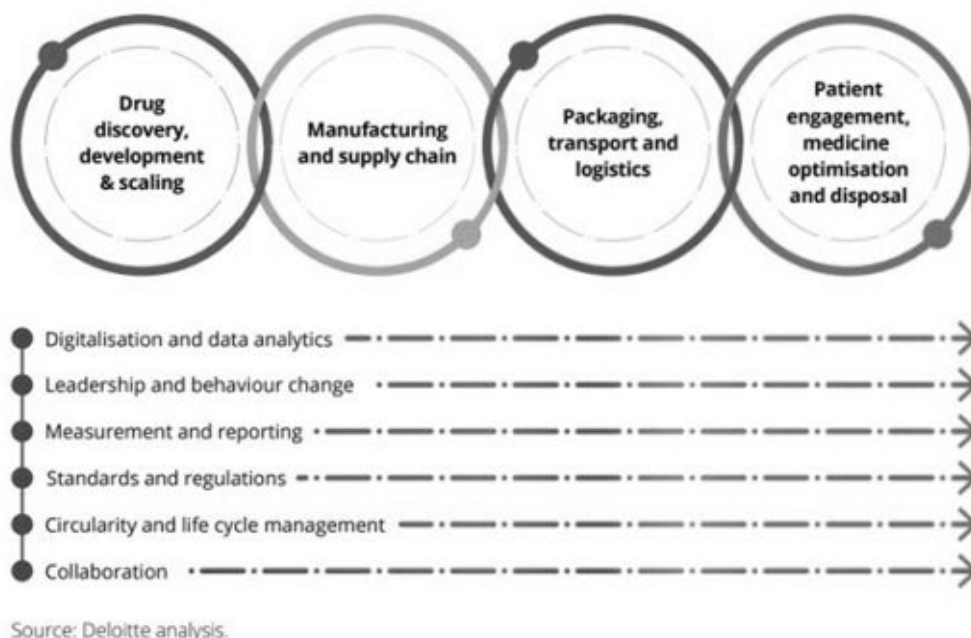


Figure 3: ESG-targets and Their Intersecting Pharmaceutical Product Value Chain.

2. INTERCALATION OF SDG INTO PHARMA DNA: WHY A MANDATE?

The pharmaceutical industry must adopt the Sustainable Development Goals (SDGs) for a number of reasons as discussed henceforth.

Resource intensive sector:

Pharmaceutical sector is one of the most resource-intensive sector that raids upon several natural (plants, water etc.), electricity generating resources, supply-chain associated resources, and human resources to a significantly high extent.

Pollution-generative sector:

Pharmaceutical pollutants include greenhouse gas emissions (GHEs), wastewater / effluent generation, paper

waste, pharmaceutical (medical/biomedical) waste.

High GHE rates: According to a recently published report, the pharmaceutical industry was reported to be responsible for > 55% pollution than the automobile industry and the environmental impact of both the industries is almost identical, despite lower share in market of the former [4]. More than 210 pharmaceutical companies have their global existence, however only 25 of them have reported unswervingly their greenhouse gas emissions (GHE) for more than five years. It has been discussed elsewhere that in order to meet the reduction targets laid down in the Paris Agreement, there must be >59% reduction in the GHEs from the present [5].

Pharmaceutical waste:

Wastewater and effluent:

The complicated composition of pharmaceutical wastewater includes significant quantities of several types of organic contaminants that adversely affect the Chemical oxygen demand (COD) and biological oxygen demand (BOD), NH₃-N and elevated suspended solids, richness of color, toxicity as well as additional characteristics. According to literature, about 500,000 cubic meters of wastewater are released each day, and approximately 100,000 tons of garbage and pollution are released annually only by the Chinese Pharmaceutical sector [6].

Pharmaceutical and biomedical waste have resulted in eco-toxic environmental repercussions due to contaminants emerging from the pharmaceuticals such as residual active pharmaceutical ingredients, reaction intermediates, toxic solvent wastes and endocrine disrupting chemicals (EDCs) that have sneaked through the food chains and contaminated the soil and water bodies [7].

Paper waste: Documentation being done conventionally by the Pharmaceutical companies to meet the regulatory specifications it takes a huge toll on the natural resources. About 90 billion sheets of paper are used annually to meet the regulatory requirements of the government just in the US as per the reports. This means the pharma paper gobbles up 1.8 million tons of Wood (more than 10

million trees), ~ 8.5 billion pounds of GHE, 12.3 million BTUs of energy, 10.6 billion gallons of water, and 585 million pounds of solid trash produced [8].

To summarize, the pharmaceutical industries implementing the SDGs can result in a more moral, sustainable, and inclusive sector that gives global health needs top priority while taking social and environmental effects also into account.

However, as mentioned earlier in the article, there are several road blockers for implementation of the SDGs in Pharmaceutical industry. These may be summarized as: high costing and investment, complex supply chains and regulatory environment, concerns for Intellectual Property, Public Health vs. Profit Motive, improper Consumer Behavior and Demand and difficult Measurement and Reporting.

3. ALIGNING ESG AND SDGs IN PHARMACEUTICALS: THE WAY FORWARD

Despite the disagreements and debates amongst the community regarding bilateral risks involved in advancing the businesses for today and the compromised future, the responsible corporates have already initiated measures to build sustainable business empires through SDG-driven market strategies. Environmental, Social, and Governance (ESG) frameworks, which aim to address the greater issue of being a good corporate citizen, are where sustainability programs are most frequently

implemented, and ESG requirements have been rising in every corporate industry including the Pharmaceuticals. Furthermore, after the ESG concerns were formalized in the UN Principles of Responsible Investment (UN PRI) in 2006, investors improved the alignment of their strategies and interests with the larger societal goals, so establishing a precedent for the mainstreaming of ESG investing. Over 1,600 signatories representing over USD 70 trillion in assets under management make up the global initiative today, which is not surprising given its amazing expansion on a worldwide scale. In 2021, a record \$649 billion was invested globally in funds with an ESG focus. More corporations are giving ESG initiatives top priority as investors pour money into enterprises with sustainability plans in place. Ethical, sustainable, and corporate variables are a subset of nonfinancial performance measures [9].

In addition to helping businesses maintain their social license to operate, an integrated business approach that incorporates the SDGs and ESG in their marketing strategies will force them to focus on both financial and non-financial factors like corporate governance, direct and indirect environmental footprint, human rights issues, and more. This will also help them move toward a more proactive approach to the adoption of new business models through disruptive or realignment strategies. Market participants, asset owners, and managers are increasingly demanding that managers consider a more

comprehensive long-term interest and strategy when assessing any and all business decisions. Furthermore, even if the SDGs are more thematic than corporate in character, they do assist in coordinating industry-and company-specific ESG concerns with more general societal and environmental objectives. Adaptation of GREENER Practices in Pharmaceutical sector has been discussed in detail elsewhere [7].

Herein, we discuss the most applicable strategies that are employed or can be employed for transforming pharmaceutical industry towards a more sustainable and eco-friendly one. ESG variables are a subset of nonfinancial performance measures that take into account difficulties with accountability and corporate governance. An effective resource management and balance can help the pharmaceutical giants to drive the future of the industry's and ultimately, people's well-being. When we examine the ESG issues in pharma more closely, several areas that are most relatable are:

Environmental (E):

- *Minimize Air pollution and GHE generated during business and business related activities:* The pharmaceutical supply chain involves the transportation of raw materials, intermediates, and final items through various sites and countries [10]. Several interventions that can be employed to reduce the GHE emissions are shown in **Fig. 4**[11].

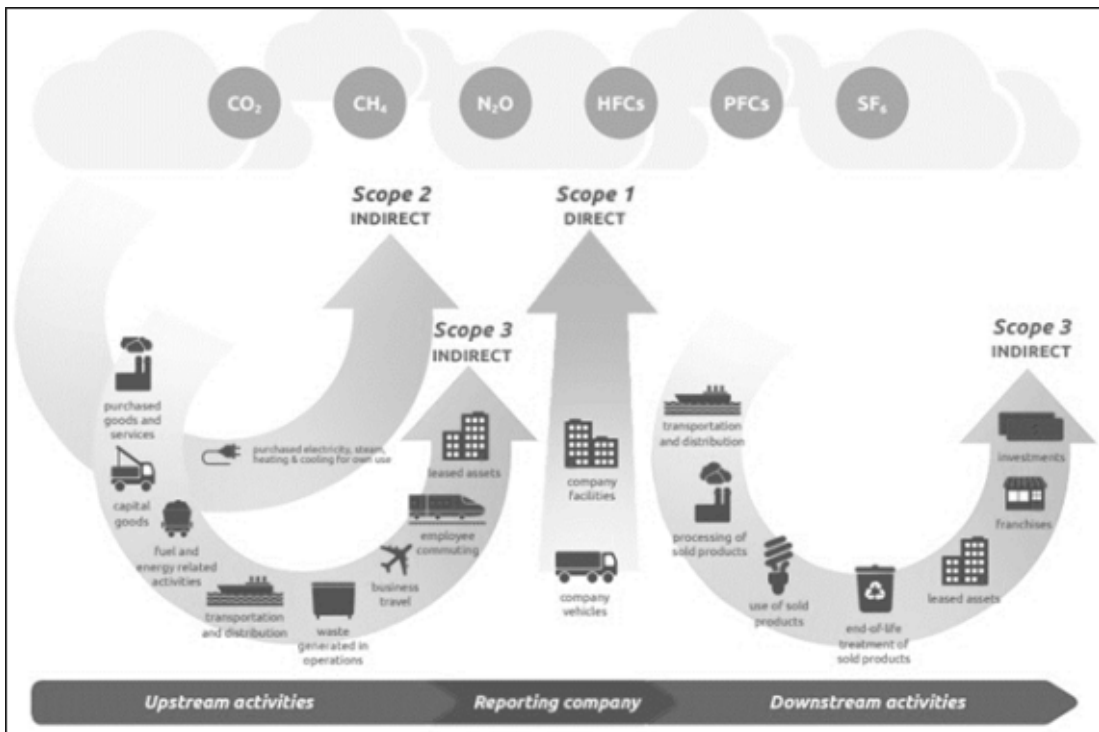


Figure 4: Emissions across various upstream and downstream activities involved in Pharmaceutical Product Chain.

- *Trash Management:* During the production process, pharmaceutical businesses produce a sizable amount of trash. In order to promote the adoption of sustainable practices and lessen their influence on the environment, ESG focuses on how businesses handle and dispose of this waste. Promote the use environment friendly methods like Plasma Incinerators.

Packaging waste reduction: they use in their packaging. For instance, natural fiber-based pulps, such as those made of cellulose, cotton, sugarcane, corn or bamboo, which provide the rigid

structure of a package, combined with a film made of polypropylene (PP), polyvinyl chloride (PVC), polybutylene adipate terephthalate (PBAT), poly caprolactone (PCL) and poly lactic acid or polyethylene terephthalate (PET), which can provide the composite with moisture-proofing, gas permeability, or other properties while still being up to 99% recyclable can be used. Smart labels and augmented reality (AR) instructions on how to administer pharmaceuticals or medications can take the place of paper inserts and manuals. Utilizing intelligent technologies to run a just-in-time

supply chain can improve the cold chain [12].

- *Energy Consumption:* Use renewable sources of energy for the business and business related activities: E.g. Use solar energy, biogas, PNG etc. to run the vehicles.
- *Water Usage:* To reduce their influence on regional water resources, pharmaceutical businesses must use water as effectively as possible, and ESG assesses whether they do so by adopting water-saving practices.
- *Employ Green chemistry principles* for synthesis and avoid the usage of solvents wherever possible.
- Promoting re-purposing of the drugs and laying down regulation for shelved drug- licensing.
- Using “Green” Phytochemicals as API and cultivating them in a sustainable fashion.
- *Reduce, re-use, recycle and refresh the resources wherever possible.* E.g. Solvent recovery for processes wherever applicable. Use effluent treatment plants for efficient saving of water and protecting the environment from probably hazardous waste generated during the processing of Pharmaceuticals [13], [14].
- *Employ metrics and methods that maximize process output and reduce waste and inefficient production:* Use

principles of QbD and DoE, KAIZEN. Poke Yoke etc. to empower technology driven-robust process and products controls so as to minimize batch failures and wastages [11].

Some suggested metrics that have been recently employed by industries are: PMI i.e Process mass intensity, Solvent intensity and Environmental impact.

PMI: “process mass intensity” (PMI) describes the utilization of resources or raw materials used for manufacturing a single unit. It’s a metric for evaluating efficacy for the pharmaceutical manufacturing processes and how they can impact the environment.

Reduction in PMI is advantageous for multiple reasons like reduced waste generation, less resource/energy utilization and reduced environmental footprint. Process optimization, recycling and Reuse and Life Cycle Assessments (LCAs) are some of the methods by which the pharmaceutical industries can reduce the PMI [14].

Solvent Intensity (SI): The quantity of solvent used in a manufacturing process per unit of product is referred to as solvent intensity (SI). Solvents are essential to the production of pharmaceuticals at many stages, such as synthesis, extraction, purification, and formulation.

It’s critical to lower solvent intensity for a number of reasons such as environmental Impact due to the presence of volatile organic compounds (VOCs), that are

potential contaminants for water bodies, air, and destroy ecosystems. Reducing the usage of solvents and re-using them are critical in reducing the SI. Solvent-usage are associated with high health risk to the personnel involved in the occupation. Reducing the usage of solvents can reduce the risk for workers too.

Use of Green solvents such as water or bio-based solvents, involving recycling and recovery, eliminating/replacing the hazardous organic solvents and continual improvement through constant refinement of the processes and maintaining records over their usage may proportionate itself with environmental stewardship, and sustainable practices.

Social Interventions (S): Access to medications: Ensuring that individuals in both developed and developing countries have access to medications is one of the most important social challenges facing pharmaceutical corporations. ESG promotes businesses to create pricing and distribution plans that increase the availability and affordability of vital medications for people who need them.

Research and Development (R&D): ESG underlines the significance of R&D in the pharmaceutical sector. ESG experts and investors favorably assess businesses that make R&D investments to meet unmet medical needs and enhance healthcare outcomes.

Patient Safety and Product Quality: ESG focuses on how pharmaceutical businesses make sure that their medicines are both

safe for patients and of high quality, including stringent testing and adherence to rules to prevent negative patient impacts.

However, stakeholders increasingly want more direct interventions on equity of access and affordability. Social sustainability through public health improvement. Pharma companies are simultaneously under increasing pressure to minimize their environmental impact throughout the product lifecycle due to their research and development (R&D) procedures and manufacturing processes, as well as by improving supply chains and logistics and collaborating more closely with patients and healthcare providers (HCPs) on product use and disposal. While the goods being developed by the pharmaceutical industry are not intended for the market today but rather for the upcoming decade and beyond, careful consideration must also be given to the environmental impact of medicines that are already on the market. To collectively meet the need of future, the pharmaceutical sector will need to fundamentally reinvent its current business models, supply chains, and digital infrastructure. Given the lengthy development cycles, this must be done immediately. This overview paper primarily focuses on the ESGs that encompass better resource management and industrial strategies that can meet the challenges in the way to sustainable pharmaceutical future and environmental sustainability. The research analyzes new investments, culture shifts, and quick wins

across the value chain as means of advancing environmental sustainability. These quick victories may give us the green light to implement the dramatic, more fundamental adjustments required to meet our objectives. The report takes into account the social ramifications of the environmental footprint-reduction measures.

Governance (G) and Regulations:

Pharmaceutical businesses are expected to uphold high standards of corporate governance, transparency, and ethical conduct. In particular, this entails revealing financial information, avoiding possible conflicts of interest, and following moral marketing principles.

Board Diversity: ESG assesses the diversity of a company's management and board of directors. Better decisions can be made when a leadership team is diverse, and it shows a commitment to inclusivity and fair opportunity.

Executive Compensation: ESG examines how executive compensation relates to the performance and long-term sustainability objectives of the organization. By doing this, it is made sure that incentives are in line with those of stakeholders and shareholders [15].

Some Case Studies [3]:

a. One of the few industrial giants, the UK-Swedish pharmaceutical corporation AstraZeneca, invests heavily in lowering emissions while

putting a strong emphasis on open, ethical business practices, fair access to healthcare, and environmental protection. For four years running, the international organization CDP has given it a double-A rating for its environmental obligations. The Ambition Zero Carbon program aims to advance the time of zero carbon emissions by ten years with a \$1 billion expenditure.

In March 2020, AstraZeneca introduced AMAZE, a cloud-based platform for managing chronic disease (for instance, in the fields of the respiratory, cardiac, and renal systems).

- b. Roche is streamlining clinical trials to make them more convenient for both patients and professionals to participate in. One illustration is the Prospective Clinico-Genomic Study, which collects a variety of data streams via liquid biopsy and remote monitoring rather than requiring the patient to undergo many invasive testing in the hospital.
- c. Novartis and Bioufourmis have created a platform that monitors the health of people with heart failure. Patients are discharged from the hospital with the heart failure medication Entresto from Novartis as well as the Everion sensor from Bioufourmis, which continuously monitors the patient's state and enables clinicians to act quickly as needed.

- d. In January 2021, Pear treatments and etectRx agreed to a partnership that will pair Pear’s ground-breaking digital remedies for drug addiction and insomnia with smart tablets that feature an ingestible wireless sensor to track adherence. In order to incorporate this technology into clinical trial programs, the two companies wish to contact potential pharmaceutical partners. More effective ways to communicate with and support patients will be offered through the integrated platform.
- e. Color Genomics, which first focused on cancer diagnosis, is now promoting COVID-19 testing across the US. Beyond the actual test, the business’s unique value extends to its flexible and expandable “infrastructure” that now reaches patients wherever they are, including in workplaces and educational institutions in addition to hospitals and clinics. The company has outlined the strategy.
- f. A high degree of industry-wide collaboration and data sharing should be a part of our vision for a net zero pharmaceutical sector (see Figure 5), which should be backed by connected data systems, powered by AI algorithms, and based on the principles of a circular economy.
- g. Every year, millions of tons of unneeded medications are thrown. Two billion people lack access to essential medications. Avoidable

losses are brought on by poor visibility throughout the pharmaceutical supply chain. Reliance on paper medicine information, which is rarely read and wastes resources. Using single-use plastics frequently in medicine packaging. The four-year SMP program aims to produce data-driven solutions, industry-wide frameworks, standards, and implementation toolkits in order to address the six pillars of sustainable pharmaceuticals.

To more accurately quantify and contrast the carbon footprint of medications, SMP Projects build tools like the Medicine Carbon Footprint (MCF) classifier. Digitizing drug information to deliver multimodal, inclusive, patient-centered, standardized drug information. Additionally, testing circular packaging ideas to cut less on single-use plastics without sacrificing functionality.

The Sustainable Medicines Partnership (SMP) program which aims to increase sustainability and access to medications. The SMP is a non-profit, public-private, multi-stakeholder global initiative with a goal of increasing awareness and putting evidence-based treatments into practice. YewMaker, an action lab that develops, tests, and scales sustainable healthcare solutions, is in charge of the program. It intends to support the creation of a cooperative ecosystem

for lowering drug waste, having a positive effect on the environment, and improving access to medications for all people.

- h.** AstraZeneca acknowledged the need to lessen the environmental impact of their extensive network of laboratories worldwide and teamed with the nonprofit organization My Green Lab in 2021 to implement a program to do so. As part of the UN Framework Convention on Climate Change (UNFCCC) Race to Zero, the pharmaceutical industry has recognized My Green Lab certification as the industry gold standard for laboratory sustainability best practices. My Green Lab accreditation offers scientists and the teams that support labs practical solutions for enacting significant change. The program covers 14 themes, including engagement, energy, water, waste, chemistry, and materials, with a particular emphasis on behavior modification and assignments that scientists can do on their own.

All stakeholders, from the R&D scientist and factory scaling lead to the packaging designer and logistics manager, should place sustainability-by-design at the forefront of their minds. To make sure that green practices are deeply ingrained across the product value chain, these should cooperate.

4. PROSPECTS AND CONCLUSION:

It could be said that the pharmaceutical sector joined the ESG and sustainability movements late. However, the sector hasn't stood idly by. Successful sustainability projects that show how they have a positive impact on the environment, society, and the bottom line draw in a large number of investors and stakeholders who favor companies with a strong sustainability attitude. The industry's potential for making a good difference is proportionally greater because of its contribution to combating climate change, which may even be greater than the car industry's. The majority of the work is still ahead of us, despite some progress made by the industry in this direction. An example of an industry group that is focused on working together to measure and gather data that can be utilized to drive improvements throughout the It may be said that the pharmaceutical business was slow to embrace the ESG and sustainability movements. However, the sector has not stayed on the are a vital part of the sustainable ecosystem. Energy and water consumption can be decreased without making a significant financial investment by implementing digital models to predict and solve waste. One strategy for maximizing a plant's beneficial impact on its energy footprint is to concentrate on renewable energy sources as a source of power. Sustainability in the pharmaceutical industry touches nearly every link in the value chain of healthcare and goes far

beyond renewable packaging. If we are to successfully reverse the disastrous effects of climate change, the industry will need to concentrate in earnest.

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