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Bhujbal Knowledge City
MET INSTITUTE OF MANAGEMENT

MET MANAGEMENT REVIEW

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Mahatma Jyotiba Phule
(1827-1890)

Shrimati Savitribai Phule
(1831-1897)

OUR FAITH

न चौर हार्यम् नच राज हार्यम्।
न भातृभाज्यम् नच भारकारी।।
व्यये कृते वर्धते एव नित्यम्।
विद्याधनं सर्वधन प्रधानम्।।

Knowledge can neither be stolen by a thief,
nor snatched by a king.
It is indivisible unlike ancestral property,
it never burdens the bearer,
it multiplies manifold when offered to others.
Knowledge is the supreme form of wealth.

MET INSTITUTE OF MANAGEMENT VISION

To emerge as a leading management Institute developing globally relevant, socially responsible and emotionally competent management professionals and entrepreneurs.

MET INSTITUTE OF MANAGEMENT MISSION

1. To empower management professionals with the latest applications offering conceptual and experiential learning.
2. To develop business leaders focused on principles of purpose, people, profit and planet.
3. To nurture managerial competence and a sustainable, growth mindset.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To apply the domain knowledge, interdisciplinary skills & technological proficiency as entrepreneurs and corporate professionals.
2. To exhibit value-based managerial competencies in fulfilling corporate and leadership responsibilities.
3. To facilitate lifelong learning for sustainable development and professional excellence.

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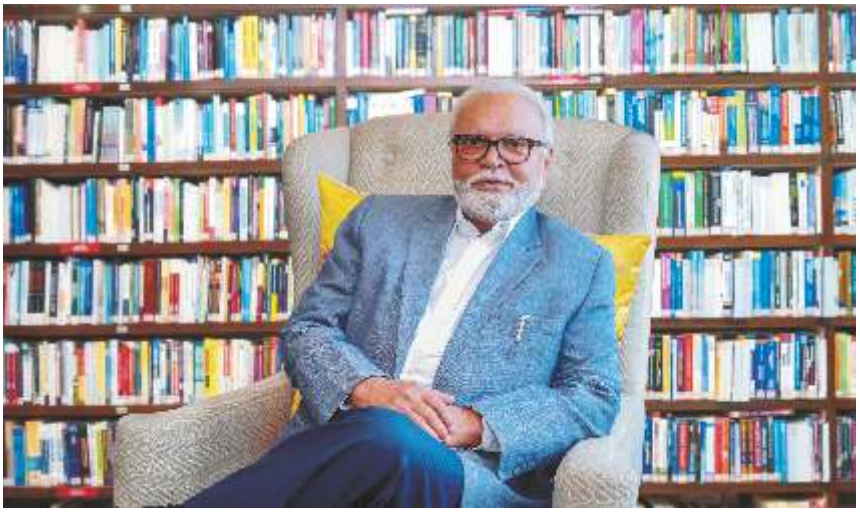
From the Chairman's Desk



With many Indians evidently occupying influential positions globally in business, research, space, design, fashion, technology and more, the world is unmistakably acknowledging India's potential, as much as counting on it. This also bears testimony to the fact that India's education system has consistently performed better than that of many countries. On one hand, the finest educational institutions like IITs, IIMs, AIMS are producing world class professionals. On the other hand, India has also successfully reached out to the rural and suburban section and significantly improved gender equality in education besides boosting literacy rate itself, making people life-long learners. This has resulted in students, even from India's interior districts, rising to commanding heights in various arenas.

With newer proposed changes in Education as a sector, and IT backing and enabling its delivery and reach, we look forward to not only better serve Indian students, but also to attract and groom talent from around the world. All stakeholders, including academia students, industries, and government will have to play critical roles in making institutions capable of taking the next major leap forward and build an independent education ecosystem.

We, at three of our world class MET BKC campuses in Mumbai and Nashik, and at our International School - MET Rishikul Vidyalaya, are ceaselessly endeavoring to provide the best infrastructure, human capital, processes and values, so that tomorrow's India will outperform the India of yesteryears. We at MET believe that India's glorious period is not behind us but ahead of us, as a matter of fact we all are carving it out today.

Chhagan Bhujbal
Hon. Founder Chairman
Mumbai Educational Trust

Mumbai Educational Trust (MET)

Mumbai Educational Trust (MET) is a conglomerate of premiere educational institutions, driven by a single-minded focus on imparting quality education, to make students sharp. Training is imparted round-the-clock, seven days a week. Projects and assignments are given utmost importance and students learn on the job. Application-oriented knowledge, garnered in the lecture halls, is applied to industry assignments. The faculty spares no effort to make the students razor sharp, so that they make their mark in the corporate world. No effort has been spared, to create an environment that encourages students, to push the limits of their minds. All this, to help young professionals face the challenges of life. And make their mark in the corporate world.

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Bhujbal Knowledge City, Adgaon, Nashik

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- Institute of D. Pharmacy
- Institute of Engineering
- Institute of Technology (Polytechnic)
- Institute of Information Technology
- Bhujbal Academy of Science and Commerce (Junior College)

Bhujbal Knowledge City, Gowardhan, Nashik

- School of Architecture and Interior Designing

At MET, over four thousands students and faculty are involved in delivering unique learning systems, through ultra modern infrastructure and academic rigour. MET Institutes are ISO certified, with affiliations to the University of Mumbai, Savitribai Phule Pune University, Directorate of Technical Education, All India Council of Technical Education, MSBTE, Pharmacy Council of India, C-DAC - Ministry of Communications and Information Technology, The Chartered Insurance Institute (CII), London.

MET also has strategic institutional collaborations with the Association of Chartered Certified Accountants (ACCA), UK, NCC Education, UK, Manhattan Institute of Management, New York, EAE Business School, Spain, Business & Hotel Management School, Switzerland, Robert Gordon University, York St. John University, SetCONNECT, USA and TCS iON.

About MET Institute of Management

Since its inception three decades ago MET Institute of Management, a top B-School in Mumbai has focused on developing industry ready management professionals shaped to cross industry threshold to seek their chosen place under the Sun. Academic and scholastic rigor are finely woven into application oriented skill sets which positions the MBA students to hit the ground running as they face the challenges of market place and society. The structured learning systems are blended with the latest tools and technologies offered by the digital world. Therefore, despite Pandemic, a unique online learning experience was offered to the management students.

The well-equipped libraries with 64,000 plus books and journals are e-enabled to offer robust theoretical inputs to the MBA students. The close connection and networking with industry integrated by thousands of corporate-successful alumni offers deep insights into the real business world and a vibrant industry academia platform.

Thus, despite statutory limitations students could access and benefit from our information and technology centers and learning aids supported by the latest audio visual facilities at our complex. A high-tech convention Centre, well equipped seminar halls and state of the art networked virtual classrooms provide a multidimensional exposure to the students as we offer a holistic immersion to the MBA students as they step into the global business arena. That is why MET Institute of Management is considered as one of the best MBA colleges in Mumbai. It remains a much sought after premium B-School in Maharashtra in which graduates and experienced MBA aspirants writing MAH-CET, CAT, CMAT, XAT, ATMA, MAT and other prestigious entrance exams seek to secure admission.

Director Speak

Dr. Swati Lodha
Director MET IOM

Dear Readers,

Greetings from the Research Cell of MET Institute of Management

The dimensions and impact of business research are changing as we proceed from a VUCA world to the BANI world, a new term coined by futurist James Cascio. This new Brittle, Anxious, Non-linear, and Incomprehensible world requires us to think about the purpose and the planet before profits.

And hence, the academic year 2022-23 has been dedicated to putting our planet first at our Institute. In sync with this prioritizing, an international conference was organized at METIOM, in collaboration with ICCE and papers were presented during that research.

Sustainability in business talks about the effect companies has on the environment or society. Some of the global issues that sustainable business strategies aim to address today include natural resource depletion, climate change, income inequality, racial and gender imparity, and pollution. The researchers have tried to explore many of these issues through their papers presented at the conference which was attended by representatives of various higher educational institutions in Mumbai and sustainability professionals. With this conference, We have launched India's first Circular Lab.

Dr. Ramesh Unnikrishnan, Adviser AICTE in his inaugural address emphasized the need of transitioning to a circular economy from the linear one as our commitment to scenario planning for generations ahead.

Mr. Atul Bagai, Country Head, UNEP spoke about the global business strategies shaping up sustainable practices in accordance with UN SDGs.

This issue comprises selected research papers presented during the Research Conference organized on November 19th, 2022 at METIOM campus. These papers explore and suggest various best practices, opportunities, and challenges that need to be implemented and addressed.

We hope to continue our research journey this year in the area of sustainability with our next International Research Conference to be organized in November in collaboration with the International Council of Circular Economy.

Do write to us to share your feedback and your research interests.

Happy Exploring

Dr. Swati Lodha
Director
MET Institute of Management

Assessing the Potential Role of Dark Fermentation of Waste Streams and Its Related Business Models in Future Circular Economy

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ABSTRACT

The global community is facing an unprecedented perfect storm battling with the Grand Challenge of climate change, with economic, societal and environmental ramifications being felt as much as never before, with South Asia at the epicenter. With greenhouse gas(GHG) emissions as the main driver of climate change, special attention is put into decarbonizing sectors that are the main contributors of these gasses. These include obvious ones, such as the energy sector, but also less obvious like waste. Nonetheless, numerous challenges lie on that end. For the former, intermittency of renewable energy is the biggest obstacle, whereas for the latter waste management and valorization are the key challenges to overcome. Dark fermentation has the potential to be the process that connects these seemingly irrelevant sectors through the solution of bio hydrogen. Hydrogen has been touted by many as the most promising alternative as an energy carrier and means of storage, primarily due to its energy density and lack of carbon content. Dark fermentation is applied both to municipal and agricultural waste, using easy to cultivate bacteria such as clostridium combined with E.coli. With the organic acids that remain, bio stimulants can be generated to benefit the rural communities, whereas with residue remaining from the lower hydrocarbon chains, useful bio methane can be channeled towards heating and cooking. This study initially examines sustainability, circularity and economic functionality of such a business model. It also assesses the implications, opportunities and challenges of a business model around dark fermentation for stakeholders, including farmers, distribution operators, energy storage companies and renewable energy communities. Finally, this study emphasizes on the public private partnership (PPP) possibilities and the strategies and policies. Multiple methods will be utilized, including empirical evidence/knowledge and literature research, but also interviewing methods will be included, if time allows, to the stakeholders involved, such as municipal workers, grid distribution/transmission professionals, regular citizens - members of renewable energy communities and farmers. The outcomes expected from this research are to identify the best and most cost-efficient dark fermentation practices, including the most cost-effective and least energy intensive byproducts, but also make a painstaking stakeholder map. In this way, the economic, social and ethical costs and benefits will also be identified.

Keywords: Fermentation, Waste Stream, Circular Economy

1. Introduction

Manmade climate change is creating the conditions for the complete degradation of our environment across all of its sectors. Firstly, it contributes to increasing extreme weather events, such as flesh floods, forest fires and hailstorms (Raupach et al, 2021). These events, in turn, significantly affect the agricultural sector, changing production patterns that seriously influence food prices and production patterns. This entails great importance especially for countries in the Global South, with a focus in arid and semi-arid regions, where like in Yemen today in the 21st century we are seeing unprecedented famine across the whole country (Adams et al, 1998). Conventional agriculture which is the most common worldwide has already depleted its soils of all nutrients and microorganisms with the overuse of pesticides, artificial fertilizers, which destroyed the biodiversity able to mitigate the climate change, and it is now by far the most unstable production chain in face of climate change. Foods produced this way have far less nutrients than their counterparts from the 1920s when the initial nutritional values were measured, and with further processing they are stripped of all micro and macro nutrients but carbohydrates and fats. These issues combined lead to severe health problems, which is a huge societal concern, such as “infectious and respiratory diseases and an increase in the mortality rate”(Rocque et al,

2021).
South Asia is expected to face the bulk of this devastation, as it is one of the most vulnerable regions to climate change. It is already among the world's most vulnerable regions to flood-related natural disasters and, since flood risk is sensitive to different levels of warming, these events are expected to substantially increase over the next few years, in particular in India, Bangladesh and Pakistan (Mirza, 2011). The region is expected to see their agricultural land shrink alarmingly and "face desertification more than most regions, resulting even in malnutrition and famine"(Jat et al, 2016). Just a quick glance at recent flash floods in Pakistan and we can clearly see the reality of these scientific claims coming to fruition. All of this will create the perfect conditions for the massive spread of diseases such as cholera, typhoid and malaria, which will have devastating effects on the people's livelihoods and health (Sen et al, 2017), without mentioning the food security which is already alarmingly high inthe region. It is audibly delineated that it is of uttermost importance to address these issues in the Global South, with a special focus and South Asia, and decarbonize every sector, with the ultimate goal of mitigating climate change.
As climate change is anthropogenic, focus will be put on the decarbonization of two human activities that are responsible for the largest part of greenhouse gas emissions (GHG). On one hand, several scholars have asserted that the chief reason for the aforementioned emissions is ithe energy sector. The solution on that regard is found in renewable energy (RE) technologies and the main challenges related to that are contemplated to be the intermittency of several renewables, the feasibility of economic models that are "beneficial for the society and the lack of investments in the Global South" (Papadis & Tsatsaronis, 2020). On the other hand, waste disposal accounts for more than 10% of CO2 emissions, because by placing it in landfills methane is emitted, which is as much as 4x more harmful than CO2. Currently, even in countries like the USA, more than half of it is disposed of in landfills, instead of seeing attempts to reintroduce it in the value chain and creating circularity. Conventional processes of waste valorization, such as coal gasification or the existing ways of aerobic wastewater treatment are deemed to be carbon positive and it is becoming increasingly complicated to push waste-to-energy processes to the socio-technical regime (Novotny, 2022). We as humans are the only animals on earth that do create waste and are destroying whole ecosystems in the process; therefore it is of utmost importance to stop, rethink and regain control of our waste streams. Begin to see the value in our waste and reintroduce the circularity of nature into our economy.
The foregoing obstacles are very difficult to be overcome and a solution that would be able to tackle all of them, decarbonizing both sectors and at the same time addressing the decarbonization challenges of intermittency, economic feasibility and social acceptance in a holistic manner could create a new economy and revive the local communities which is particularly needed in the Global South.

2. The solution of dark fermentation for biohydrogen production

Hydrogen has been championed as the most suitable energy carrier solution to cope with the intermittent nature of most of the renewable energy solutions and provide "a sustainable and clean approach to storage and transport of energy on a global scale"(El Ammam & Ozcan, 2019). Hydrogen has already been produced mostly for industry use, and there are several ways of producing it, from conventional fuels such as coal, oil and gas, but also from renewable sources, such as solar and wind. Over the past years, biomass is becoming an increasingly promising way of producing hydrogen as well, gaining traction as we move forward with the energy transition, with research studies on the different feedstocks being seen as "the sole scientific challenge at the moment"(Nikolaidis & Poullikkas, 2017). The main obstacle is mainly due to the fact that hydrogen production from biological processes has not been well-studied so far.
Out of the biological processes, dark fermentation is touted to carry out the biggest potential of creating a reliable and scalable source of hydrogen. It mainly consists of fermentation of both obligate and facultative anaerobes, in the absence of oxygen and light. The substrate for the process is chiefly composed of lignocellulosic biomass, carbohydrate materials like wastewater from industry, sugar-containing crop residues, and municipal solid waste(Kamran & Fazal, 2021). It can also include other types of biomass with a similar chemical composition, such as aquaculture products, namely micro- and macroalgae. Numerous species of both have been found to be rich in either proteins, carbohydrates or lipids, all of which are valuable feedstock for the dark fermentation process(Jacob-Lopes et al, 2020). Algae in particular would be an ideal type of feedstock, because it has been found that wet biomass has much greater potential as feedstock for dark fermentation than dry one(Dahiya et al, 2021).

The metabolic pathways that are considered the most suitable thermodynamically are the following:
- Hexose to acetic acid
- Hexose to butyric acid
- Acetate to ethanol

The third one is deemed to be the best option for hydrogen production (Sarangi & Nanda, 2020).

The end product of this process is a mix of H2 and CO2, but also traces of CH4, CO and H2S are found in most of the mixes. The initial glucose, through the glycolytic pathways can be converted later to pyruvic acid, which, in its turn, is then further converted to CO2 and H2. The ratio of butyrate to acetate can highly determine the level of biohydrogen on the mix from glucose.

A table of the microorganisms and substrates that have been tried so far and the yields generated can be found in table 1. A pattern that can be comprehended in this case is that sugar-related products in general generate higher yields, which also highlights the type of feedstocks that would be good to be further studied.

Table 1: Microorganisms and substrates combination for biohydrogen production, and hydrogen yield. Data was retrieved from Jacob-Lopes et al, 2020.

Microorganisms	Substrates	Hydrogen Yield
Caldicellulosiruptor saccharolyticus DSM 8903	Hydrolyzed potato peels	3.4mol/mol
Clostridium butysicum	Sugarcane bagasse hydrolysate	1.73 mol/mol
Clostridium saccharoperbutylacetonicum	Cheese whey	7.89 mol/mol
Clostridium thermocellum	Wood Fibers	1.47 mol/mol
Clostridium thermocellum ATCC 27405	Sugarcane bagasse	109.6ml/g
Clostridium thermocellum 7072	Corn stalk	1.2 mol/mol
Clostridium thermolacticum DSM 2910	Lactose	1.5 mol/mol
Clostridium thermopalmarium DSM 5974 and Clostridium thermocellum DSM 1237	Cellulose	1.36 mol/mol
Enterobacter aerogenes	Glycerol	172.9 mol/g
Enterobacter aerogenes HO-39	Arabinose	120.9ml/g
Enterobacter aerogenes HO-39	Fructose	121.9ml/g
Enterobacter aerogenes HO-39	Galactose	118.2 ml/g

Enterobacter aerogenes HO-39	Galactose	118.2 ml/g
Enterobacter aerogenes HO-39	Glucose	124.5ml/g
Enterobacter aerogenes HO-39	Lactose	37.8ml/g
Enterbacter aerogenes HO-39	Maltose	140.7ml/g
Enterobacter aerogenes HO-39	Mannitol	206.8ml/g
Enterobacter aerogenes HO-39	Mannose	121.9ml/g
Enterobacter aerogenes HO-39	Rhamnose	69.7ml/g
Enterobacter aerogenes HO-39	Xylose	117.9ml/g
Thermoanaerobacterium thermosaccharolyticum W16	Corn stover	2.24mol/mol
Thermotoga neapolitana	Rice straw	68.2ml/g
Rumicoccus albus	Sweet sorghum residues	2.59mol/mol
Thermotoga neapolitana DSM 4349	Hydrolyzed potato peels	3.3mol/mol

During the process, positive standard Gibbs free energy is achieved, which means that there is no group of microorganisms that can result to a complete conversion of the substrate into biohydrogen. This means that byproducts are inevitable. The bulk of these comprises of organic acids and their utilization is the most promising means to make a biohydrogen-based business model truly profitable(Ding et al, 2020). The most common method involves further processing of the remaining acids into biohythane, a mixture of biohydrogen and biomethane(Sarangi & Nanda, 2022), but it is certainly not the sole manner and more profitable ones are going to be explored during this research, involving more stakeholders in the process

Nonetheless, bio-H2 production still entails challenges related with the economic viability of certain processes and their limitations. Taking this into consideration, there is great value in better understanding the sustainability, circularity, economic feasibility and scalability of such business models related with biohydrogen.

3. Assessing several indicators of a business model - LCA

Biohydrogen production from numerous biomass feedstocks, such as (in)organic waste, woody biomass, marine biomass such as micro and macroalgae essentially introduces novel business models. This primarily happens due to several reasons. Firstly, it is a fact that decentralized production will be prevalent in these energy sources, since biomass resources are numerous and it makes more sense in terms of transportation costs and emissions to move to such a model. Secondly, it can

introduce the notion of the biomass renewable energy communities, where certain facilities can gather the whole community's biomass, convert it into biohydrogen and store it for utilization or trade. This also creates the very interesting concept of the prosumer. A prosumer in the case of a biohydrogen economy can become more than an energy trader and actually can valorize the residue from the biohydrogen production or trade the valorized products, which adds additional dimensions to these types of business models. Lastly, as mentioned, the scalability can be severely affected by the type of biomass, so this also needs to be taken into consideration. Finally, after the foregoing assessment, a better comprehension of the role of each stakeholder ought to be created.

3.1. Circularity

The aspect of perfect valorization of all the waste(or other) biomass is the chief obstacle on the circularity of dark fermentation. Most studies have delineated that hydrogen conversion efficiency has not exceeded 60% through the utilization of any type of feedstock(Ghimire et al, 2015). It should be indicated that the aforementioned efficiency largely depends on the type of feedstock and that substantial improvements have been made, considering that less than a decade ago the efficiency of dark fermentation combined with photofermentation was 34%(Xia et al, 2013). Currently, as mentioned, applying dark fermentation to biomass can result in a 40% remaining residue, which can be valorized through coupling with biorefinery in different products, ranging from soil amendments to platform chemicals. Reflecting on the end product value, a certain preference is expected to be made towards the platform chemicals industry, which is a very promising bio-based industry(Becker et al, 2015). Recent research has shown that biorefinery can have a degradation efficiency of more than 60%(Liu et al, 2021), which still leaves a 16% of the residue going to waste. It is an eminent need that biotechnological advances reach the socio-technical regime and that their costs fall rapidly over the next years, so that such promising techniques can become affordable for local communities of the Global South. A working pattern that can have revitalizing effects on these communities are open-source hardware, living labs, citizen science and crowdsourcing models. By leveraging the crowds' strengths, true Renewable Energy Communities can be created and thrive.

3.2. Economic Feasibility

Economic feasibility is a major component of each clean technology process that aspires to be introduced into the Global South local communities. A breakdown of several techno-economic analyses that have been made can be found in Table 2

Table 2: Techno-economic analyses of a biohydrogen plant

Research	CAPEX	OPEX	Revenues from H2 per year	Revenue from FW per year	Profit per year	Capacity	Raw material
Han et al, 2016(1)	443100	366700	516400	58400	176885	10ton/day	Food Waste
Han et al, 2016(2)	318800	122920	66278	10950	-45691	10m3	Molasses
Li et al, 2012	-	91000	80000	12000	1000	10m3	Wastewater
Li et al, 2012	-	99000	19000	3000	-77000	10m3	Agricultural waste

Chang & Hsu, 2012	220000	29230	27000	50000	47770	10m3	Wastewater
Bonk et al, 2015	74.4mln	12.2mln	400000	21.6mln	7.8mln	1 ton	Solid waste

It should be mentioned that the final revenue largely depends on the FW further valorization. Both Li et al(2012) and Han et al (2016(2)) assume its conversion solely into CO2 and that has two main components that need to be addressed. First, it does not discuss their conversion into platform chemicals. Second, the prices of CO2 have skyrocketed ever since 2016, hence it can be argued that the financial losses that have been calculated do not reflect the present CO2 prices and the technological advances that have been made ever since.

3.3. Scalability

In order to enhance scalability, the inhibiting factors need to be mapped. Rittman & Herwig (2012) stressed that the key culture parameters that need to be increased with that regard are "H2/S ratio, methane evolution rate (MER) and qH2". Another important factor encompasses finding the "optimal enterobacter anaerobes"(Rambabu et al, 2021), meaning the ones that have can generate the highest hydrogen yield or that have the highest growth rates

3.4. Societal Acceptance

The lack of a full-scale elaborative life cycle analysis to this date is also the chief reason for the potential backlash such a technology might face in terms of societal acceptance. Moura et al(2022) point towards "toxicity dispersal and resource availability, primarily water", as the main elements that might inhibit such a technology being accepted from society and in the case of dark fermentation, several of these can have a negative impact. Overall, hydrogen technologies have generally faced backlash due to issues related with the gas's probability of explosion and the potential NOx emissions that can severely affect its environmental impact. In addition, the fact that this process leaves by-products can be conceived negatively from the local communities, if no capacity building takes place beforehand. Another aspect that ought to be taken into consideration is the coupling with the biorefinery factor. As biorefinery is already being perceived with skepticism(Marciano et al, 2014) due to notions revolving around the fact that one should not meddle with the natural landscape and nature in general, the potential for lack of acceptance is augmented.

For this reason, it is of uttermost importance to combat this by creating capacity building mechanisms that focus on the economic impact of such business models for each stakeholder. Also pointing out the great advantages which come with a circular approach to producing hydrogen and to general utilization of green hydrogen as a transitioning alternative to both fossil fuels and electric vehicles, as well as the climate mitigation potential of implementing such a round up approach. It is this very reason that a thorough stakeholder mapping practice must take place, identifying all stakeholders' key strengths, deficiencies and main benefits that they possess in this process, so that it can be conveyed to them in the optimal manner.

4. Stakeholder mapping

In the case of the emerging biohydrogen economy, a new type of interaction between state and private actors, public private partnerships, but also interaction with nature is bound to take place. In such cases, several human stakeholders are expected to be largely interested in services and goods provided by this ecosystem. Linking these goods and services and mapping the stakes that these players have on them is essential if we are going to have "effective, equitable and sustainable ecosystem governance and management"(Raum, 2018), because in this way it is understood who is part of this system and what is their actual involvement. Thus, in this chapter, a mapping of all relevant stakeholders will take place, presented in the end via an interest-influence matrix.

4.1. Waste Collection Utility/Company - Landfill

Companies and utilities related to the collection of waste have very clear objectives with regards to waste valorization. This lies within the waste reduction on the landfills, as in most countries globally there are issues related to overcrowding of landfills. Hence, their interests within a biohydrogen economy lay as a provider of raw materials. This means that it is in their best interest both to comply with national/

international regulations on circularity, but also to make endeavours to make profit from providing these materials to the biohydrogen labs/facilities. The primary challenge in these stakeholders' cases is having the financial capacity to pre-process/separate waste so it can then be used by the biohydrogen plant in an optimal manner.

4.2. Wastewater Company or Municipal Sewage

Wastewater companies/municipal sewage position in the ecosystem is similar to that of the aforementioned utilities. Their objectives and interests are more related with minimizing the waste that is disposed of and they will attempt to also achieve substantial gains from selling the wastewater. In this case, there is great interest to see whether wastewater or solid waste (and its different types) generate higher yields. As well as for whom it could generate higher profits when introduced into the circular hydrogen economy, as per today we have many wastewater processing plants that do sell humus as final product for gardeners, and this is usually the case across dry regions where its availability is scarce. Therefore will dark fermentation provide higher yields in biomass and further increase the scale of humus or alternative soil amendments? This has great importance as there might be competition with their solid waste counterparts (or other biomass providers). This means that there should be discussion over whether this new biomass market will be regulated or free, depending on the local (or national) governance models and religions. Similarly to the solid waste actors, managing to pre-treat wastewater is the most complicated task for them.

4.3. Municipality

The municipality's main objective is mostly to achieve sustainability and circularity for its citizens' livelihoods. Their chief interest as part of a biohydrogen economy is to ensure that it runs smoothly, in a fair manner and that certain standards of quality of the different processes are met (from processing of the biomass to its utilization). However, the most important aspect is correlated with the financing part. Each municipality's interest to ensure that there is adequate public financing to support such biohydrogen initiatives is the top priority. In terms of means used, this entails:

- Coordinating with regional and national governments and with international institutions (UNDP, USAID etc) to secure financing resources for its citizens.
- Working together with adjacent municipalities to create cooperation schemes. For example, rural-urban partnerships can create a great tandem, leading to energy and other products' trade.
- Creating a regulatory and legal framework to support clean hydrogen fair trade that will be inclusive for all groups of people within the community
- Increase demand for hydrogen by retrofitting their existing vehicles (e.g public buses and cars) to running on hydrogen

The most difficult work for the municipality will be to create the framework/provide the incentives in a correct manner that ensures circularity and eliminates emissions, given the fact that the people working there will require capacity building for the new economy.

4.4. Renewable Energy Community (REC)

The RECs objectives and interests are similar to the municipal actors' ones, but have a more technical approach. Their main objective is energy management is optimized in the community and that storage options optimize the facilitation of this management. It is in their best interest to maximize profits for its prosumers, both economic and environmental, and to distribute these profits in the best manner, generating gains for the local community/society as well. The means that they can deploy are:

- Organize a REC framework, that creates a clear roadmap on how the REC will function, how trade will other RECs/the grid will take place
- Coordinate with the local municipality and the international institutions to express the REC's needs in terms of financing and to inform the interested parties about where these funds will be allocated

4.5. Microloans, micro creditors and similar agencies subsidizing green alternatives and their adoption

Microloan providers and microcreditors will be acutely important in the case of small-scale biohydrogen power plants. They can mobilize funds of up to $100,000 and hence they could fully fund the whole power plant. Their objective is to generate traction for a green economy (such as a biohydrogen economy) on a small-scale and also create profits for themselves, essentially such as most financial institutions. The means that the pursue are:

- Providing microloans to RECs/biohydrogen plant operators to buy equipment
- Coordinate with international institutions to create a broader financing scheme for biohydrogen communities

The most complex situation that microloan providers will have to face is structuring the loans themselves, given that many stakeholders will be involved in the production process of biohydrogen, so equipment will need to be purchased by many of them.

4.6.NGOs and other non SMS non government players advocating for diversifying of green alternatives.

NGOs in the field of clean energy technologies have a clear objective: to facilitate the adoption of such technologies by the broader population. This means that they are interested more than anyone to make people knowledgeable on the technical, economic, societal and ethical aspects of, among other technologies, a biohydrogen economy. The means they can deploy involve:

- Raising awareness campaigns
- Providing workshops on technical/economic skills on hydrogen - Capacity building of municipal workers/sewage and solid waste workers in the optimal separation of biomass and other relevant and important skills

They will unfortunately have to face the lack of societal acceptance towards hydrogen due to claims about its explosive nature or due to other assertions about how clean energy from biomass actually is. But as it is their mission to spread awareness and contribute to wider knowledge dissemination, it will be their role to dispute the claims and reassure populations on its benefits through different approaches such as handson workshops, integrated management of a communal hydrogen power plant, or other approaches similar to introducing regenerative farming in conventional farming communities, where resilience towards any other way but conventional farming, was built through generations.

4.7.Energy Storage Companies

Companies that manufacture and/or operate hydrogen tanks want to maximize their profits or, alternatively, see the demand being maximized. Their interest is to see a booming biohydrogen economy and their main challenge is to be able to provide such options at affordable costs and at small-scale. Their main means are:

- Invest in R&D for the optimal solutions for biohydrogen RECs at low costs
- Work together with NGOs to raise awareness on safe storage of hydrogen
- Lobby/promote the biohydrogen REC concept within local, regional and national governments

4.8.Distribution Operator

The DSO main objective is to facilitate the transition into a micro- and smart grid electrical system. Hence, their interest in biohydrogen in that regard is that it becomes a key player in storage and management within microgrids. What they can do about it is mostly coordinate with RECs, so that biohydrogen is managed and stored in a manner that maximizes profits for its prosumers, without at the same time overloading the grid or making an acute increase in the electricity/energy costs.

4.9.Hydrogen vehicles manufacturers

Retrofitting garages and car manufacturers see enormous value in this innovation, as this will result in a spike in need for new vehicles/retrofitted vehicles. This is their best interest in this case. The best way to express their interest and pursue it within a biohydrogen economy is by raising awareness in the local communities and coordinating with the government on creating financial incentives for owners of such vehicles. This can happen at a national level if big players such as car manufacturers are involved, or at a local level, if hydrogen retrofitting garage owners are included. In addition, these stakeholders can incentivize the local community by themselves, by providing easier payment schemes in installations with low(or zero) interest,

4.10.Smallholder farmers

Farmers are similar to waste-related stakeholders, in the sense that they possess the raw materials that can later be converted to biohydrogen. However, their interest lies not so much on being compliant with environmental regulations, such as the sewage companies, for example. Their interest in this case is maximizing economic profitability by utilizing agricultural materials that would otherwise go to waste. Another potential reason for interest is the utilization of hydrogen to power their vehicles, namely their tractors and relevant equipment. By gathering in associations, they can leverage their collective power and request from public state actors (e.g municipalities, ministry of agriculture) to provide them with incentives to increase the circularity aspects of their businesses. These can be achieved through numerous actions, such as buying out the agricultural waste from the farmers associations, or offering subsidized/ free retrofitting of their vehicles and further subsidized hydrogen for the duration of their contribution in the circular chain.

4.11.Other agencies working on rebuilding the town-village link

In this business model, a new type of partnership will emerge: the rural-urban partnership. This will encapsulate farmers and waste(water) utilities sharing their waste streams and retrofitting companies of tractors and buses sharing best practices so that end-users convert to hydrogen. Their harmonic and best co-existence is in the best interest of new emerging agencies that will be working on rebuilding the link between urban centers and rural areas. Their biggest challenge, at the same time, will be to show if and how such a business model will work and how will the new types of public-private partnerships (PPP) , such as the farmers-waste(water) utilities one would actually function.

Business Models

Business Models

There are many possible business models in a circular economy that involve green hydrogen. Here we will try to explain two such models interlinking the hydrogen usability and future circularity between the city and a village. As mentioned in our stakeholder map and throughout the chapter, we can use municipal waste streams as well as sewage and agricultural waste to produce green hydrogen using dark fermentation. This gas furter gets distributed locally and increases the retrofitting of buses and other public transportation vehicles in the cities for example, while increasing the retrofitting desire for tractors in the villages, which could be incentives by local governments or subsidized. These further make the hydrogen more available at the local gas stations making the phasing out of the fossil era into a regenerative one more effective, faster, safer and readily available.

As there is no need for manufacturing the brand new cars or vehicles, all can be retrofitted in a similar fashion as petrol engines are being retrofitted today in any Joe's garage to methane or natural gas. The second link is the residue after fermentation which can be processed into soil amendments for agriculture, increasing the soil productivity and leading to greater yields and providing for future agricultural waste. Looking into the storage question, hydrogen is a fuel so there is no need for lithium batteries, meaning no mining and all the other CO2 expensive activities related to new battery productions. Also old fossil fuel storage cells can be refurbished into Hydrogen ones.

4.12. Main takeaways of the business models

All these will create the space for phasing out of fossil fuel economy faster and give space for electric vehicles to develop more sustainable battery solutions and conversions, giving us a buffer to not have to fall on fossil fuels again, like we are falling today from gas to coal and other much more destructive fuel alternatives when it comes to heating the Europe due to the current political situation. As for EVs we still need heavy duty machinery to dig for lithium, and the whole chain of production is heavily dependent on fossil fuels, as creating a fully new vehicle is today. However if we create a new rounded hydrogen value chain, it will not only secure the ultimate safer transition to EVs phasing out of fossil fuels, as it will allow for us not to bank everything on one single modus of powering but allow for diversification which has proven again and again to be the safest bet. 7 Conclusion

As climate change is induced and intensified and amidst its catastrophic consequences for rapidly growing regions like South Asia, the energy transition will require many more "weapons" to become efficient and truly protect the environment and people. One of the relevant technologies that are very promising is biohydrogen production through dark fermentation and valorization of the residue organic acids. There has already been research that has provided extended information on the expected hydrogen yield based on the waste valorized, however there are limitations, as all types of biomass can participate in the process. Additionally, economic analyses have had severe limitations, as they do not account for the myriads of uses the residues from the dark fermentation process can have, which can significantly increase the revenue generated. This research has great value in light of the Indian presidency in the G20, where the agenda includes more RES implementation, increasing regional interconnections and scaling-up storage and energy management technologies. A biohydrogen economy touches upon all the foregoing topics and hence should be endorsed, both financially and in terms of legal/regulatory framework, by state actors in the Global South, so that all of its potential benefits can be distributed to the stakeholders involved.

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Starch-based edible protective coating obtained from sweet potato waste.

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ABSTRACT

There is a need for sustainable solutions to increase shelf time and ensure food safety. The use of edible protective coatings in the food industry is and simple and innovative alternative, even more, when the coating is combined with active agents that confer additional functional attributes. Natural polymers such as polysaccharides are very interesting given their edibility, biodegradability, and easy access, among other aspects. Starch is one of the most widely used polysaccharides mainly due to its low cost and simplicity of processing technologies. In this work, sweet potato wastes were used to extract starch. This biopolymer was combined to develop an edible film, by gelation process. The edible coating was characterized in terms of surface morphology (SEM), chemical composition (FTIR) and wettability. For the protective effect, different fruits (bananas, apples, passion fruit, tomato and guava) were coated with 1 or 2 layers of this film. The results showed, in general, that the coated samples revealed better results regarding, texture, color, odor and delayed maturation when compared to the uncoated controls. This is indicative of the potential for increased shelf-time of fruits without significant alterations to their intrinsic properties. Moreover, the extraction process, based on food waste recovery and circularity combined with the protective effect shows the importance of this work and its alignment with several sustainable development goal.

Keywords: Starch Based, Protective Coating, Potato Waste

1. Introduction

Food safety is an essential part of food security. Foodborne disease (FBD) can lead to the spread of infectious illnesses in many places around the globe: World Health Organization recently reported that 70 % of 600 million food poisoning cases resulted in death worldwide (Pires & Devleesschauwer, 2021).

Also, the incidence of that type of disease is very high in countries like the USA and Australia: 76 million and 5.4 million cases of food poison per year, respectively (Mullan & Wong, 2009).

FBD economic burden can also be a problem: human illness caused by food poisoning cost the United States around 2.9 and 6.7 billion dollars (Buzby, Roberts, Lin, & MacDonald, 1996).

These diseases may result from poor food safety procedures followed by farmers and producers, who may use prohibited pesticides to cultivate goods. This is undesirable since it could create not only food poisoning but also environmental damage (Nayak & Jespersen, 2022).

Wrong food safety procedures are not the only cause of environmental damage: food packaging has a major role on this cause. In general, goods are usually packed using plastic since it protects the product and improves the shelf time. (Zhang, Dhir, & Kaur, 2022). Stronger arguments are made for the urgent need to reduce or reconsider the use of plastic in the world (Azzi, Battini, Persona, & Sgarbossa, 2012; Hu, Shen, Zhang, Li, & Zeng, 2019; Shen et al., 2019; Thompson et al., 2004). This is essential to reduce pollution, enhance sustainability, and protect biodiversity (Shen et al., 2020).

Efforts have been made in order to tackle this challenge: Franz and Welle (2022) developed a new food package based on plastic waste; Molina-Besch and Keszleri (2022) explored de possibility of using biobased plastics to reduce the impacts of this material. Others investigated the potential for developing an edible packing for fruits and vegetables (Kumar et al., 2022), based on biopolymers. Some of them use starches, cellulose derivatives, chitosan, animal or plant-based proteins, and lipids. These biocompatible polymers can help extend the shelf life

of fruits preventing also food poisoning (Trajkovska Petkoska, Daniloski, D'Cunha, Naumovski, & Broach, 2021).

Among those different biopolymers, starch (which is found in seeds, roots, and tubers (Bello Perez & Agama-Acevedo, 2017)) has received considerable attention since it is low cost, abundant, edible, and biodegradable (Abral et al., 2019; Davoodi, Kavoosi, & Shakeri, 2017).

This prompt researchers to investigate food waste as a source of starch for the development of innovative food packaging.

Sweet potato (Ipomoea batatas L (Lam)) starch has excellent gas permeability, good film-forming and mechanical tolerance (Oyom et al., 2022) making it adequate to use in food packaging. Also, millions of sweet potato (> 90 million) (Guo et al., 2022) are produced worldwide, generating a considerable amount of waste that does not comply with the food industry requirements Thus, it an be re-used to develop new products such as edible packaging.

In this study, an edible food packaging solution is developed, considering circular economy concept (Zhu, Liu, Ye, & Batista, 2022).

A starch-based edible coating, produced from sweet potato waste, was developed and its protective effect on different fruits was tested. This approach intends to reduce waste through the valorization of food excedents not suitable for human consumption, while developing sustainable alternatives for food safety.

2. Materials and Methods

2.1. Materials

The purple sweet potato was provided by the OTM Verde, an agriculture company from Azores, Portugal; ethanol (96%) analytical grade supplied by Labkit (Azores, Portugal); citric acid from Sigma (Spain); neutral gelatin powder supplied by Panifor (Azores, Portugal).

2.2. Methods

2.3. Extraction of starch from purple sweet potato waste

The purple sweet potato tubers were washed and cleaned carefully with tap water to remove the soil spots. The cleaned tubers were peeled and cut into small pieces. Next, the pieces were transferred to a food processer containing distilled water (1:2 v/v). The mixture was grinded until a pulp was obtained. Thereafter, the pulp was filtered using a cotton cloth and the solid matter was discarded. The filtrated was let to settle allowing for the sedimentation of starch. The wet starch was then kept at −30 °C for 4 h and freeze-dried for 21h (Scanvac Cool Safe). Finally, the dried starch was grinded into a fine powder, and stored in sealed containers for later use.

2.4. Characterization of extracted starch

The extracted starch was analyzed in reference to its nutritional components, namely: moisture, protein, sugar, and ash content. For that, the starch was kept at 100 ºC for 24 hours. The protein content was quantified using the Kjelhahl method, while the amount of carbohydrates was determined using the Luff-Schoorl method. (Senanayake, Ranaweera, Gunaratne, & Bamunuarachchi, 2013).

2.5. Development of starch films

The starch was dissolved in distilled water to form a uniform solution. The solution was subject to heating at 75ºC for 5 min, under constant agitation, and cooled in ambient temperature. After that, neutral gelatin powder was added (0.42/0.30/99.30(m/m/m) (starch/ gelatin/ water).

The mixture was stirred until complete dissolution of the gelatin powder.

2.6. Characterization of starch films

2.6.1. Scanning electron microscopy (SEM)

The surface morphology of coated surfaces were analyzed using NOVA 200 Nano SEM equipment from FEI Company. Before observation, the surfaces were vacuum coated with a thin layer of gold to make them electrically conductive.

2.6.2. Fourier transform infrared spectroscopy (FTIR)

A Shimadzu IRAffinity-1S equipment. was used to record the scanning spectra in the wavenumber range of 4000 and 400 cm−1, operating at attenuated total reflection mode.

2.6.3. Wettability analysis

The wettability was measured through the contact angle, using a Goinometer (DataPhysics Instruments, model OCA 15plus; Germany). The experiments were performed according to the standard ASTM D7334-08 (Standard practice for surface wettability of coatings, substrates, and pigments by advancing contact angle measurement). Briefly: the sessile drop method was applied. The procedure consisted in dispensing a 3 μL drop of water at different zones of each sample. At least ten measurements were carried out (n = 10).

2.6. 4. Protective Effect

To assess the protective effect of the liquid film, several fruits were coated with it.

Initially, the fruits were sanitized with a cotton cloth. Secondly, the coating was applied by dipping the fruits into the coating solution for 30 s. The excess solution was left to drip off. When appropriated, a second layer was applied after a 10 minute interval, following the same procedure. Then the samples were air-dried for 12h at room temperature to remove any superficial moisture.

The protective effect was tested in five different fruits: guava, banana, passion fruit, apple and tomato. Each experiment was done in triplicate (n=3). The protective effect was evaluated visually and by analyzing the odor.

3. Results and Discussion

3.1. Starch extraction yield

The nutritional results, for the extracted starch, are presented in **Error! Reference source not found.**

TABLE 1. NUTRITIONAL ASSAY OF EXTRACTED STARCH.

Assay / Method Physical-Chemical Parameters	Units	Freshly harvested
Moisture content	g/100g	4,0
Protein Kjeldahl Method	g/100g	0,9
Carbohydrates Measurement	g/100g	92,3
Sugars (mono- and disaccharides) Luff-Schoorl method	g/100g	<0,1
Fibers *	g/100g	2,1
Lipids *	g/100g	0,3
Total Ash*	g/100g	0,4
*Parameter determined by gravimetric method		

The starch content was 92.3%, an acceptable value, especially when considering that there
was no chemical purification process involved.

3.1.1. Effect of potato aging on the yield of the extraction process

In order to determine the effect of aging on the obtained percentage of starch, the same extraction process was applied to freshly harvest potatoes and compared to matured potatoes (1 month after harvest).

The percentage of starch extracted from freshly harvest potatoes, 47 ± 2%, was calculated using Equation 1:

Equation 1: % of starch =

Where is the mass of dry starch (g) and is the mass of dry sweet potato pulp (g).

The same was done for the starch extracted from the matured harvests samples, 27.4 ± 3 %.

According to Suraji A. Senanayake, et al., the percentage of starch present in sweet potato can vary between 33% and 65% of dry content (Senanayake et al., 2013) . Considering the middle point as the expected theoretical starch percentage of sweet potato, the yield, η, can
be determined by, equation 2:

Equation 2: η=

Where the amount of starch obtained corresponds to the percentage of dry starch and the Theoretical amounts of starch, correspond to the middle value between the interval referred in the literature.

Thus, the starch yield for freshly harvest extraction was ~96% whereas, the mature harvest only led to ~56%.

The results indicate that there is a decrease in the yield of the starch extraction process as the tuber ages. This decrease is related to the fact that the potato, being deprived of photosynthesis via its branches, resorts to the consumption of the starch stored in its granules in order to survive and be able to germinate again, which is in agreenment with other published work (Yang et al., 2022) .

3.2. SEM

The surface of the coatings with both one and two layers had a homogeneous appearance, without pores or cracks, Figure 1 A and B. Figure 1 C and D show the cross-sections of the liquid coatings with one and two layers, respectively. Compact structures can be seen, which are indicative of their structural integrity. In the case of the two-layer coating, granules of insoluble particles can be observed.

Regarding the thickness of the coatings, Figure 1 C and D, with 1 layer there was an average thickness of 2.62 ± 0.5 μm, and with 2 layers an average thickness of 3.76 ± 0.6 μm.

3.3. FTIR

Figure 2 shows the absorption spectra in the infrared region for: the control coverslip (glass), the 1-layer sample and the 2-layer sample. As expected, there is a band related to the presence of water on the film (3700-3000cm^{-1}), which is not observed on the control glass coverslip (red). It can also be observed that this band is more pronounced for the two layer coating (green), which is as expected.

Additionally, and as expected, no significant differences were observed between the main peaks of the spectra of the different layered coatings. Nevertheless, the obtain results are in accordance with other starch-based composition found in literature().

3.4. Wettability analysis

The contact angle between the coating (one and two layers) and the water droplet is shown in Table 1.

TABLE 1: CONTACT ANGLE RESULTS

	Control	1 layer	2 layers
Angle (°)	22±5	80±2	82±5

The results show that the glass coverslips coated with the starch film, either with one or two layers, have a higher contact angle than the control coverslip (without coating). It is possible to state that the film coating based on sweet potato starch is hydrophilic (< 90º). However, the value of the contact angle is very close to the hydrophobic/hydrophilic boundary, which may justify the difficulty in adhesion of the coating to some specific surfaces.

3.5. Protective Effects

3.5. 1. Banana

Figure 3, shows the protective effect study on bananas. It can be seen that the starch coating, in general, delayed ripening process. The control samples revealed aging signs after 7 days. For the coated samples the process was delayed until 8-12th days.

3.5. 2. Guava

Regarding the guava, Figure 4 shows the evolution of the test. After 3 days of testing, a change in coloration was observed in the control samples, while in the coated sample, significant alterations were only visible after the 5th day.

The control samples showed at day 5 a considerably less firm texture than the coated samples. Regarding the inside of the fruit, the control sample showed a more yellowish color when compared to the coated. Furthermore, the odor of the control samples revealed a slightly fermentation scent, while the conted samples maintained their characteristic odor.

3.5.3. Passion Fruit

Figure 5 shows the evolution of the test for the passion fruit.

After 5 days, the one layred coated samples presented a wrinkled texture, and the same was not observed for both the control and the two layers samples. On the 10th day of the test, all samples seemed the same.

Regarding the interior of the fruit, it was observed that coated samples, either with one or two layers, showed a more orange color compared to the control samples. In addition, all samples presented the characteristic smell of ripe fruit.

3.5. 4. Apple

Figure 6 presents the test results for apples. It was observed that the coated samples remain the same until the 22 day, when a slight change in coloration was observed. The uncoated samples change appearance by day 16. After 22 days of testing the control samples showed a wrinkled surface when compared to the coated ones. This is indicative of the protective effect regarding the loss of water. The inside of the control apples, showed higher oxidation when compared to the coated samples.

3.5. 5. Tomato

Figure 7 shows the evolution of the test for tomatoes. By the 4th day of the test there was a change in the color of the tomatoes in general. However, this color change was more evident in the control samples, indicating a protective effect of the coatings. Regarding texture, all samples showed firm texture until the 8th day of the test. Nevertheless, by the 10th day, the samples coated with two layers developed mold.

4. Conclusion

In this work, starch was extracted from sweet potato waste. A protective starch-based coating was developed using the extracted biopolymer. The protective effect on several fruits was evaluated. The obtained results allowed the conclusion of pertinent points, such as:

→ In bananas, guavas and passion fruits, the samples coated with either one or two layers of coating at the end of the trial showed better texture and characteristic odor of the fruit, while the control samples showed some considerable fermentation;

→ In apples, samples coated with either one or two layers of the liquid coating showed better results both in color and texture and in the oxidative process inside the fruit;

→ In tomatoes, the coated samples showed better results compared to the control, in terms of delayed maturation. However, the presence of the starch-based coating led to the formation of mold.

In is important to note that there is no formulation that meets all conditions or that can be universally applied to all fruits. Each fruit presents its own physiology, such as respiration rate, maturation and senescence, characterizing it as unique from the point of view of the elaboration of a suitable coating. In addition, since starch is a natural polymer there is a greater predisposition, when used without a preservative, to the development of molds.

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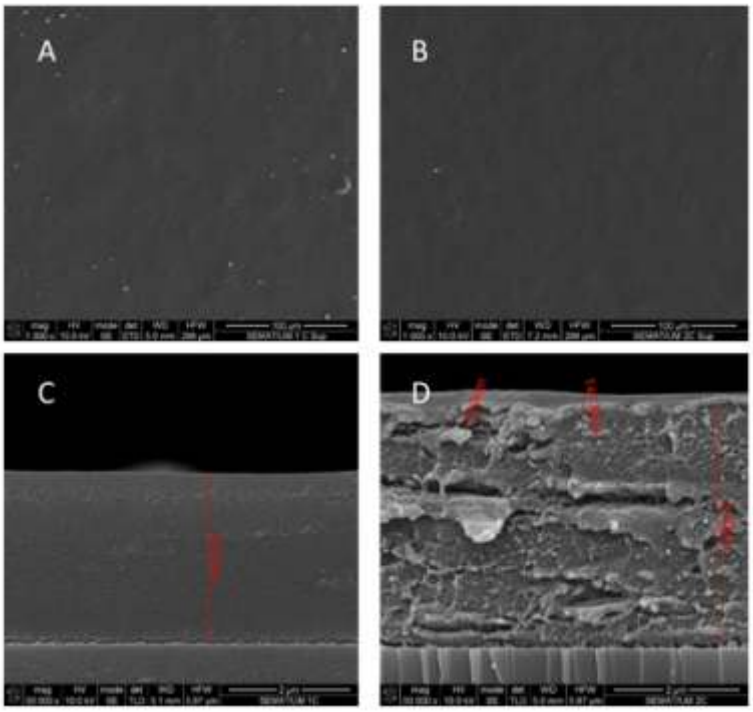
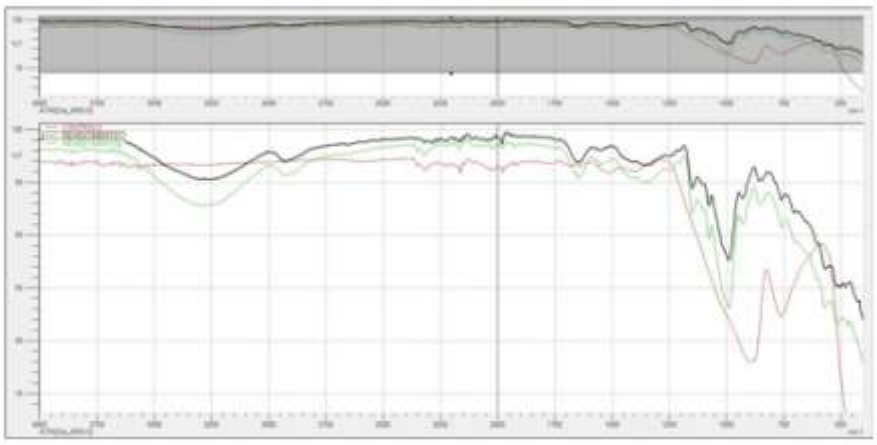


Figure 1: Sem Micrographs of The Starch Film: **A** - Surface of Liquid Coatings One Layer; **B** - Surface of Liquid Coatings Two Layers; **C**- Cross Section of Liquid Coatings One Layer; **D** - Cross Section of Liquid Coatings Two Layers.



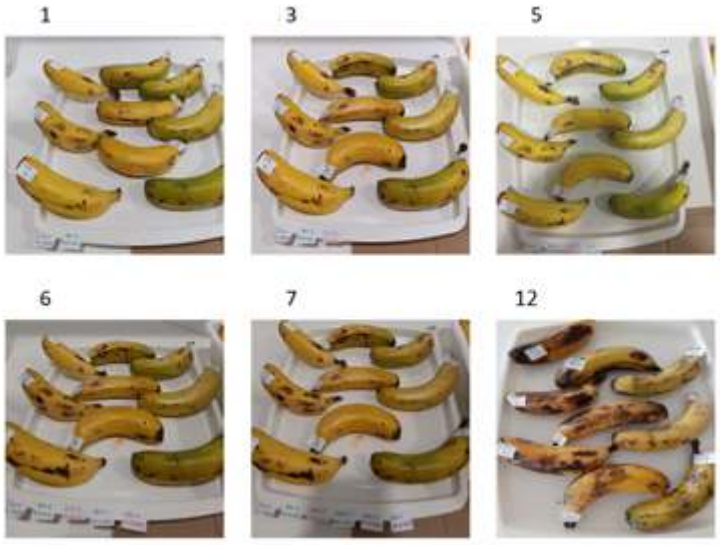


Figure 3: Study of The Protective Effect (starch Coating) on Bananas During 8 Days of Testing. for each Image, Consider: Column 1 - control; Column 2-1 Layer Coating; Column 3-2 Layer Coating.

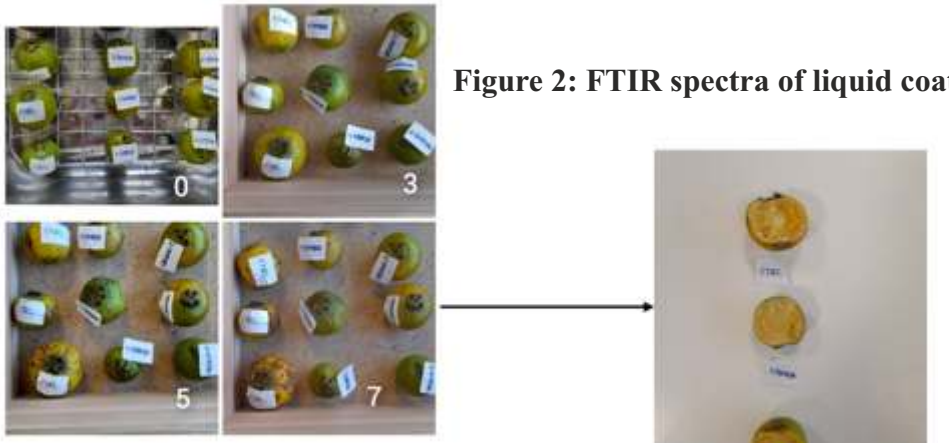


Figure 2: FTIR spectra of liquid coatings

Figure 4: Study of The Protective Effect (starch Coating) on Guavas After 3, 5 and 7 Days of Testing, On the **Left**. for each Image, Consider: Column 1 - control; Column 2- 1 Layer Coating; Column 3- 2 Layer Coating. On The **Right** Side It can be seen The Interior of Bananas after 7 Days of Testing (control, 1 and 2 Layers Starch Coating).

Figure 5: Study of The Protective Effect (liquid Starch Coating) on passion fruit after 5, 10 And 12 Days of Test on The **Left**. for each Image, Consider: Column 1 - control; Column 2- 1 Layer Coating; Column 3- 2 Layer Coating. On The **Right** Side it can be seen The Interior of Passion Fruit After 13 Days of Test (control, 1 and 2 Layers of Coating).

Figure 6: Study of The Protective Effect (starch Coating) on Apples After 5, 8, 16 And 22 Days of Testing on The **Left**. on The **Right** Side it can be seen The Interior of Apples after 23 Days of Testing (control, 1 and 2 Layers). for each image, Consider: Column 1 - control; Column 2- 1 Layer Coating; Column 3- 2 Layer Coating.

Figure 7: Study of The Protective Effect (starch Coating) on Tomatoes (optimal Picking Maturity) After 1, 4, 6, 8, 9, 10, 11, 14 Days of Testing on The **Left**. for each Image, Consider: Column 1-control; Column 2- 1 Layer Coating; Column 3- 2 Layer Coating. Molds After 14 Days of Testing on The **Right**.

Circular Economy and Sustainable Development Goals

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ABSTRACT

Although governments, businesses, and organisations representing civil society have all shown an interest in helping to accomplish the Sustainable Development Goals, doing so is not always simple. Sustainability and the circular economy (CE) are connected but distinct concepts-While sustainability seeks to balance the use of non -renewable resources with their rising consumption, CE which may be the only sustainable economic model for the future aims to increase the productivity of the productive process by minimising, reusing, and recycling as many of the by-products as is practical. The aim of this paper is to present the solution by bringing in the concept of Circular economy and the Sustainable development goals. And to inform the various stakeholders about the importance of the circular economy as a tool to accelerate progress toward the Sustainable Development Goals.

Keywords: Circular economy, Sustainability, Sustainable Development Goals

Introduction: The sustainability of the earth is threatened by a number of factors, including deforestation, energy shortages, biodiversity loss, poverty, and inequality. Natural resources are scarce, and the capacity of the ecosystem to absorb waste from rising non-renewable energy and raw material use is in jeopardy. Numerous studies link human activities to these problems. It is obvious that maximising the effectiveness of human resource use is now a top priority given that, in 2014, the natural resources we consume each year required the regenerative capacity of 1.5 planet Earths, and that the world's population and consumption levels are currently rising.

The fundamental cause of the issue is human activity, so society must try to overcome these conflicts by sensibly and intelligently rethinking the market economy and production model currently in place. Institutions, societies, and organisations have taken a number of actions in an effort to address the problem and achieve more sustainable development, which is defined in the Brundtland report as "development that meets the needs of the present without jeopardising the ability of future generations to meet their own needs." There are numerous techniques related to this goal, but only the Sustainable Development Goals (SDGs) and associated 2030 Agenda, transforming our World, have the power to spark the essential changes on a global scale. To achieve sustainable development, organisations must be more actively involved. Additionally, economic and production systems that support this type of development must be implemented. These strategies must be added to the overarching framework. This makes the circular economy one of the most useful models for bringing about systemic change.

In order to adequately define the scope of the investigation, researchers have chosen just one meaning of the phrase "circular economy" from among the many that are available. After analysing 114 distinct definitions to come up with the chosen term, Kirchherr, Reike, and Hekkert came to the following conclusions:

“A circular economy is an economic system based on business models that replace the idea of "end-of-life" with methods for reducing, alternatively reusing, recycling, and recovering resources in both consumption and production processes, operating at the micro scale (products, companies, and customers), meso level (eco-industrial parks), and macro level (city, region, nation, and beyond), with the goal of achieving sustainable development, which necessitates creating New business strategies and cautious consumers make it possible.

The circular economy ought to be the preferred economic model, so it makes sense to consider it a tool towards achieving the sustainable development goals, which has been defined as economic growth that is harmonious with such a sustainable future.

Agenda 2030 provides a framework to attain this utilising the Sustainable Development Goals.
The new circular economy model seeks to achieve both environmental sustainability and social equality. The circular economy may be the only sustainable economic model for the future since it decouples economic growth from resource consumption, establishes international standards for product sustainability, limits resource use to the planet's carrying capacity, and encourages material recycling. Long-term, it might result in a healthier world and a wealthier human race; however, in the very near future, it might also result in new job opportunities and business models.
Beyond material consumption, the circular economy can help reduce activities that damage the air, water, and land and release greenhouse gases. It can also contribute to the creation of a more just and equitable world by ensuring that minorities have equal access to resources and a variety of safe, respectable professions. While there is a clear connection between circularity and some SDGs, particularly those that deal with the environment or the economy, its relationship with other SDGs also raises the possibility of great potential: when implemented globally and holistically, a circular economy can help achieve the SDGs.
The necessity to promote deeper understanding, skill development, and knowledge growth for the circular economy's less well-known social dimensions - which should include a circular society - is only highlighted by this. One should take into account how to meet the requirements of everyone with the resources one has while developing and implementing circular strategies, in addition to how to shut loops on material resources.

This study examines circular economy and share similar characteristics it to the SDGs in depth to find evidence that supports or negates the existence of a qualitative relationship between both the implementation of circular economy and the attainment of the SDGs. The study views the Sustainable Development Goals as a key catalyst for change for use by public authorities, businesses, as well as citizens in achieving sustainable development, and seeks to highlight the factors that are helpful in achieving these goals.

Linking CE and SDGs-

The literature on CE and SDGs is searched, arranged and analysed using a descriptive literature review approach. The use of narrative reviews is common in the area of development studies. Narrative review of literature is useful for connecting studies on various themes, and although they lack the rigour of systematic reviews. This is especially true when trying to reinterpret or show linkages between studies, as did in this study. In order to find academic and non-academic material on CE and the SDGs, a keyword search was conducted using online search engines Google and Google Scholar, academic databases Scopus, and search engines of academic publishers Wiley Online Library and ScienceDirect.

Definition of Circular economy concepts-

An industrial system which is restoring or regenerative by purpose and design is known as a circular economy. It substitutes the idea of end-of-life with restoration, moves toward the utilization of renewable energy, and forgoes the use of harmful chemicals that impede reuse and biosphere re-inhabitation. Through the improved design of the materials, products, systems, and business models, it seeks to eliminate waste.

The circular economy is based on the four principles which are-

- **Waste=food**, meaning there is nothing like the concept of waste in the circular economy. What is considered waste for one is considered as the food for the other organism.
- **Build Resillience Through Diversity,** meaning being able to change while continuing to develop. Greater biodiversity contributes to the general health of the system.
- **Energy From Renewable Sources**, meaning the focus should be on the usage of the renewable sources of energy.
- **Think in System,** meaning numerous actors working together to creative and effective flows of material and consumption.

It establishes a clear distinction between a product's consumable and durable parts. The majority of the consumable in the circular economy are made of biological components that really are non-toxic and perhaps even beneficial. They may be safely recycled into new products or used repeatedly before being returned to the biosphere. Contrarily, durables like computers and motors are built of technical materials like metals and the majority of plastics that are not suited for the biosphere. Both of these go to further reduce resource dependence and boost system resilience, the energy needed to power this cycle ought to be renewable by nature.

The idea of a consumer is replaced with that of a user, necessitating the formation of a new contract amongst companies and their clients based on the performance of their products. Wherever possible, the durable goods are leased, rented, or shared. If they are purchased, there are agreements or incentives in place to guarantee the product's return and subsequent reuse. The circular economy does have the ability to boost output, generate employment, lower carbon emissions, and protect priceless raw materials. It offers a means of producing value. Building knowledge and capability in the circular economy is the challenge, prone to rapid technological advancement are created with the goal of being upgraded.

Benefits of circular economy for economy, environment and employment.

Economy- Despite the emphasis on technical solutions, academic research, grey literature, and pertinent reports indicate that CE approaches may result in significant cost reductions and employment creation. Creation, innovation, productivity, and resource efficiency are increasing in both wealthy and developing nations (Yuan et al. 2006; Friends of Europe 2014; Ellen MacArthur Foundation 2015; Gower and Schroeder 2016). The estimated benefits are of a large order. By 2030, according to the Ellen MacArthur Foundation, a CE may result in a €600 billion yearly reduction in net hard - earned cash in the European Union (EU), a 3% annual increase in resource productivity, and a €1.8 trillion annual net benefit. Despite these encouraging financial advantages, just 6% of the materials processed by the world economy are recycled so far and help close the loop. Although the EU economy's level of circularity—roughly 13% of processed materials—is half as high as that of the global average, it is still low.

Environment- By structuring manufacturing in accordance with CE principles, reducing waste, and increasing material reuse and recycling, Sweden may become approximately 25% more energy efficient and enhance overall material efficiency by 25%. As per Ecofys and Circle Economy (2016), global CO2 emissions could be reduced by up to 7.5 billion tonnes through the use of CE practises like chemical leasing, nutrient recovery in agriculture, material substitution in the construction industry, and joint ownership models in transportation systems. This would close half of the current emissions gap, allowing to adhere to the Paris Agreement's 1.5°C objective.

Employment- Regarding employment, the CE in France is equivalent to about 800,000 full-time positions, or 3% of the overall labour force. According to Morgan and Mitchell (2015), the UK could create 517,000 new skilled employment by 2030 under a "Transformation" scenario with substantial growth in reprocessing (up to 85%) and remanufacturing (up to 50%), as opposed to just 31,000 low-skilled jobs under a "No new initiatives" scenario. By 2025, the European Environment Bureau predicts employment opportunities in the European CE sector ranging from 634,769 (in a modest scenario) to 747,829 (in an ambitious scenario). At the same time, it was determined that the lack of CE programmes at all educational levels and the skills deficit in the workforce were the two main obstacles to converting the linear to a CE

Literature review-

1- Ana Birliga Sutherland(2019); Circle Economy

The article demonstrates how the circular economy can assist governments in achieving the Sustainable Development Goals, which serve as a critical road map for sustainable development, and advance efforts toward a safe, just, and peaceful world for all. Reducing resource extraction and keeping warming to 1.5 degrees has been proposed as a way to alleviate ecological disintegration. Circularity, a paradigm shift, refers to a system where waste is eliminated, material value is kept to the maximum extent possible, and nature is renewed. Practitioners are now critically investigating how a CE with social and ethical issues at its core could open the door to a brighter and more inclusive future for everyone. If properly managed, the CE approach has the ability to produce new, well-paying jobs, enable more equitable resource management, prevent societal crises, and promote resilient local economies.

2-Jindal public Business school(2016)- The proposed Digital Circular Economy for Sustainable Development Goals Center (DCE-SDG) is shown in the report (focussing on Business, Society and Nature). This proposed development project is based on a basic understanding of the center's mission, vision, and objectives, taking into account the five major pillars (P1-P5).

3-Juan manuel (2019);Circular Economy as a Catalyst for Progress towards the Sustainable Development Goals: A Positive Relationship between Two Self-Sufficient Variables– the proposed study focuses on how both the concepts of

circular economy and sustainable development are inter related and what are its scope if both the concepts are taken care by the share holders.

Objectives-

1. To study the concept of Circular economy.
2. To study the importance of CE.
3. To study how Sustainable development goals are related to CE.

Research Methodology-

This study is very useful to know about the Circular economy as by 2050, India's adoption of a circular economy will generate $624 billion in benefits annually and cut greenhouse gas emissions by 44%. Therefore, the circular economy is essential for maintaining the environment's quality and developing a system of incentives for recycling electronic devices. This study also focuses on how the circular economy is related to sustainable development goals and how it can be helpful to achieve the same.

Methodology-

A method based on heuristics created by Polya was chosen since there isn't just one scientific approach; rather, there are numerous scientific ways to comprehend reality. In this qualitative methodology, the study question: Is there a beneficial relationship between the adoption of a CE and the Sustainable Development Goals is addressed through an analysis of the information gathered.

These steps are included in the study in order to adhere to this methodology:

- The goal of the study is to establish the link between CE and advancement toward the SDGs.
- The connection between CE and the SDGs.
- The results will be discussed to determine the concept's future.

In order to understand how the two concepts are interconnected and how it would shape the future of business, it is important to understand the relationship between the circular economy and sustainable development goals. The concept can provide prospects for the industry if it is fully understood.

Link between CE and SDGs-

A sizable number of SDG targets can be achieved by using CE practises as a "toolbox," or set of techniques.

1- SDGs directly benefitting from CE practices-

The study found that putting CE practises into practise can directly help achieve 21 SDG targets The following have the greatest influence CE linkages and synergies:

- SDG 6 - Clean Water and Sanitation: Environmentally friendly practises (ECE) like small-scale water treatment, sustainable sanitization, wastewater treatment, water reuse and recycling nutrient recovery, biogas systems, etc. can greatly boost access to clean drinking water and equitable sanitation, lower pollution, and improve water quality.

- Affordable and clean energy is one of the Sustainable Development Goals (SDG) 7, and it is supported by renewable energy systems, including small-scale biomass technologies and second-generation biofuels, energy (heat) recovery, and improved industrial system utilisation (such as industrial symbiosis).

- New circular business models are a potentially significant source of increased resource efficiency and effectiveness waste valorisation, and green jobs, which is a component of SDG 8 – Decent Work and Economic Growth. According to numerous additional estimates, the global possibility for CE implementation is in the multi-trillion Euro range, with a net benefit of EUR 1.8 trillion per year.

- SDG 15 - Life on Land: The goal of restoring natural capital lies at the heart of CE activities. This entails implementing sustainable and regenerative farming and agroforestry methods, which are essential for recovering terrestrial ecosystems. These practises embrace and safeguard biodiversity and return biological material to soils as nutrients.

2- SDGs indirectly benefitting from CE-

- SDG 1: "No Poverty": The creation of jobs through the adoption of CE practises like repair, remanufacturing, and recycling can help to indirectly reduce poverty. Resilience is also increased through CE practises, such as those pertaining to agriculture and water management. Strong connections exist between SDGs 8 and 9.

- Implementing CE concepts in local agriculture, such as composting and diverse integrated farming practises, improves soil, which raises agricultural

productivity and system resilience, in line with SDG 2: Zero Hunger. Farmland can be made available for human consumption when coupled with circular food chain initiatives that address these issues and/or cascade food waste into animal feed.

• Sustainable Cities and Communities SDG 11: A shift to a circular economy is essential to lowering cities' resource and ecological consequences because it is predicted that three-quarters of the world's population would live in cities by 2050. Additionally, CE principles like modular, adaptable, and adaptable building design can aid in facilitating low-income populations' housing access.

• SDG 14 - Life below Water: By using CE practises, land-based activities can be prevented from generating pollution and leaking waste into the oceans. Prior to entering the oceans, this also includes the recovery of minerals from waste water streams. The contribution of CE to combating climate change will also indirectly lessen ocean acidification.

3- SDGs facilitating the uptake of CE practices-

• SDG 4 - Quality Education: Enabling circular practises requires efforts toward a number of the targets related to, for example, equal opportunities for technical, vocational, and tertiary education - especially when combined with a concentrate on CE, systems thinking, layout for circular logic, entrepreneurship, and innovation.

• SDG 9 - Industry, Innovation, and Infrastructure: Achieving targets under this goal is crucial for establishing a CE, even though CE practises will directly contribute to upgrading industries to make them better resilient and sustainable. Reverse logistics, new infrastructure for renewable power, circular waste and water management, support for research and innovation, and ensuring access to proper funding are all included in this.

• SDG 10: Lessening Inequalities Promoting safe working conditions has strong synergies with social and economic inclusion; this is crucial, especially for those employed in the unregulated trash sector in developing nations. This objective also pertains to ensuring that poor nations are fairly represented in international cooperation, that they have equal access to scientific assistance and funding for CEs, and that trade agreements enable equal system rather than working against it.

• SDG 13 - Climate Action: CE practises help to mitigate climate change and boost resilience both directly and indirectly. According to the 2019 Circular Gap Report, in addition to currently available low-carbon technology, applying CE practises may reduce greenhouse gas emissions by more than one third by 2100. Additionally, accomplishing national, regional, or local climate policy goals, providing incentives and financing options, and raising public knowledge of climate change are likely to encourage the adoption of CE practises.

• Peace, Justice, and Strong Institutions (SDG 16): With the aid of CE practises, better and much more equitable access to basic supplies as well as higher natural system resilience contribute to environmental justice and can obviate social problems that are indirectly brought on by the environment.

• Partnership for the Goals, SDG 17: According to the report, achieving goals linked to debt restructuring for developing nations, more equitable free trade systems and agreements, improved macroeconomic stability, improved global sustainability policy, and developing nations' access to technical support can all help CE practises.

4- SDGs with no link with CE practices-

• Good Health and Well-Being: SDG 3 Although not clearly supported in the recognised literature, the analysis acknowledges a potential indirect benefit of CE to health, well-being, and lower child mortality through, for example, reduced pollution and improved water treatment. In contrast hand, there could be a cost associated with CE procedures like recycling human waste. A weak or non-existent direct correlation was found for the majority of SDG 3 targets.

• SDG 5 - Gender Equality: Weak or no connections were found between the goals of eradicating violence, discrimination, and harmful behaviours against women and girls, as well as the goals of enhancing their empowerment. Nevertheless, accomplishing goals regarding equal rights for women to possess and influence over land and other natural resources as well as involvement in leadership roles has the potential to encourage CE practises and related entrepreneurship.

• SDG10 - Despite the influence of "reducing inequality" on enabling CE, as previously indicated, there is a lesser link with other aims, such as those

involving eliminating discrimination and guaranteeing equality in policies and laws supervision of financial markets.

• Sustainable Cities and Communities SDG 11: As already mentioned, there is a direct connection between CE and several of the goals listed under this one. The study discovered a decreased correlation between CE and factors like enabling access to green spaces and public areas, as well as lowering disaster-related deaths and damages.

• Peace, Justice, and Strong Institutions (SDG 16): Finding a weak link between CE. practises and achieving goals on, for example, people smuggling, equitable access to justice, illicit trafficking, and organised crime, as well as providing legal identification for everyone and strengthening national organisations that address these issues, may not come as a surprise.

5-SDG cooperation promoting CE practices-

Nearly all of the SDGs feature targets that can support collaborations and cooperation that could support the promotion of CE practises, especially SDG 17 - Partnerships for the Goals.

Conclusion-

The research presented in this paper suggests that CE practises can assist in achieving a number of SDG targets. They help to achieve 21 of the aims directly and help to achieve another 28 targets indirectly. The aims of SDGs 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 15 have the strongest relationships with CE practises (Life on Land). Additionally, CE practises have the potential to foster synergies across various SDGs, such as SDGs 1 and 2 (which aim to end hunger and promote sustainable food production), 8 (which promotes economic growth and jobs), and 14 (which aims to safeguard biodiversity on land and in the oceans) (SDG 15). The SDGs can aid in both the development of CE practises as well as the achievement of various SDG targets. The adoption of CE practises will benefit from progress on many of the key SDGs goals, even those that are not specifically linked to CE. SDG 16 (Peace, Justice, and Strong Institutions), SDG 4 (Quality Education), which represents the "software" components of democratic accountability and skills, and SDG 9 (Industry, Innovation, and Infrastructure), which represents the "hardware" components of infrastructure and facilities for a circular economic system, are of particular importance.

Limitations of the study-

Given the limits of this analysis, the conclusion is drawn and additional in-depth research to produce more empirical proof of the relationship amongst CE and the Goals, to expand and strengthen this exploratory evaluation is recommended.

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Exploring the Critical Role of Circular Economy in Green Energy Transition in India

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ABSTRACT

Abstract- In line with the national commitments of reduction in carbon emissions India is undergoing a radical transition to green energy. The revised targets declared at Glasgow are ambitious and far reaching. But this transition is based on use of many precious elements used in batteries and solar panels as well as many potentially hazardous components. The transition, therefore, needs to be sustainable and should not be the cause of any environmental degradation. The implementation of circular economy with the integrated principles of reuse and recycle is imperative to achieve this objective.

Keywords: Green Energy, Sustainable Development, SDGs, Climate Change, Global Warming

Introduction

Given that India is the most populous developing country, its response to the climate crisis will determine if the mission for sustainable development and climate preservation is successful. India has taken the lead in the effort to protect the environment. The Indian case study on current trends is a story of outstanding achievement in this regard. Even though India has historically only supplied 5% of global emissions. The swift adoption of solar and wind energy sources as well as conservation initiatives have produced excellent results. Particularly in the use of renewable energy, the country has gradually set the bar higher. In addition to the 175 GW by 2022 pledge made in Paris, 450 GW by 2030 pledge made at the UN Climate Summit, and now 500 GW by 2030 pledge made by the CoP-26. By itself, the perform, accomplish, and trade initiative reduced conservation-related CO2 equivalent emissions by almost 92 million tonnes. Through the LED bulb programme, annual CO2 emissions were reduced by almost 39 million tonnes.

These actions led to a 21% decrease in the nation's emission intensity between 2005 and 2014. India is apparently the only G-20 nation to have accomplished its promised goals for lowering emissions in accordance with the Paris Agreement. The National Solar Mission, LiFE project, National Hydrogen Mission, and the Faster Adoption of Manufacturing of Electric Vehicles (FAME) programme are a few examples of the country's cutting-edge strategy for assisting the switch to renewable energy.

Glasgow served as the site of the 26th Conference of Parties (CoP26) to the United Nations Framework Convention on Climate Change. In order to help the world move closer to the goal of limiting global warming to 1.5 degrees Celsius, Indian Prime Minister Shri Narendra Modi submitted a five-point plan for India on November 1, 2021, the first day of the international climate summit.

The prime minister referred to his plan as "Panchamrita," which is Sanskrit for "the five ambrosia." A traditional way of combining five natural foods; milk, ghee, curd, honey, and jaggery.

The five components of the 'Panchamrita' promises are:

1) India will enhance its renewable and green energy capacity to 500 GW by 2030
2) By 2030 India will meet at least half of its energy requirements by green and renewable energy
3) The projected carbon emissions in the country will be reduced by one billion tonnes by 2030
4) The country will achieve a reduction of 45 per cent in the carbon emissions of its economy by 2030 as compared to the 2005 levels
5) India will achieve net zero by 2070

II. Greening of Indian Power Sector

India's climate and geographical diversity present numerous prospects for successfully executing the switch to green energy. India has a solar energy potential of over 750 GW. On the other hand, the potential for small hydropower is 211 GW, and the total potential for wind power is close to 690 GW. India's utilisation of renewable energy sources has increased significantly over the last ten years. These sources made up about 10% of the total grid capacity in 2010. In 2022, this percentage rose to above 28%. In fact, for the first time in 2018, the overall annual addition of RE sources exceeded the total annual addition of coal. In 2015, the Indian government set the target of 175 GW of RE capacity by 2022. As of June 30, 2022, the installed RE capacity on the Indian grid had reached 114 GW. About 161 GW of total capacity is based on non-fossil fuels.

The growth of solar energy in the Indian power sector surged 5700 times between 2010 and 2022, according to an analysis of the data. The total amount of solar capacity built in India increased from 10 MW in 2010 to 57.7 GW in June 2022. Currently, solar accounts for 51% of all RE sources. The majority of this growth occurred in the last seven years. Over the past eight years, solar capacity has expanded from about 2.6 GW to more than 57 GW. One of the key factors influencing the rise of solar energy is the sharp decline in the cost of solar panels. Additionally, the economics of scale and vigorous government promotion have contributed to this enormous rise. In terms of total installed renewable energy capacity, India is now ranked fourth worldwide.

Through various initiatives and policies of the federal government, many states in the nation have adopted solar energy. Table 1 lists the top five states in the nation for renewable energy as of May 2022. Important state-level measures to increase the RE capacity further are also addressed.

Table 1: The top 5 states in terms of Renewable Tenergy as on May 2022

State Rank	State	Renewable Capacity	Remarks
1	Rajasthan	18707 MW	In just about 6 months moved from 4th to 1st rank. The concerns related to transmission infrastructure and distribution companies financial needs to be addressed.
2	Gujrat	17330 MW	State is doing well on solar but also planning to expand wind power capacity. A 30 GW renewable energy park is to be established.
3	Tamil Nadu	16604 MW	The state has been leading in terms of wind power capacity. An important development is the renewable power capacity of 20 GW with battery storage
4	Karnataka	15952 MW	Recently approved Renewable Energy policy for next 5 years. 10 GW capacity of Renewable Energy is to be added in next 5 years
5	Maharashtra	10695 MW	6.5 GW of Renewable Energy projects to be added in northern and western regions of the state

Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyaan (PM KUSUM)

A significant portion of the Indian electricity load comes from agriculture. Therefore, if agriculture is not considered, the goal of decarbonizing the national electricity system cannot be achieved. Keeping this in mind the PM KUSUM scheme has been launched. By 2022, 25,750 MW of installed capacity will have been completed under this plan. The PM KUSUM system consists of three parts:

1. Ground Mounted Grid Connected Renewable Power Plants

Component A of the scheme is the installation of distributed ground-based, grid-connected renewable power plants. This program's goal is to encourage the building of renewable energy facilities with capacities ranging from 500 kW to 2 MW on underproductive agricultural land. The overall installed target capacity is 10 GW. The distribution

companies will purchase the electricity generated by the power plant developer.

The power regulatory body of the state where the project is installed will decide on the Feed in Tariff. A single farmer or a group of farmers can install the plant. The project may potentially be developed by larger panchayats or cooperative groupings.

2. Installation of 17.50 lakh standalone Solar Powered Agriculture Pumps

Installation of 17.50 lakh independent Solar Powered Agriculture Pumps is part of the PM KUSUM scheme's component B. A pump can have a maximum horsepower rating of 7.5 HP. In the 30-30-40 programme, the farmer will receive financial assistance for the pump installation. 30 percent of the benchmark cost or tender cost of the pump will be supported by the central government. The state government will contribute 30% toward the cost as a subsidy, leaving the farmer responsible for the remaining 40%. Only in the North Eastern States, Sikkim, Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Lakshadweep, and the Andaman & Nicobar Islands would the farmer be responsible for paying 20% of the total. The central support will rise to 50% for these states.

3. Solarisation of 10 Lakh Grid-connected Agriculture Pumps

The goal of the scheme's C component is to solarize 10 lakh grid-connected agricultural pumps. The maximum pump power in this component is similarly 7.5 HP. The pump will be powered by the electricity produced by the solar PV panels. However, the farmer will also have the advantage of sending the extra production to the grid.

This scheme's financial support follows the same 30-30-40 paradigm as it does for component B. The financial support model for the states in the special category, as indicated in component B, shall be 50-30-20.

Residential Rooftop Solar PV

More than 20% of India's total electricity demand, according to estimates, comes from the residential sector. The market for residential rooftop solar PV has lagged behind large ground-mounted solar farms while having tremendous potential. This is also supported by the data. As of February 2022, just about 6 GW of the nation's approximately 50 GW of solar PV installations were placed on residential rooftops. Despite this, the residential sector has a significant amount of untapped energy and might use more than the 1.3 PWh of electricity it currently consumes annually.

To further promote the adoption of residential rooftop solar PV, the government has started phase II of its Grid Connected Solar Rooftop Program. As part of this scheme, rooftop solar arrays with a 40 GW capacity are to be erected by 2022. In accordance with this programme, central financial assistance is also provided, but only if the project makes use of domestically produced solar modules and cells. For the initial 4 GW capacity, residential users are also given some financial assistance.

Battery Storage

Major green energy sources such as solar and wind are erratic in nature because the sun doesn't always shine and the wind doesn't constantly blow. There are worries due to this changeable nature as the installation of these plants integrated with the grid is rising dramatically. For instance, there will be a dramatic load ramp in the evening when the grid is feeding a lot of load during the day. Additionally, there is a significant fluctuation in temperature across the majority of a country like India. The load exhibits significant seasonal change as a result. The variability with these variable sources affects both the source and the load. Bulk storage is going to be quite significant in this situation. Bulk storage at the grid level allows for the storage of extra electricity for usage during periods of low generation.

The grid operators face a significant task when it comes to reducing renewable energy. The electricity generated from these sustainable sources should be the network's first priority supply due to its lower cost. The operators are frequently compelled to reduce the output of these renewable energy facilities due to the limited flexibility of traditional generation systems. Battery storage systems at the grid level can solve this issue. The surplus energy could be kept in the batteries as opposed to being reduced from low cost and green electricity.

The type of storage that the future grid will need can only be provided by battery-based systems. The greatest alternative for this has come to be Lithium-Ion. In actuality, lithium-ion batteries account for more than 90% of all installed big storage. Over the past ten years, the cost of these batteries has decreased by more than 80%. This is anticipated to be the new

power grid's next major development. The installed capacity of bulk storage batteries has significantly increased as a result. The total installed capacity of these batteries was 10 GWh as of the end of 2017.

By 2030, India will have 27GW/108 GWh (four-hour storage of grid level BESS) installed capacity. In this direction, the first pilot project for the installation of 1000 MWh of battery storage has already been put out to bid.

Small scale batteries put at the customer premises are as as significant as grid-level storage. As was already indicated, these batteries allow for the efficient exploitation of tiny rooftop solar plants and provide consumer independence. These batteries are crucial for the utility as well because they help with demand response programmes and tend to lower peak demand. In Germany, batteries are fitted with new rooftop systems in more than 60% of cases.

Battery Swapping Policy for Electric Vehicle

Electric car adoption is crucial to achieving the nation's aim of a green energy transition. However, there are significant obstacles in this sector, such as a lack of infrastructure for charging, expensive expenses, and lengthy refilling times. The battery switching system may be one answer to several of these problems. The administration stated its intentions to implement such a programme in the nation in the budget for 2022–2023 Based on this, the NITI Ayog published a draught battery switching policy. The fundamental goal of the proposed policy is to reduce EV idle time caused by low battery charge while using the least amount of money and space possible. With this new system, EV owners will be able to swap out their drained battery with a charged one at approved stations rather than having to wait for the vehicle to be charged at a charging station. In the initial phase, the policy must be put into effect in all major cities with a population of more than 4 million. The second phase of the programme is expected to reach all major cities with a population of more than 0.5 million.

Circular Economy for Green Energy Transition

The basic idea behind implementing a circular economy is to reduce waste by making the most of resources, making goods durable, and effective implementation of their recycling. The transition to green energy in India depends on utilization of solar panels and batteries which are mafde of precious as well as potentially harmful elements for the environment. The implementation of circular economy, therefore, is the need of hour. The basic elements of circular economy and how the same can be implemented in green energy transition are discussed in the following sections.

Recycling

The fundamental concept for effective transition to green energy with circular economy is recycling and reusing. Recycling helps in eliminating waste and ensures continual use of resources. India at present don't have a policy on management of PV waste and recycling at the end of life. However, the successful experience of Europe with Extended Producer Responsibility (EPR) framework can serve as an effective guideline. Extended Producer Responsibility (EPR) pushes the manufacturers to factor in environmental costs as part of their project planning – both technical and financial.

The exponential rise of solar PV plants as a green source of electricity is a major boost to the decarbonisation of the electric energy system. But one important concern, particularly from the point of view of climate, is the imminent challenge of disposal of solar PV panels once they complete their life. Although the installation of the solar PV plants on a large scale is a recent development and the useful life of these panels is high, this problem will come up in a big way only after 15-20 years. But still considering the level of challenge, it needs to be planned and implemented at the earliest. According to the International Renewable Energy Agency, India alone is expected to generate about 0.5 million metric tonnes (mmt) of solar PV waste by 2030. Considering the revised ambitious new target of 500GW by 2030, the amount of solar waste generated can be 4.5 to 7.5 million tonnes by 2050.

The solar panel is an essential source for, in the spirit of sustainable development, reuse and recycle of the material involved. The bulk of solar PV modules used are of crystalline silicon type. These modules are made of glass and aluminium. Silicon metal solar cells, copper connectors, silver and other metals like tin and lead are also part of the module.

From 1 MWp of solar plant we can recover approximately 70 tonnes of glass, 56 tonnes of steel, 47 tonnes of concrete, 19 tonnes of aluminium, 7 tonnes of silicon and copper, and 6 tonnes of plastic. A sustainable approach is when about 50-70% of the recycled material is reused.

In India also, in view of the exponential growth of solar PV installations, handling of PV waste is an important concern. Solar Waste Action Plan (SWAP), in this regard, is an important initiative in the country. A pilot project, under SWAP initiative has already been completed.

Under this project a capacity of processing 2.5 tonnes of solar PV waste per day was started at Gummudipoondi, Tamil Nadu in September 2020. The plant uses the mechanical crushing method for disposal. It is planned to increase the capacity to over 200 tonnes of waste per day. The total recovery is also planned to be increased from the present 60-80 percent to 95%.

Based on the experience of this project, one of the major challenges identified is bringing the panel to the waste disposal site. This responsibility may be fixed on the developer. But considering the long life of the panel, its implementation will be a challenge. The developer, moreover, can include the cost in the price of the panel itself which will discourage the consumers. In view of these challenges the use of mobile processors of PV waste is also being discussed and explored.

The transition to green energy is leading to exponential demand for vital minerals like lithium, cobalt, and rare earths. Some critical metals, like lithium, might have growth rates of over 40 times, and nickel and cobalt demand could increase by more than 20 times. If implemented successfully the circular economy can reduce reliance on mining and secure longer-term usage of these material.

Utilising circular, low-carbon materials

An important aspect of decarbonisation is the technology/material used should not only be carbon emission free but the emissions involved in its manufacturing should also be minimum. Accordingto a World Economic Forum report, the materials needed to make automobiles might account for 60% of all lifetime emissions by 2040, compared to 18% in 2020, when most cars are expected to be electric.

The emissions produced by the global production of all materials have been on a rapidly rising trend. According to a recent UNEP analysis, the emissions involved have increased from 5 billion tonnes of carbon dioxide equivalent in 1995 to over 11 billion tonnes in 2015, or about a fifth of all emissions of greenhouse gases. Circular economy shall be helpful in reducing these emissions also. For example, the emissions generated when producing aluminium using recycle is about 95 % less than the emissions produced when getting it from original sources.

Integrating Circularity in the System

The implementation of circular economy should be an integral part of the system and it must be taken into account during the planning phase of an energy transition to be truly sustainable. It is important to consider how the solar PV panels and batteries being installed on a huge scale can be made to last longer, disassemble easily, and be recycled. If the panels which shall be removed after 25 years of service can be deployed again with some refurbishments, it'll be a great boost to the sustainability efforts. Life extension is a crucial aspect of circular design. We ought to create enduring goods that can be utilised for different purposes. Utilized automobile batteries still have between 60 and 80 percent of their original capacity, which means they can be used successfully in other applications that call for less performance, including stationary energy storage to support the grid.

II. Conclusion

The transition to green energy in India is a massive development. The target declared at CO-26 of installation of 500GW renewable energy plants by 2030 combined with large scale implementation of electric mobility means exponential increase in the use of precious elements and material potentially harmful for the environment. The implementation of circular economy in this scenario is a primary requirement for making this transition green as well as sustainable. This paper examined these aspects and presented that the three-pronged approach of recycle, reuse and integration of aspects of circular economy in the design phase has to be pursued to achieve this sustainable transition.

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Green Marketing:- A Step Towards Sustainability

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ABSTRACT

With the ecological issues getting worse day by day and sustainability becoming major concern, the time has come when we need to focus our thoughts and action son reviving our resources and utilizing the existing ones in a much more sensible manner.It is a need of an hour to work towards sustainability and safeguard our MOTHEREARTH. Environmentalists, business units, corporates, and people all need to work toward the cause. In this, a shift to GREEN MARKETING is a holistic approach. Marketers and consumers today are well aware of the importance of the GO-GREEN concept. Green marketing and green product development can be recognized as a paradigm in such a situation. This paper addresses the importance in such a scenario. Although the concept is still in its infancy stage, but the start toward a better and sustainable move is there. This paper is an attempt in identifying the concerns about selling and buying green products, consumers changing attitudes, and the promising benefits.

Keywords: Sustainability, Ecological, Green Marketing, Customers, Holistic, Paradigm

Introduction

Green marketing is a fairly new concept in India but it is promising and still developing. Green symbolizes nature and mother earth. But with emerging times and the constantly developing world, we are destroying the very thing that gives us life. In the process of making India a developed nation, we are focusing on economic development rather than sustainable development. Global warming, depletion of resources, decreased overall health quality of humans and many more reasons gave rise to green marketing.

Green marketing means all the activities from producing to selling a product are done with considering the eco-system. It is about forming plans and strategies that not only market the product but give back to the environment as well.

All parts of society are responsible for the depletion of our ecosystem in some or the other way and hence the need for green marketing for sustainability is slowly and steadily understood by governments, firms, and general customers, and is taking respective steps for the needful. Contribution to green marketing is not solely dependent on government or non-government organizations but on society as a whole.

The use of renewable resources, recycling, sustainable packaging, and communication channels are some methods being adopted in support of green marketing.

Objectives:

1. To understand/ study the current scenario of green marketing and how different stakeholders are adapting.
2. Possible future advancement in the field – employment, 1 charger, mobile appliances.
3. A study of sustainable development through green marketing in the country.

Research Methodology:

The study is based on the observation and experience of the researcher and through literature.

Limitations:

The study is based on the observation and experience of the researcher and through literature. It is still a relatively new concept.

Statistical Review:

Literature Review:

1. Arjun Gupta, Rohit Bansal, and Dr. Ashutosh Nigam (2013) in their study have emphasized the need for the protection of the environment which is more now compared to those days when people and firms just destroyed natural resources and the environment and also discussed the future of green marketing for sustainable development. In today's world, several companies like IndusInd bank, Kansai Nerolac, SBI, etc. are taking an initiative for ecological development. There are challenges such as marketing myopia and standardization but with proper consumer awareness and the production of goods that serve at the same level as the alternatives, these challenges can be overcome. Selecting the right target audience and considering of right price is important.

2. Shrikanth and Raju (2012) have discussed in their paper how all the stakeholders need to be aware of the importance and need for green and environmentally friendly products. Firms are understanding the importance of corporate social responsibility and adopting green marketing in their strategy for survival.

3. Mary Wanjiru Kinoti (2011) has written about the connection between green marketing and sustainable development. Some people still have the notion that green marketing means the advertisement or promotion of ecological products. Whereas, green marketing means undertaking all marketing activities with consideration for the environment. Sustainable development talks about a better environmental future for the next generation, and hence sustainable development is a dependent variable for green marketing.

4. Sanjay Jain & Gurmeet Kaur (2004) in their study have discussed the rise of the practice of green marketing strategies by several business firms. This rise is caused due to green consumerism. Consumer environmental awareness is also assessed in this paper through the survey.

5. Dr. Vandana Pandey (2016) in her paper has presented the challenges and opportunities of green marketing and also its relation to sustainable development. Sustainable development is the means of achieving product satisfaction for our needs without compromising the needs of future generations. Green marketing in India is still facing issues as it is a new concept still in its infancy phase. Although, there are opportunities for business firms to give them a competitive advantage.

6. Jacquelyn Ottman, (1998) suggests that not just the consumer or an organization is responsible for contributing to ecological marketing but society at large. Not just suppliers and retailers but also educators, government, NGOs, etc. Our needs should not be at the cost of our environment. Sustainable development is only possible if we opt for green products.

Green Marketing Mix:

Marketing – the mix is the base of any marketing strategy that needs to be considered even in green marketing. The 4Ps around which all-marketing strategies revolve are product, price, promotion, and packaging, these elements can play a major role in

having and guarding sustainability.

In Sustainability marketing, there is some sustainability principle that needs to be followed all along marketing mix, which helps in:

1) Strengthen of brand identity;

2) Providing credibility;

3) Ensuring honest, reliable communications and required transparency.

Source:

https://saylordotorg.github.io/text_the-sustainable-business-case book/section_10/0f57d746a8154fb0332ec970ea4df341.jpg

Product

The product should be designed according to the need of the consumers and customers who prefers to buy environmentally friendly products.

As an organization, if you are making a sustainable-marketed product, then you must consider where you are sourcing materials from, the ingredients used in making the product, and how you are manufacturing the product. Only natural and organic materials must be used and not only this but environmentally friendly materials should also be used. Adopting the technology which contributes minimum towards carbon footprint for manufacturing and distribution.

Mama Earth is an organic baby care brand that offers a gentle and eco-friendly product range. The brand's baby essentials kit is a best-seller that consists of gentle baby shampoo, a moisturizing body wash, an organic body lotion, and a soothing massage oil that boasts a subtle and calming scent. Each product is 100% chemical-free and is enriched with nourishing ingredients like cocoa and Shea butter, coconut, and jojoba oil.

Price

The pricing factor focuses on the how factor which means how much the customers are willing to pay for the product. So, to decide on price the aim will not only be to earn profit but also look at optimum level of productivity. In regards to sustainable products pricing is an issue which leads to limiting mass acceptance and market growth of product or services. These products are more costly because the material which is used in the product is costlier than their conventional counterparts.

Packaging

Making an environmentally friendly product is not the only thing required to serve your target audience but environment-friendly packaging is also important.

Packaging plays an important role in the consumer buying decision because they may choose not to buy your product if you are not using environmentally friendly material for packaging even though your core product is ready to satisfy the needs of consumers. The consumers have been constantly made aware of the relevance and importance of environmental packaging and its impact so as a result buying decisions according to the packaging are also changing. The best example could be water bottles. It is seen that many consumers switched from purchasing plastic water bottles to using refillable water containers.

Promotion

When we see strong sustainable product brands one recognizes that brands should have more brand awareness of the product or service as it leads to positive impact on people and the environment. St

Place

Place is said to be any online or offline platform where the products are made available to the customers. Various E-retailers are now focusing on delivering of sustainable and organic products If managed properly with all the above strategies in place the concept of Green Marketing can easily be adapted making sustainability possible.

Benefits of green marketing to different market participants:

The increasing threat of Global Warming, thinning of the Ozone layer, etc. has worsened the situation

thereby giving a threat to sustainability and survival a challenge. In such a scenario Green Marketing concept would be life-saving. The following benefits can easily be traced:

1. You can promote for the better to customer
As a marketer, the focus should be on providing best to the stakeholders, by making a green marketing strategy you can do it. For the betterment of consumers, which means to provide packaging that can support in contributing in making the environment better. One can have a food product which can focus on consumer's health and its impacts. Along with it more attention can be put on giving something better than other products and it can make the product and out in the eyes of the customer.

2. More green attractive products.
Practicing green marketing makes you stand different and unique in the eyes of customers and other stakeholders hence it will create more interest among people for your product. It is without fail a reality that implementation of green marketing is certainly not an easy task, and fort hat, one must know the steps to arrive at green marketing.

3. To create awareness among consumer
Not every part of the country is aware of the benefits of protecting the environment (Ruralareas),so running a green marketing campaign can be beneficial for educating consumers to protect the environment.

4. Your employee will feel
Proud and responsible Green marketing is a manifestation of a brand that cares about the good of the natural surroundings, not just pursuing the benefits offered by a brand by making a green marketing campaign that creates a product that can be used to preserve the environment.

5. Open the opportunity for customers to participate
An initiative in the green marketing campaigns allows to invite consumers to also participate. But how is the bigger question that needs focused attention. Surely this is the first question that comes to one's mind, how to invite consumers to participate in the green campaign.

6. Create a new kind of infotainment
It is a known fact that each and every brand needs the presence of various IMC tools for the soul purpose of infotainment to make it known; by using a green marketing campaign can also accomplish it. Green marketing campaigns disruptive types of media and public visibility that can be a medium to communicate and motivate consumers to see.

GREEN INITIATIVES TAKEN BY INDIAN BRANDS:

1. Wipro: Wipro has launched a green range of desktops that are 100% renewable andtoxin-free. It uses sustainable products and solutions which help in better productivity of energy.

2. IndusInd Bank: One of the first bank that started using paper less receipt in ATMs, and adopted the practice of sending text messages, which was a great initiative towards saving paper and reducing deforestation. Its initiative 'Hum Aur Hariyali' had took plans such as solar-powered ATMs, thin computing, e-archiving, e-learning, e-waste management, paperless fax, energy conservation, CNG cars. It has also initiated finance programs with incentives to go green.

3. Oil and Natural Gas Company: ONGC, one of the largest oil producing company has come up with new concept of "Green Crematoriums" which is environmental friendly without harming the societal & cultural sentiments. This will replace the traditional funerals & crematorium procession that emits lot of smoke polluting the environment.

4. In India big chains of Hotels by Dr Kamat with brand names as Orchid, lotus suites, Rodas, Uppal's orchid, and rain tree and Tata Group of hotels have adopted the concept of 3R and are having ECOTEL certification – global certification for eco-friendly hotels. (36 overall).

5. Tata BP Solar, vajra, TATADEEP, and jugnu – sell renewable energy products like solar panels, domestic water heating systems and home lighting kits, etc.

6. Lead-free paints from Kansai Nerolac – Leading brand in paints like Nerolac also took a step forward by removing components that are harmful for human being. Metals like lead, mercury, chromium, arsenic, and antimony are removed from its paint. This will save future generations from many problems like respiratory tract infection

7. Best Green IT Project: State Bank of India – SBI bank has installed eco and power-friendly equipment in its 10,000 new ATMs which has helped to save power costs and earn carbon credits. SBI started promoting paperless banking. It has also shifted to wind energy, reducing emissions and carbon footprint.

8. IDEA Cellular: "USE Mobile, Save Paper" - IDEA Cellular launched a nationwide campaign of "Use mobile, Save Paper" to save trees and protect the environment. The mobile phone can be used as a newspaper, generate electronic bills, and make transactions.

9. Electric vehicles - TATA motors, Athers, Ola, Hero, Mahindra electric, Ashok Leyland, etc. are some companies that have launched electric vehicles in India.

10. VOLTAS - In 2007, they launched the green range of electronics such as air conditioners, which was made mandatory to have star ratings on home appliances, by the government.

GREEN INITIATIVES BY OTHER BRANDS:

1. IKEA - Ikea creates its products from wood that certifies its origin from natural intact resources. These products are recyclable, renewable, and reusable. They also used recycled bottles for kitchen fronts.

2. Starbucks - Its CSR activity of the shared planet initiative promotes environmental responsibility to its employees and customers whom they promise to buy products responsibly.

GREEN INITIATIVES TAKEN BY THE GOVERNMENT:

1. Eco-mark scheme: The government has come up with the Eco mark Scheme, an eco-labelingprogram that creates awareness for the consumer and encourages them to purchase environmentally-friendly products. It is a certification mark issued by the Bureau of Indian Standards (BIS) that adheres to the standard and promotes ecologically safe products.

2. Union Finance Minister of India Mrs. Nirmala Sitharaman issued Rs 3030 Crores for the ministry for the financial year 2022-23, from which Rs 460 Crores were assigned for controlling pollution in India, but the budget assigned this year was Rs 10 Crores less than last financial year i.e. FY 2021-2022.

3. In last year's Union Budget i.e. 2021-22, the coal was assigned Rs 19,246 crore ($2.5 billion) but the MNRE was allocated Rs 11,778 Crores($ 1.5Billion) which is an ongoing trend since the year 2009-10, this was reported in India Spend August 2019.The allotment of budget for the Climate Change Action Plan under MOEFCC was deducted from Rs 40 Crores in the year 2020-21 to Rs 30 Crores in 2021-22

4. One nation and one charger: The government of India is coming up with another policy called a one nation one charger which is a very good initiative to boil down electronic waste. It helps not only help in conserving resources but also eliminate e-waste and another impact of this will be seen in consumers' pockets. They need not buy chargers for every gadget they have.

National Incentives:

FAME, or Faster Adoption and Manufacturing of (Hybrid and) Electric vehicles, is currently India's flagship scheme for promoting electric mobility. Currently in its 2nd phase of implementation, FAME-II is being implemented for a period of 3 years, eff. 1st April 2019 with a budget allocation of 10,000 Cr. The incentives offered in the scheme are:

Total Approximate Incentives	Approximate Size of Battery
Two wheelers: Rs 15000/- per kWh upto 40% of the cost of Vehicles	**Two wheelers:**2 kWh
Three wheelers: Rs 10000/- per kWh	**Three wheelers:**5 kWh
Four wheelers: Rs 10000/- per kWh	**Four wheelers:**15 kWh
E Buses: Rs 20000/- per kWh	**E Buses:**250 kWh
E Trucks: Rs 20000/- per kWh	

Source: https://e-amrit.niti.gov.in/electric-vehicle-incentives

1. Uttar Pradesh government issued the draft of the Green Hydrogen Policy – 2022 and has opened itself to public comments and suggestions. This is a precursor to bringing out the final policy in 2035 that would make the state a 100% green hydrogen/ammonia-consuming state. Hyderabad wins the prestigious 'World Green Cities Award 2022'

2. Punjab had its first Green Summit this year where both public policymakers and industry leaders discussed and shared their ideas on innovation for a better tomorrow by ensuring clean air. The initiative was organized by APAC News Network. With its core belief in making a clean, green, and pollution-free environment for all, this initiative is supported by THINK Gas. Polythene-free Himachal: Himachal Government

3. E-waste management: central pollution board of India -

CHALLENGES

1. New concept: The concept & practice of green marketing is new and benefits were unknown to many and the rural population is still not aware of the concept and hence targeting the rural area is the biggest challenge as lots of effort will require to serve the rural area consumers.

2. Patience: Lots of patience will be required if you are selling green products or if you are investing in green products because it is new for people and expecting immediate results will not be the right thing. Investors and entrepreneurs must look at it as a longer-term investment.

3. Credibility: People who are ready to pay a premium price to buy green products are still hesitant about the authenticity of green products because of lack of credibility. Hence promoting and branding such products again will be a challenge, when it comes to convincing customers.

4. Green Myopia: Main aim of green marketing is to focus on providing customer benefits. The consumer will only buy if the product will satisfy the needs of the customers and not when the product is organic or greener in various aspects.

SUGGESTIONS:

1. Awareness: As youth is majorly on social media, social media can be used as a tool to promote green Marketing, and also various campaigns should be run to build customer trust.

2. Government intervention: Government should strictly check whether companies are following the policies and norms for making organic products or not. If not then strict action should be taken so that companies do not cheat customers in the name of Green or environment-friendlyproducts.

3. 3R: companies should use their packaging in such a manner that can be recycled and reused like bottles, paper bags, etc. they can also reduce their waste material to less harm the environment.

Conclusion:

Green marketing being in the infancy phase in India still is growing at a linear pace. The firms are coming up with new, innovative ideas for their product or marketing strategies and are trying to incorporate ecologically sustainable procedures. Customers are becoming more and more aware of this new concept but there are still challenges to spreading awareness nationwide. India is coming up with standardizations to overcome greenwashing. There's a certain segment of customers who are ready to pay the extra bucks for environmentally friendly products. The government is also coming up with some schemes and plans to promote green marketing and save the environment. Green marketing and sustainability go hand in hand. Where green marketing talks about an elaborate process from manufacturing to the selling of products with keeping our environment in consideration, sustainability talks about conserving and properly utilizing resources that can be passed on to the future generation. Green marketing is a roadmap to achieving sustainability

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Challenges for The Circular Economy in Manufacturing

Rashmi Ranjan Mohapatra - Hindalco Industries Limited

ABSTRACT

The introduction of the circular economy (CE) in production, minimizing waste, maximizing resource use, reducing environmental impact, conservation, and safety for society. The main objective is to choose appropriate methods that influence product design, process design, service design, and production design. 1.5 °C Supply chain leaders have taken the initiative to reduce greenhouse gas emissions throughout the value chain, halving them by 2030 and reducing emissions to zero by 2050. Achieving a circular economy requires the integration of the three critical elements of products, processes, and systems across the three dimensions of environment, economy and social. CE has become a major paradigm shift in the way companies interact with society and the environment. The implementation of CE initiatives aims to conserve scarce resources, close energy, and material loops, and enable sustainable development at various levels of business processes. The United Nations Sustainable Development Goals (SDG) target 12.5 aims to significantly reduce waste generation through prevention, reduction, recycling, and reuse by 2030, which will require actions and strategies from various stakeholders to achieve the goals. It may take time to see the impact on the organization and society, but the timeline has already begun.

Keywords: Circular Economy, Environmental, Economic, and Social

Overview: The circular economy (CE) has become increasingly important to the manufacturing sector as customers, governments, and investors demand more sustainable products in the future. CE is a growing topic that promotes the responsible and cyclical use of resources and potentially contributes to sustainable development. CE is the new way to create shared value and promote inclusive and sustainable development. The concept of CE has gained attention from scholars and practitioners around the world. Recently, environmental pressures have made it increasingly important to promote corporate sustainability through technological innovation to improve the design, implementation, and evaluation of sustainable strategies. In such a scenario, a major challenge for enterprises is to balance economic needs with environmental sustainability. Many companies seek to apply circular economy principles to their business practices to achieve positive economic, environmental, and social benefits. However, these companies often struggle to transform their existing linear business models into circular models because the steps required for successful transformation are not yet well understood. Achieving the circular model requires cyclical and regenerative environmental innovation at all levels of the corporate value chain. Given the alarming level of concern about resource depletion and corporate sustainability, it is critical to create a global platform to discuss the emerging issues in implementing the circular economy at the micro and macro levels. This paper aims to discuss critical issues in promoting the principles of CE and achieving corporate sustainability. "Climate change is wrecking our path to sustainability. We live in a world with looming challenges and increasingly limited resources. Sustainable development offers the best chance to correct our course." - Ban Ki moon, United Nations Secretary-General.

Figure 1: Products, Processes, and Systems, in three dimensions of Environmental, Economic, and Social.

India is the second most populous country in the world, with a population of more than 1.35 billion in 2020. With an average annual gross domestic product (GDP) growth rate of 6-8%, India is also the fastest growing major economy in the last decade, contributing $3.05 trillion to global GDP in 2021. Although the COVID -19 pandemic has significantly affected the economy and people's lives, GDP declined to -7.3 in 2020 and is expected to be 9.5% and 8.5% in 2021 and 2022, respectively. However, India's contribution to global GDP and international trade is moderately small in contrast to its population and size. The country also faces numerous social, economic, and environmental problems compared to developed countries.

The manufacturing sector is one of the most important components in creating a balance between employment, economic growth, and environmental sustainability. For this reason, it is considered the backbone of the country's economy, as it contributes significantly to GDP and job creation. Globalization continues to impact it through the driving forces of outsourcing and distributed manufacturing with technological advances. However, the declining share of GDP and shrinking employment in manufacturing has become a concern.

Micro, small, and medium enterprises (MSMEs) are the major players in the manufacturing sector as they produce a lot, export, and create jobs. However, in India, MSMEs are not well equipped with new technologies and do not adhere to quality and environmental standards.

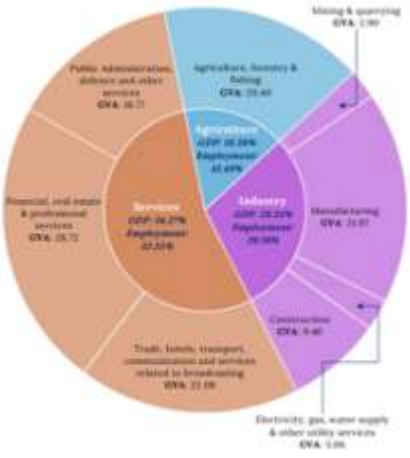

Figure 2: Sector wise GDP in India
GVA – Gross Value Addition, GDP – Gross Domestic Product
Source: https://statisticstimes.com/economy/country/india-gdp-sectorwise.php

Another factor of concern is environmental degradation, and a 2018 report ranked India 168th out of 180 countries in the Environmental Performance Index (EPI). Even Indian products do not meet international requirement standards as they are manufactured using outdated technologies or jugaad innovations that result in inferior products, import-export deficit, and promotion of cheaper imports. As a result, India was ranked 68th out of 141 countries on the Global Competitiveness Index (GCI) in 2019. In short, India needs to adopt a new technologically equipped production system by considering the practical impact on the industrial sector, which is consistent with several triple-bottom-line sustainability requirements. Moreover, India presents a great opportunity as it is the only South Asian country ranked 30th and 31st in terms of manufacturing structure and manufacturing drivers, respectively, in a World Economic Forum report on Industry 4.0 preparedness. Therefore, we are confident that the development of systems will be a breakthrough in achieving the goal and vision of "Make in India" and the Indian Century - 21st Century.

Rank	GCI	GMO	GMRI	Net Export	GMCI	CIPI	GDP
1	Singapore – 84.8	China – 28.7%	China	China	China -100	Germany	US – 19.5
2	US – 83.7	US – 16.8%	India	Germany	US – 99.5	China	China – 12.2
3	Hong Kong – 83.1	Japan – 7.5%	US	Ireland	Germany – 93.9	South Korea	Japan – 4.8
4	Netherland – 82.4	Germany – 5.3%	Canada	Russia	Japan – 80.4	US	Germany – 3.7
5	Switzerland – 82.3	India – 3.1 %	Czech Republic	South Korea	South Korea – 76.7	Japan	UK – 2.7
India	**68th – 61.4**	**5th**	**2nd**	**108th**	**11th – 67.2**	**42nd**	**6th – 2.6**

Figure 3: The Rank of India in comparison to other developed countries

GCI - Global Competitiveness Index (Score)
GMO - Global Manufacturing Output (Percentage)
GMRI - Global Manufacturing Risk Index (Rank)
GMCI - Global Manufacturing Competitiveness Index (Score)
CIPI - Competitive Industrial Performance index (Rank)
GDP - Gross Domestic Product Nominal (in Trillion USD)

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"We must develop a comprehensive and globally shared view of how technology is affecting our lives and reshaping our economic, social, cultural, and human environments. There has never been a time of greater promise, or greater peril." - Dr. Klaus Schwab, Founder and Executive Chairman, World Economic Forum

1. Challenges for the Circular Economy

1.1 Environmental Policies and Standards

Environmental degradation has been recognized as a major concern by world-level organizations such as the United Nations, the International Finance Corporation, and the governments of several countries. Various environmental policies have been described to combat air pollution, water pollution, waste management, soil pollution, and climate change, which must also be considered by manufacturing companies. To support this policy, the International Organization for Standardization (ISO) has set some international standards for the manufacturing sector, such as the ISO 14000 series. In India, the authorities have introduced the Environmental Protection Act of 1986, the Water (Prevention & Control of Pollution Act, 1974), the Air (Prevention & Control of Pollution Act, 1981) and the Environmental Impact Assessment Notification 2006 to protect the environment.

1.2 Economic Policies

Manufacturing is the backbone of any economy as it contributes to GDP and job creation. The Government of India has pursued many ambitious goals under the Make in India plan, such as Foreign Direct Investment (FDI), Goods and Services Tax (GST 2017), and Foreign Trade Policy (2016-2020) to reach the level of a developed economy. MSMEs will contribute significantly to a fully developed advanced production system through efficient and systematic management of taxes and transactions.

1.3 Societal Laws and Policies

Since the first industrial revolution, social problems have been observed, such as overtime, inadequate distribution of labor, wage differentials, protection claims, health care, and essential facilities. The Indian government has enacted several laws to protect workers' rights and improve living standards, such as the Trade Union Act and the Industrial Employment Act. Labor laws and policies should be binding guidelines for MSME registration.

1.4 Quality Standards

The quality of a product plays a crucial role in attracting the customer's attention. Due to inferior quality and lack of standardization, many Indian products are rejected several times in the international market, resulting in huge costs, which are called quality costs. The reason for this inadequate quality is inadequate monitoring of quality standards by the manufacturer. For quality control, International Organization for Standards (ISO 9000 series), American Society for Quality (ASQ) and Bureau of Indian Standards (BIS) are considered as the most important institutions in the world, USA, and India respectively, which must be followed by Indian manufacturers to expand cross border trade. Low quality also invites cheaper imports from competing countries.

2. Proposed Model Inclusive Manufacturing System (ims) for the Circular Economy

MSMEs are the backbone of populous countries like China and India, but most of these MSMEs are not well equipped with new technologies. They are also not fully aware of regulatory compliance, legal

requirements, policies, and innovations. Considering the current situation in populous developing countries, especially in India, a new manufacturing paradigm has been introduced, the Inclusive Manufacturing System (IMS), as shown in Figure 4. Inclusive manufacturing can be defined as: "incorporating innovations and advances in manufacturing to address societal (employment, education, health care, and labour), economic (cross-border business, trade policy, cost of products and services, and contribution of manufacturing to GDP), and environmental (natural resources, energy, air quality, clean water availability, recyclable and sustainable products) solutions by bringing together resources in a geographically distributed environment with the support of advanced manufacturing technologies (IT systems, Artificial Intelligence, High-Performance computation, and CPSs) through the integration of the semantic web and the Internet of Things to achieve the goal of minimal market time, better quality, lower cost, faster services, and greener manufacturing."

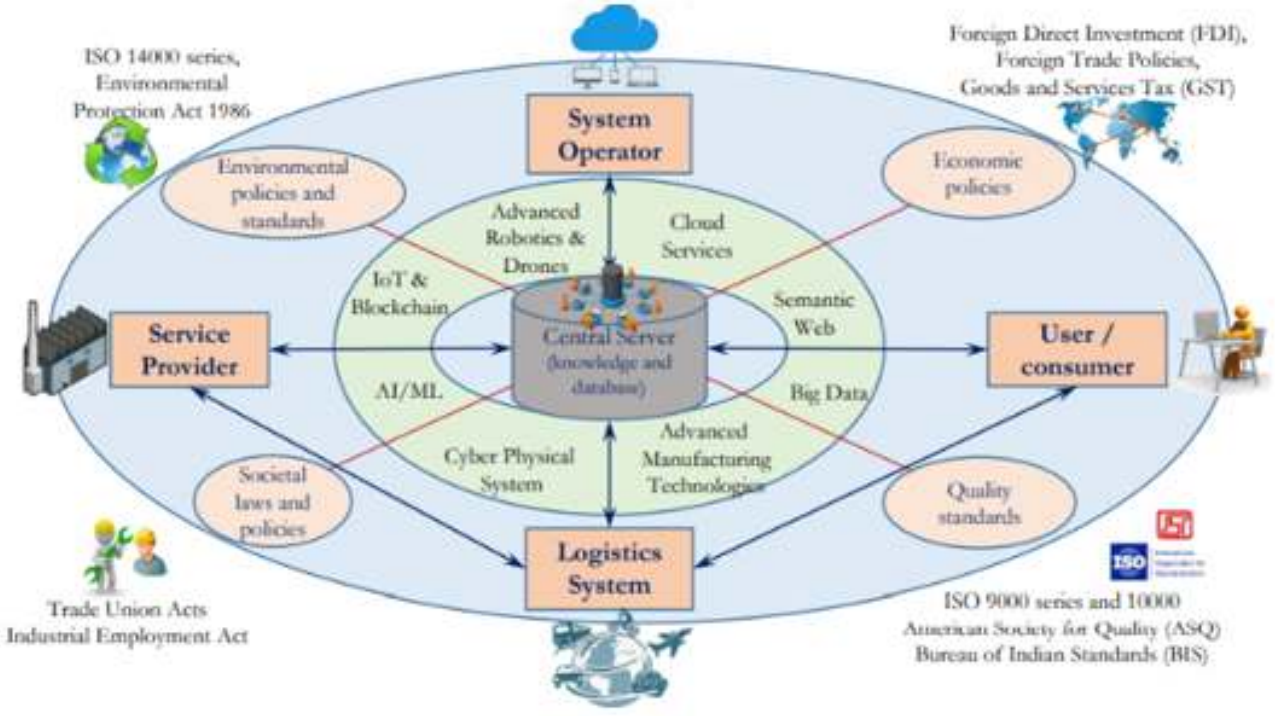

Figure 4. Inclusive Manufacturing System Source: Singh et al. (2019).

2.1 System Operator: A leading IMS member operates and manages the entire system with support from platform providers. Essential assistance is provided to service providers and customers by making the latest technologies available. System operators and platform providers work as brokers because they are the third parties connecting consumers and service providers.

2.2 Service Provider: Production resources and capabilities are provided by this participant in the form of services. Service providers fulfill the technical requirements of a physical item or design activity requested by customers.

2.3 Logistics System: The logistics system is the fourth partner in the proposed integrative production system. It is used to provide transportation and physical movement of goods from one place to another, storage, and warehousing activities by using real-time data monitoring and tracking technologies.

2.4 User or Organization: Consumers are crucial players in a business that purchases and consumes manufactured goods and related services.

The figure shows the framework of the IMS considering four participants that perform different activities from order initialization to final delivery. These include the user or customer (end user and organization), the system operator, the service providers (software services, suppliers, manufacturing

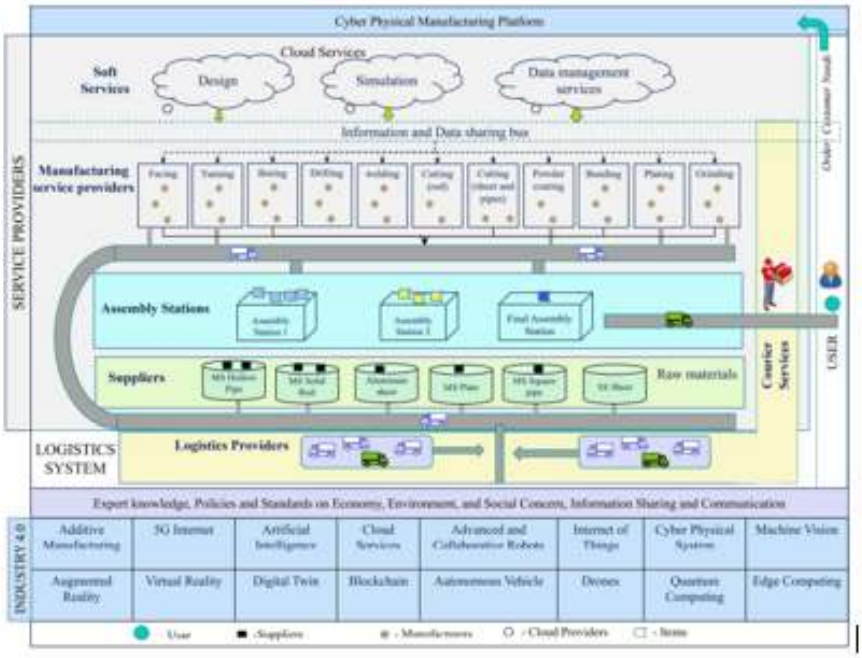

Figure 5: Cyber Physical Manufacturing Platform Source: Singh et al. (2019).

services, and assembly stations), and the logistics system (transportation and courier services). The suppliers provide raw materials and semi-finished products (e.g., only raw materials in this study). Logistics service providers help connect suppliers with manufacturers, manufacturers with other production units and assembly stations, and assembly stations with customers through courier services. Various manufacturers perform numerous operations (e.g., facing, drilling, boring) to process the original raw material through subsequent production steps (e.g., operations) into a final product. Depending on the available resources, i.e., machines, several manufacturing steps can be carried out in a company. Assembly stations put the product into its final form by picking up parts and assemblies from manufacturers. Finally, courier service providers take care of the delivery of the products to the customers by using logistics service providers.

3. Resource Recovery

Resource recovery is the systematic detour of waste that was destined for disposal for a specific reuse. It is the processing of recyclables to recover or reclaim materials and resources or convert them to energy. These activities are carried out in a recovery facility. Resource recovery is not only environmentally important, but also cost effective. It reduces the amount of waste requiring disposal, saves landfill space, and conserves natural resources.

Resource recovery (as opposed to waste management) uses LCA (life cycle analysis) and attempts to provide alternatives to waste management. For mixed MSW, several broad studies have found that management, source separation and collection, followed by reuse and recycling of the non-organic portion and energy and compost/fertilizer production from the organic material through anaerobic digestion is the preferred path.

An example of the benefits of resource recycling is that many discarded items contain metals that can be profitably recycled, such as the components of circuit boards. Wood French fries in pallets and other packaging materials can be recycled into useful products for horticulture. Recycled wood French fries can be used as surfacing for paths, walkways or play areas.

Application of rational and consistent waste management practices can yield a range of benefits including:

3.1 Economic:

Improving economic efficiency through the means of resource use, treatment, and disposal and creating markets for recyclables can lead to efficient practices in the production and consumption of products and materials, resulting in the recovery of valuable materials for reuse and the potential for new jobs and new business opportunities.

3.2 Social:

By reducing negative health impacts through proper waste management, the resulting impacts are more

attractive to civic communities. Better social benefits can lead to new employment opportunities and potentially lift communities out of poverty, especially in some of the poorer developing countries and cities.

3.3 Environmental:

Reducing or eliminating negative impacts on the environment by reducing, reusing, recycling, and minimizing resource extraction can lead to improved air and water quality and help reduce greenhouse gas emissions.

3.3.1 Waste reducing, reusing, and recycling (3R) Waste Hierarchy

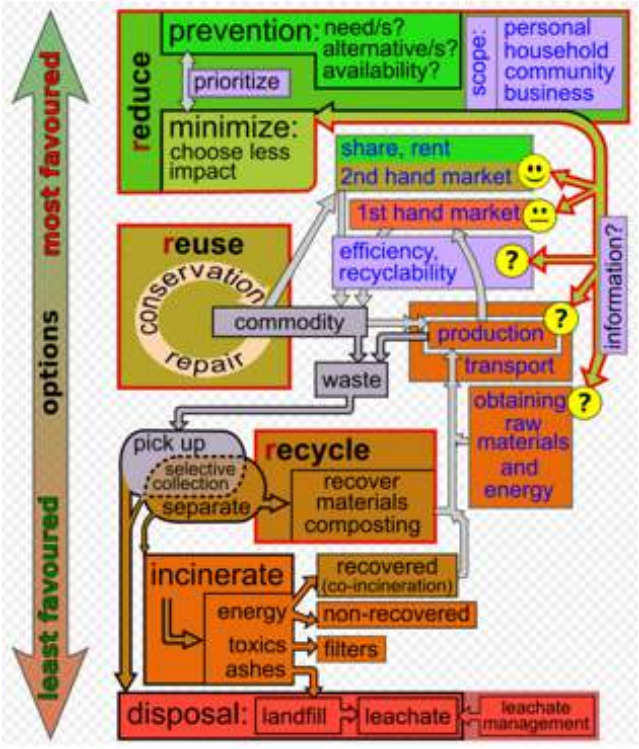

Figure 6: waste hierarchy the 3 Rs (reduce, reuse, recycle)

Source:https://en.wikipedia.org/wiki/Waste_management#/media/File:Waste_hierarchy_rect-en.svg

The philosophy of today's society is "take-make-use-dispose", i.e., we use resources, process them into products and throw them away as waste after use. This leads to two problems: one is the scarcity of resources on the earth, and the other is the increase of waste on the earth, because the earth has limited resources and a finite capacity to absorb waste, and with the increase of population and luxurious lifestyle, this problem is getting bigger. Manufacturers are making efforts to use resources efficiently. They are continuously working to minimize costs and waste. However, this is limited only to production and not to the whole system. There are some research practices toward end-of-use/end-of-life (EOU/EOL) that are not currently accepted by manufacturers. Our interest must be to close the loop of manufacturing by recycling and reusing the materials. So, we can say that remanufacturing is not accepted by companies, although its benefits are highlighted by researchers. The United Nations Development Program (UNDP) - Responsible Consumption and Production (RCP-12) focuses on the efficient management of our common natural resources and the disposal of toxic waste and pollutants. The goal is to encourage industry, businesses, and consumers to recycle or reduce waste, and to help developing countries shift to more sustainable consumption patterns by 2030. To reduce the burden of waste and pollution, both industrial and municipal waste should be recycled and reused. Therefore, circular economy or circulation systems should be implemented in the production process to minimize the use of raw materials and waste generation (Hysa et al., 2020).

In addition, hazardous and infectious medical waste should be properly disposed of according to guidelines (WHO, 2020c). It is now clear that the majority of people (especially in developing countries) are not adequately informed about waste segregation and disposal (Rahman et al., 2020). Therefore, the government should conduct comprehensive awareness campaigns on proper waste separation, treatment, and disposal through various mass media.

For example, India is the country with the fifth largest e-waste generation (Bandela, 2018) and generated 3230 kilotons of e-waste in 2019, which is equivalent to 2.4 kg per capita (Forti et al., 2020). Figure 6 shows the growth of e-waste in India.

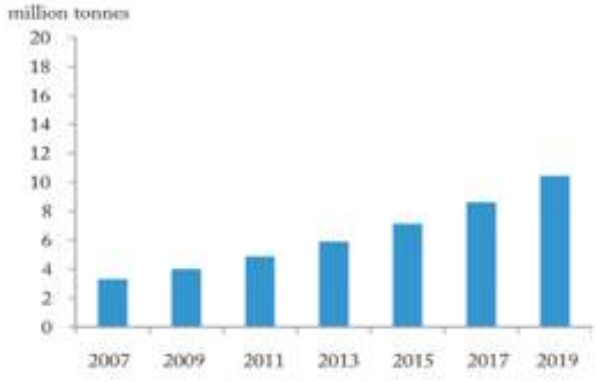

Figure 6: E-waste in India {Source: Annamalai (2015)}

Although laws requiring manufacturers to collect and properly recycle e-waste have been in place in India since 2011 (Kaur, 2019), only 1.5 percent of India's total e-waste is recycled by certified recyclers (Pandit, 2016). Pandit (2016) notes that improper dismantling by the unorganized sector and scrap dealers has resulted in e-waste concentrations in Indian soil that are twice the global average.

For example, Advert Foundation launched an e-waste management campaign in Delhi (TNN, 2014). Nokia, in turn, launched its e-waste "take back" campaign through its Priority Dealers and Nokia Care Centers in New Delhi (Sadia, 2013). However, in the absence of formal collection mechanisms, "unused" products are stored in homes in both cities. These "unused" products stored in houses could eventually end up in the unorganized sector (Gautam, 2016) if the public is not educated to dispose of e-waste properly. Kwatra et al. (2014) found that 74 percent of households sold e-waste to scrap dealers. Therefore, there is a need to raise awareness and establish proper collection points to reduce the problem of e-waste.

There is an increasing need for end-of-life management of products by manufacturers. ninety-five percent of e-waste is collected and recycled by the informal sector (Agarwal et al., 2021). Manufacturers should establish a take-back mechanism for e-waste collection.

From the end-user perspective, the following is needed: education on the 3Rs (reduce, reuse, recycle) and awareness of collection points.

In this context, there is a need to improve skills and provide certification for repair work (Gautam, 2016). There is an urgent need to improve the infrastructure of recycling facilities to reduce the amount of e-waste that ends up in landfills and to raise awareness in the informal sector to reduce processes such as open burning and acid bleeding (Manish and Chakraborty, 2019).

Finally, there is a need to involve local nongovernmental organizations in e-waste collection (Central Pollution Control Board, 2011) and to integrate informal e-waste collectors into formal e-waste processing facilities (Turraga and Bhaskar, 2017).

3.3.2 Challenges in developing countries like India related to waste.

In areas with developing economies, waste collection services are often depleted, and landfills are inadequately managed and uncontrolled. The problems are exacerbated. Problems with management complicate the situation. Waste management in these countries and cities is an ongoing challenge due to weak institutions, chronically inadequate resources, and rapid urbanization. All these challenges, along with a lack of understanding of the various factors that contribute to the waste management hierarchy, impact waste treatment.

In developing countries, waste management is usually done by the poor to ensure their survival. It is estimated that 2% of the population in Asia, Latin America, and Africa rely on waste for their livelihoods. Family-based or individual manual waste pickers are often engaged in waste management practices for which there are few support networks and facilities, putting them at increased risk for health consequences. In addition, this practice prevents their children from further education. Participation of most citizens in waste management is low, and residents of urban areas are not actively involved in the waste management process.

3.3.3 Wastewater treatment and reuse The world is facing increased water stress, driven by population and economic growth, land use changes, increased climate variability, and change, growing industries declining groundwater supplies, and water quality. Water pollution due to toxic metals and organic compounds remains a serious environmental and public problem. Moreover, faced more and more stringent regulations. Water pollution has also become a major source of concern and a priority for most industrial sectors. It is important to know the potential threats to source water and human beings from wastewater discharged by industrial or commercial activities prior to its release into the environment. Wastewater treatment is closely related to the standards and/or expectations set for effluent quality.

Industrial wastewater treatment describes the processes used for treating wastewater that is produced by industries as an undesirable by-product. After treatment, the treated industrial wastewater (or effluent) may be reused or released to a sanitary sewer or to surface water in the environment. Some industrial facilities generate wastewater that can be treated in sewage treatment plants. Most industrial processes, such as petroleum refineries, and chemical and petrochemical plants have their own specialized facilities to treat their wastewater so that the pollutant concentrations in the treated wastewater comply with the regulations regarding disposal of wastewater into sewers or into rivers, lakes, or oceans. This applies to industries that generate wastewater with high

concentrations of organic matter (e.g., oil and grease), toxic pollutants (e.g., heavy metals, volatile organic compounds), or nutrients such as ammonia. Some industries install a pre-treatment system to remove some pollutants (e.g., toxic compounds), and then discharge the partially treated wastewater to the municipal sewer system.

Most industries produce some wastewater. Recent trends have been to minimize such production or to recycle treated wastewater within the production process. Some industries have been successful at redesigning their manufacturing processes to reduce or eliminate pollutants. Sources of industrial wastewater include battery manufacturing, chemical manufacturing, electric power plants, the food industry, the iron and steel industry, metal working, mines and quarries, the nuclear industry, oil, and gas extraction, petroleum refining and petrochemicals, pharmaceutical manufacturing, pulp, and paper industry, smelters, textile mills, industrial oil contamination, water treatment, and wood preserving. Treatment processes include brine treatment, solids removal (e.g., chemical precipitation, filtration), oils and grease removal, removal of biodegradable organics, removal of other organics, removal of acids and alkalis, and removal of toxic materials.

To control the challenges of water pollution, both industrial and municipal wastewater should be properly treated before discharge. Besides, the reuse of treated wastewater in non-production processes like toilet flushing and road cleaning can reduce the burden of excess water withdrawal.

Case Study: Water harvesting and conservation by reuse of runoff water.

Hindalco has always focused on aspects of resource criticalities. Water, being a scarce resource, Hindalco takes various initiatives to reduce its freshwater consumption. This is evident through the initiatives taken at our plant, which are described below:

Our plant location is a low-lying area compared to our locality. The wastewater of the community is being entered into our premises through seepage into the stormwater drain. We have taken the initiative towards water reuse by collecting that stormwater in our stormwater collection pit as runoff water. We took this runoff water as an opportunity for us. We have laid down a pipeline from the stormwater pit to our effluent treatment plant (ETP). At ETP, we have a clarifier and reverse osmosis (RO) system to treat this runoff water. To monitor this runoff water, we have installed one level sensor at the stormwater pit and one flow meter at ETP for monitoring the quantity of utilized runoff water.

Benefits and impact on business

- A step ahead to sustainable development through natural resource conservation.
- There is a possibility to multiply water conservation practices in other areas also.
- Reduction in freshwater consumption.

3.3.4 Solutions for waste reducing, reusing, and recycling (3R)

3.3.4a Behavioral change in daily life

To reduce the carbon footmark and global carbon emigration, it's necessary to change the mindset in our diurnal life and optimum consumption or coffers like; avoiding reused and take locally grown food, making compost from food waste, switching off or freeing electronic bias when not used, and use a bike rather of a auto for shorter distances.

3.3.4b International cooperation

To meet the sustainable environmental pretensions and protection of global environmental coffers, similar as the global climate and natural diversity, combined transnational trouble is essential(ICIMOD, 2020). Hence, a responsible transnational authority like united nations terrain programme (UNEP) should take an effective part to prepare time-acquainted programs, arranging transnational conventions, and coordinating global leaders for proper perpetration. Science and Technology play a vital part in the socio- profitable development of a nation. Rapid advances in technology have led to significant enhancement in all sectors of frugality. With the emergence of the rearmost technologies, there has been a drastic shift in the way we suppose, work, and unite with others. Also, access to new technologies has fully converted the nature/ operation of work. The entire world has become a global village. On the one hand, it has increased the effectiveness and effectiveness of associations, on the other hand, it has rebounded in increased complexity, query, and competition in the internal and external terrain of the associations. To manage this turbulence in the terrain, enterprises have to make judicious relinquishment and prolixity of technologies, which may lead to improvement of productivity, enhancement in living conditions, and profitable growth of the country. More specifically, enterprises need to map their technological capability and capability so that innovative products and services may be produced, thereby leading to the inclusive and

sustainable development of the nation.

3.4 Inter-generational Equity: Following effective waste management practices can provide subsequent generations with a more robust economy, a fairer and more inclusive society, and a cleaner environment.

4 Prospects and Scope of IMS

To achieve the sustainable pretensions of UNDP, the target of' Make in India', Inclusive growth of the frugality, arising trends of the current marketing strategy, and changing client actions and conditions, tremendous openings are envisaged for the Inclusive Manufacturing System. Many of the reasons are mentioned herewith IMS perpetration provides a centralized platform to Micro, Small, and Medium Enterprises(MSMEs) for their collaboration with resource composition. Grounded on literal data and client demand, substantiated and customized orders can be fulfilled. colorful environmental, profitable, and societal issues can be resolved with the perpetration of associated programs and norms, and it helps in maintaining the sustainability aspects. Continued monitoring and selection of the stylish players from the request through the system, perfecting product quality and effective services that lead to significant growth in cross-border business and donation of the manufacturing sector. New inventions, implicit openings, job creation, perfecting life, and inclusive growth can be witnessed with the expansion of the manufacturing sector. Eventually, similar generalities can play a big part and come the backbone of Atmanirbhar Bharat(Self- reliant India), giving the ideas of' oral for original',' original for global',' make for the world', and' brain drain to brain gain'.

Conclusion

To meet the sustainable environmental pretensions and protection of global environmental coffers, similar as the global climate and natural diversity, combined transnational trouble is essential(ICIMOD, 2020). Hence, a responsible transnational authority like united nations terrain programme(UN Environment) should take an effective part to prepare time- acquainted programs, arranging transnational conventions, and in order to achieve profitable, social, and ecological impacts, a paradigm shift is needed. This necessitates companies redefining resource use, product processes, and their relationship with business mates along the entire value chain. In 1784, the first artificial revolution began with water- powered machines. Electricity (2.0) made mass product possible. With the help of IT and electronics (3.0), robotization was advanced up to the moment's digitalization (4.0). With indirect frugality, we want to drive the urgently necessary Revolution5.0, creating a positive influence on people and our terrain. The ideal of the indirect frugality powered by Cradle to Cradle is to ensure that the coffers used can serve as starting accoutrements for new, pollutant-free products after they've been used. This allows them to circulate continuously in product cycles rather of" downcycling", the end is to enable the" upcycling" of products. Current results like participating generalities or play are formerly a way in the right direction on the road to indirect frugality. Still, the thing is to produce a positive footmark with optimized nutrient cycles through results that are suitable for the biosphere and the technosphere. It isn't enough if only many deals with these motifs and only individual product groups are optimized. However, there's no way around the indirect frugality, If companies want to make a really conspicuous donation to climate protection and resource conservation. Everyone can make a donation and be part of the result. Together, we're driving a 5th artificial revolution, with Cradle to Cradle as a new approach for products, processes, structures, and metropolises.

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Marketing Approaches for a Circular Economy

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ABSTRACT

The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended. In practice, it implies reducing waste to a minimum. When a product reaches the end of its life, its materials are kept within the economy wherever possible. These can be productively used again and again, thereby creating further value. The circular economy is based on the model of production-consumption-recycling/reuse. At the end of a product's life cycle, its materials are reused to create other goods. The circular model (or sustainable practices) can be adopted by companies in any sector. In a circular economy, marketing can be used as a tool to explore circularity opportunities among the target audiences, and to understand what circular opportunities exist, uncover those opportunities, and then collaborate with production specialists and R&D teams in creating the products to serve those needs. However, there are few studies that incorporate a marketing and communications perspective on the circular economy or which focus on the ways in which businesses providing circular products or services currently use communications to market their offerings and influence consumer behaviour. This paper represents an initial, exploratory study that highlights the recycling done in various Industrial sectors

Keywords: Circular Economy, Consumption, Waste, and Recycle

Importance of the Study.

Recycling is important in today's world if we want to leave this planet for our future generations. It is good for the environment since we are making new products from the old products which are of no use to us. Recycling begins at home. If you are not throwing away any of your old products and instead utilizing it for something new, then you are actually recycling. When you think of recycling, you should really think about the whole idea; reduce, reuse and recycle. We've been careless up to this point with the way we've treated the Earth, and it's time to change, not just the way we do things but the way we think. United States Environmental Protection Agency (EPA), defines recycling as, "Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products. Recycling can benefit your community and the environment." Recycling is good for the environment; in a sense, we are using old and waste products that are of no use and then converting them back to the same new products. Since we are saving resources and are sending less trash to the landfills, it helps in reducing air and water pollution. With each passing day, the population is increasing. With that, the quantity of waste so produced is also increasing manifolds. The more the waste production, the more is the amount of space required to dump these wastes. Now, it must be remembered that the space available on earth is very limited, and it is obviously up to us to use it judiciously. The ever-growing population needs space to live and also to grow what they eat by means of agriculture. If all this space were to be taken up by dumpsters and landfills, the survival of humankind on this planet would be really difficult. Recycling solves this problem because, with recycling, a lesser amount of wastes is dumped, and some valuable space is saved. In recent years, incinerators are being used extensively to reduce the amount of waste produced. Incinerators burn the wastes that it takes up lesser space when being disposed of. But what are these incinerators powered with? Also referred to as the thermal treatment of wastes, incinerators use up our precious, non-renewable fossil fuels to burn wastes into ashes. We are producing and losing precious energy just for the sake of a little less space used up by waste. Not only that, but we are also causing severe air pollution

as well.

Review of Literature

1. Final Report on Design of Recyclable Products
2. Waste paper for recycling: Overview and identification of potentially critical substances
3. Final Report on Design of Recyclable Products
4. Consumer acceptance of products made from recycled materials: A scoping review
5. Waste paper for recycling: Overview and identification of potentially critical substances Pivnenko, Kostyantyn; Eriksson, Eva; Astrup, Thomas Fruergaard

Objectives of the Study

This research paper is an attempt to understand how recycling is done in various industrial sectors. As also this paper highlights the types of marketing used for Reusable / Recycling the products.

Introduction to Circular Economy

The circular economy is a systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution.

Currently, the concept of circular economy has been integrated through many national and organizational policies. For example, it was acknowledged as one of China's national development strategies throughout the country's 12th Five-Year Plan (2011-2015) and its Circular Economy Promotion Law of 2009. In 2015, the European Commission launched its own Action Plan for the Circular Economy programme, which sets out a policy framework with measures and targets on waste management. The concept of circular economy is also an integral part of the following United Nations' Sustainable Development Goals.

A circular economy is a regenerative or regenerative production system. It is also often possible to find other names for this approach, such as green economy, closedloop economy, and non-waste economy. This approach provides for replacing the concept of "end-of-life" repair, shifting the interest towards the use of renewable energy sources, completely eliminating the use of toxic chemicals that interfere with product reuse, and waste elimination through the improvement of design, materials, products and, as a result, the entire business model. A wasteful lifestyle, mainly in industrialized countries, has led to a decline in ecosystems, limited resources and an increasingly unstable climate. At the same time, population growth and the much-needed increase in per capita income in low-income countries put additional pressure on resources. Business circles often see the environmental policy development as a threat to competitiveness, but there is reason to consider resource efficiency as an opportunity. The current economy is built on the principle of "quick turnover". The faster the consumptions items are replaced, the better it is for manufacturers. As a result, the Earth's resources are managed very inefficiently. The transition to a circular economy through reuse will bring many benefits.

The economic effect of introducing the concept of a circular economy is expressed in reducing the consumption of raw materials and energy resources, and as a result – in reducing demand for them and price volatility in resource markets; as well as an increase in the number of jobs due to the formation of new sectors of the circular economy (Van Buren et al., 2016). The acceleration of urbanization leads to an incentive for the state to promote the development of a circular economy. The advantages for enterprises are expressed in the strengthening of relationships with partners along the entire value chain, increasing innovation and customer loyalty, the emergence of additional competitive advantages and new sources of profit (Firnkorn & Muller, 2012; Shafiee & Stec, 2014), and for consumers – in the consumption of environmentally friendly products and, in some cases, a decrease in their cost.

Popular Types of Marketing for Reusble Products

1. Green Marketing (or environmental marketing) is the promotion of environmentally friendly products, services, and initiatives. More specifically, green marketing refers a broad range of environmentally friendly practices and strategies. Some green marketing examples include: Creating eco-friendly products. Green marketing is the marketing of products that are presumed to be environmentally safe. It incorporates a broad range of activities, including product modification, changes to the production process, sustainable packaging, as well as modifying advertising. Green marketing is becoming more popular as more people become concerned with environmental issues. Indeed, in 2020, more than three quarters of consumers (77%) cited a brand's sustainability and environmental responsibility as very important or moderately important in their

choice of brands.

While green marketing can be more expensive than traditional marketing messages and practices, but it can also be profitable due to increasing demand. For example, products made locally in North America tend to be more expensive than those made overseas using cheap labor, but local sourcing and supply chain means they have a much smaller carbon footprint than goods flown in from overseas. For some consumers and business owners, the environmental benefit outweighs the price difference.

Green, environmental and eco-marketing are part of the new marketing approaches which do not just refocus, adjust or enhance existing marketing thinking and practice, but seek to challenge those approaches and provide a substantially different perspective. In more detail green, environmental and eco-marketing belong to the group of approaches which seek to address the lack of fit between marketing as it is currently practiced and the ecological and social realities of the wider marketing environment.

2. Sustainable Marketing :

Sustainability can be defined as the ability for us to meet the needs of everyone today without compromising the security and opportunities for future generations. While environmental sustainability is the first thing that comes to mind for most when this term comes up, it also has a great deal to do with social equity (meeting the needs of everyone). In the business world, companies have been rapidly adopting the sustainability mindset and as a result, have begun to evaluate themselves according to the triple bottom line. This measurement of performance includes three areas: people, profit, and planet. So, while businesses must be profitable in order to survive, for them to be sustainable they need to equally consider the other two priorities of people (all stakeholders in and outside the company) and the planet. Adopting a sustainability focus can bring enormous positives for companies – this is true in the short-term, and even-more-so in the long-term. A first major benefit is in terms of attracting customers. Forbes reports that millennials are becoming the most important consumer group, with buying power of $2.45 trillion. Millennials care where they spend their money. In fact, roughly 70% will pay more for brands that support a cause they care about. Other benefits for sustainable businesses, reported by Harvard Business Review are greater risk management, more innovation and better financial performance, including larger profits, more cost savings and improved efficiencies and logistics. So clearly, including sustainability as a main principle in your organization can poise it for success today and in the long-run. In any business, there are three functions that are central to success. These are operations, finance, and marketing. Sustainable marketing is absolutely key to the success of any company as it encompasses every activity to do with generating revenues. However, consumers tend to have unfavourable attitudes toward marketing practices. This is largely the result of traditional marketing using the tactic of pressuring consumers and influencing their perspective in order to make them think they need a company's product. This manipulative style of marketing leads to unsustainable relationships with customers as they often realize that the product they were convinced to buy didn't really make their life better. Sustainable marketing works because it promotes the core values that your business and your stakeholders actually value – environmental wellness, human health, resource security, fair trade, social equity, etc. As a result, it makes your company's advertising stand-out in a market that is still dominated by the traditional "put-down" style of advertising. By engaging in sustainable marketing, your business will earn the trust of consumers and in turn, their loyalty. And in today's market, loyalty is the biggest competitive advantage of them all.

Industrial Sectors Where Recycling is Done

1. Packaging Sector: It is very important to know what your customers do with the packaging. Do they recycle or reuse it? Or do they simply throw it away? Sustainability in packaging is a prime necessity these days. Not only does it reduce wastes, but it also encourages and enables consumers to recycle. You can recycle most of the packaging materials, but some. Packaging plays a key role in our modern way of life. Without it, most products would expire or get damaged before arriving in a store. However, it's frequently pointed out as one of the main villains in our planet's battle for environmental sustainability because it turns into waste after its use. That's why companies from across industries are searching for ways to close the loop and minimize the negative environmental impact of packaging while still benefitting from its positive properties. This search relies on people with a range of skills – but packaging designers are the key players when it comes to

tackling the challenges of sustainable packaging. From making packaging easier to recycle after use through to integrating more recycled material in new packaging: These experts create packaging that protects the products we love while also offering a better contribution to the planet. The biggest problem with packaging is that it usually becomes waste as soon as a consumer finishes using a product. That's why experts in smart packaging also focus on creating designs that are optimized for recycling. By making their existing packaging easier to recycle – and also using more and more recycled material in new packaging – companies can help keep materials in the value chain for longer. This idea is at the heart of the circular economy model: A way of thinking that seeks to gather materials after they have been used and process them so they can be reused or recycled over and over again. This eliminates waste and reduces the environmental impact of packaging – as long as strong recycling and waste management systems are in place.

2. Building & Construction Industry: Scarcity of resources and the need to reduce the environmental impacts of winning and processing construction materials and products is placing a greater emphasis on resource efficiency within the construction industry. It is estimated that the UK construction industry consumes some 400Mt of materials annually and generates some 120Mt of (construction, demolition and excavation) waste, of which 5Mt ends up in landfill. Therefore, there is significant scope for improving resource efficiency within the industry, particularly at the end-of-life of buildings. Importantly, the majority of the construction and demolition arisings are heavy bulk wastes such as concrete, masonry and asphalt which are generally crushed and down cycled into lower grade applications such as general fill. Although landfill is avoided,

Down cycling is low-grade recycling and low down on the UK waste hierarchy. More has to be done to encourage reuse and higher grade recycling of these problem materials. Steel is used because it binds well to concrete, has a similar thermal expansion coefficient and is strong and relatively cost-effective. Reinforced concrete is also used to provide deep foundations and basements and is currently the world's primary building material.One major benefit of reusing steel from buildings and structures is that beams, columns, and other structural pieces can be used without having to be re-melted or processed. Scrap pieces of steel, on the other hand, can be melted down and made into something new

3. Textile Industry: Textile recycling is the process of recovering fiber, yarn, or fabric and reprocessing the material into new, useful products. Textile waste is split into pre-consumer and post-consumer waste and is sorted into five different categories derived from a pyramid model. Rags are collected and sent to the wiping and flocking industry. Other materials will be sent for fibre reclamation and stuffing. Fibres from the old fabrics are reclaimed and are used for making new garments. Threads from the fabric is pulled out and used for re-weaving new garments or blankets. Textiles have a significant impact on the environment during their lifecycle. Large amount of water, energy, pesticides and fertilizers have made the global textile industry one of the most polluting and waste producing industries in the world. Recycling textile has become the newest addition to the materials that are recycled and redirected from the landfill. Recycling and reusing textiles, fibres and waste materials is an effective method to build sustainability in the apparel industry. A report by U.S. Environmental Protection Agency states that textiles are an important source of greenhouse gas emissions. In order to reduce the greenhouse gas emissions, efforts are made to increase textile recycling. In the current scenario, recycling clothing would have an effect equivalent to removing one million cars off the road every year. In U.K. people consume 2 million tons of clothing from which, 0.5 million tons are recycled. However, 1 million ton is still disposed off. While in Europe, one can find a textile waste of around 14million tons out of which, a quarter of 5 million tons are recycled. Therefore, it has become imperative to develop innovative methods to recycle textiles and produce beneficial items out of recycled post-consumer materials.

4. Automotive Industry : Vehicle recycling refers to the process of disassembling automobiles to recover and recycle spare parts, fuel and scrap metals. This involves processes such as dismantling, crushing, shredding and material recovery through which magnetic pieces, sheet metals, seats, wheels and other components are retrieved. Separation technologies, such as laser, infrared, eddy current and flotation methods, are used to isolate the non-ferrous metals from other materials, which are then sent for re-smelting. In addition to this, the reusable components are cleaned, tested and refurbished for resale, while the fluids are drained over an impervious surface and

stored for later use.

The rapid industrialization and urbanization across the globe are among the key factors driving the growth of the market. Additionally, widespread adoption of metal scrap, especially steel, for the manufacturing of more affordable, lightweight and fuel-efficient vehicles, is acting as another growth-inducing factor. Furthermore, increasing consumer awareness regarding the environmental benefits of using recycled materials and minimizing the dependency on natural resources is also providing a boost to the market growth. Automotive recyclers are utilizing sophisticated tools and methods to recycle used vehicles to extract polymers, fluids and natural materials that cause minimal damage to the environment. They are also using various innovative products, such as optical sensors, to identify small pieces of metal in the scrap. Other factors, including the increasing utilization of recycled batteries in the manufacturing of consumer electronics and the implementation of government regulations to minimize environmental hazards associated with the disposal of batteries, rubber, oils and other materials, are expected to drive the market in the upcoming years.

IMARC Group's latest report provides a deep insight into the global vehicle recycling market covering all its essential aspects. This ranges from macro overview of the market to micro details of the industry performance, recent trends, key market drivers and challenges, SWOT analysis, Porter's five forces analysis, value chain analysis, etc. This report is a must-read for industry players, investors, researchers, consultants, business strategists, and all those who have any kind of stake or are planning to foray into the vehicle recycling industry in any manner.

As an industry, auto recycling is integral in preserving energy by limiting fossil fuel use and preserving natural resources. It's possible to recycle up to 75 percent of a vehicle by reusing parts for cars still on the road or melting down materials for cars yet to be manufactured.

5. Agricultural Industry: The role of the agricultural sector in human development and economic development cannot be overemphasized. Awareness for increased agricultural production is on the increase, arising from the need to feed the ever-increasing human population. Interestingly, almost all agricultural activities generate wastes, which are generated in large quantities in many countries. However, these wastes may constitute a serious threat to human health through environmental pollution and handling them may result in huge economic loss. Unfortunately, in many developing countries where large quantities of these wastes are generated, they are not properly managed because little is known about their potential risks and benefits if properly managed. There are studies that address some of the challenges of agricultural solid wastes as well as suggestions on how they can be properly managed. In this chapter, we intend to explore the major sources of agricultural solid wastes, their potential risks, and how they can be properly managed. recycling organic wastes in agriculture conserves finite phosphate resources and the embodied energy from industrial nitrogen fixation, thus supporting the goal of sustainable food production. Organic wastes, such as waste wood and paper sludge, also provide alternative types of livestock bedding. Agro-industrial wastes are used for manufacturing of biofuels, enzymes, vitamins, antioxidants, animal feed, antibiotics, and other chemicals through solid state fermentation (SSF). A variety of microorganisms are used for the production of these valuable products through SSF processes.

Cases / Examples From Published Sources ;

1. Henkel: HENKEL operates globally with a well-balanced and diversified portfolio. The company holds leading positions with its three business units in both industrial and consumer businesses thanks to strong brands, innovations and technologies. Henkel Adhesive Technologies is the global leader in the adhesives market – across all industry segments worldwide. In its Laundry & Home Care and Beauty Care businesses, Henkel holds leading positions in many markets and categories around the world. Founded in 1876, Henkel looks back on more than 140 years of success. In 2021, Henkel reported sales of 20 billion euros and an operating profit of 2.7 billion euros (adjusted for one-time gains/charges and restructuring charges). Henkel employs more than 52,000 people worldwide – a passionate and highly diverse team, united by a strong company culture, a common purpose and shared values. As a recognized leader in sustainability, Henkel holds top positions in many international indices and rankings. Henkel's preferred shares are listed in the German stock index DAX.

Henkel India
Henkel in India operates in two business areas: Adhesive Technologies and Beauty Care, both in the business-to-business realm. It has two legal entities in the country: namely, Henkel Adhesives Technologies India Private Limited (a wholly owned subsidiary of Henkel) and Henkel Anand India Private Limited (a joint venture company of Henkel and Anand Group). Headquartered in Navi Mumbai, currently, Henkel in India has a footprint comprising five manufacturing sites, two innovation/product development centers, a flexible packaging academy and five Schwarzkopf Professional academies. It employs approximately 1,000 employees across these sites.

Henkel is the name behind many well-known brands such as Loctite, Bonderite, Technomelt, Teroson, Aquence and Schwarzkopf. The company offers a multitude of applications and services to satisfy the needs of different customers.

2. Attero - Touted as India's largest electronic asset management company, Noida-based Attero promotes the reuse and recycling of electronics sustainably through its recycling plants. Attero recovers reusable resources and precious metals by processing e-waste with clean technology to minimize carbon footprint. Attero also list of global pending patent applications. Backed by World Bank (IFC), DFJ, IUVP and Granite Hill, Attero was among 9 innovators from across the globe that made it to the NASA conference on waste management in 2018. Aterro is also the only e-waste management firm in India which has taken environmental clearance from Ministry of Environment & Forests (MoEF).

3. Banyan Nation Hyderabad-based Banyan Nation, an incubatee of T-Hub, India's largest startup incubator, is a vertically integrated plastics recycling company that helps brands/companies to use recycled plastics instead of virgin plastics in mainstream product and packaging.

Banyan Nation collects discarded HDPE and PP (High-Density PolyEthylene and Polypropylene) - type consumer plastics from the street corners, water bodies and landfills. Once collected, the plastics are recycled at Banyan's state of the art recycling plant. Banyan's proprietary plastics cleaning technology removes product and packaging contaminants such as labels, adhesive, inks, etc. from post-consumer plastics. Besides, the waste-management company leverages mobile technology to map, integrate and train thousands of informal recyclers. Backed by Centre for Innovation Incubation and Entrepreneurship (CIIE) and Artha Capital, Banyan Nation was among chosen one shortlisted for Awards at The World Economic Forum (WEF), in year 2018. It also won Intel DST Challenge 2.0 2017.

4. Lucro - Mumbai-based Lucro Plastecycle is a Mumbai-based recycling company that converts the dirtiest plastic waste into recycled granules which ultimately are remade into recycled products at a cost less than virgin plastics to produce high quality, innovative and recycled-content products such as shrink wrap and films. The company claims to handle the entire waste value chain right from collection to recycling and manufacturing of final recycled products. Funded by Singapore-based Circulate Capital, Lucro has recently became first company in India to be successfully certified Ocean Bound Plastic (OBP) recycling, which means that it can now offer clients globally looking for OBP certified recycled films made from flexible plastic.

5. Phool.co - Kanpur-based Phool (Fomerly HelpUsGreen) is one of most interesting startups in India that are into waste management's segments. It converts flowers and offerings collected from religious places into bio-degradable alternative to Thermacol and incense sticks. With help of rural women self-help groups, Phool and its team collect floral waste from the temples and mosques in Uttar Pradesh and thereafter handcrafted by rural women self-help groups into patented organic fertilizer and incense sticks via what the company named as "Flowercycling". The company had also received the United Nations Young Leaders Award at the United Nations General Assembly in New York, in year 2018. Backed by Tata Trusts' Social Alpha and IIT Kanpur, the company raised US$1.4 Million in a funding round led by IAN Fund and San Francisco-based Draper Richards Kaplan Foundation, in August 2020.The company claims to have prevented 7600 Kgs waste flowers and 97 Kgs toxic chemicals from getting into the the Ganges river daily.

6. Saahas Zero Waste - Founded by a journalist, Wilma Rodrigues, Saahas Zero Waste is socio-environmental enterprise with 17 years of experience in waste management and resource recovery. The company specializes in designing and executing customized solutions for the goal of zero waste to landfills, especially for bulk waste generators such as

technology parks, residential complexes, educational institutions, hotels and others. Backed by Artha India Ventures and Indian Angel Network, Saahas Zero Waste claims to have diverted 10,000 MT of plastic waste from dumpsites and other open spaces under the extended producer responsibility program, in the year 2019. In 2018, Saahas Zero Waste was awarded the Swachh Best Practice Award by Prime Minister Narendra Modi as recognition of the work done in the space.To add to the circular economy, the company also offers products made from waste such as roofing sheets, clipboards, stationary, upcycled textile products, apparel and more.

Summary

Sustainability improves the quality of our lives, protects our ecosystem and preserves natural resources for future generations. In the corporate world, sustainability is associated with an organization's holistic approach, taking into account everything, from manufacturing to logistics to customer service.

Environmental sustainability is important because of how much energy, food and human-made resources we use every day. Rapid population growth has resulted in increased farming and manufacturing, leading to more greenhouse gas emissions, unsustainable energy use, and deforestation.

Sustainability improves the quality of our lives, protects our ecosystem and preserves natural resources for future generations. In the corporate world, sustainability is associated with an organization's holistic approach, taking into account everything, from manufacturing to logistics to customer service. Going green and sustainable is not only beneficial for the company; it also maximizes the benefits from an environmental focus in the long-term. Regardless of who we are, where we live, and what we do, we all have a moral obligation to each other, our future generations, and other species to sustain the planet. Our present choices and actions have huge long-term impacts on future generations. Practicing sustainability ensures that we make ethical choices that bring a safe and livable future to everyone. If we deplete the resources of the Earth, future generations will be depleted. For example, if we over fish our oceans, we risk not only depleting the supply of fish, but also depleting the supply of every organism in the food chain related to that fish.

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Implementation of circular economical strategies for adaptive reuse of Hill-forts in Mawal Taluka- Pune, Maharashtra.

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ABSTRACT

The circular economy is used as a consumption model, for providing rational optimization framework inorder to share, rent or lease, reuse, repair, reconstruct, and recycle existing materials and products to generate an economy. Adaptive use of cultural elements like heritage buildings, forts, art, tradition, and literature will lead to the development of an economy. For all Adaptive Reuse projects, the safe bearing capacity of site along with its total embodied energy, and non-renewable energy of resource materials play crucial roles. However, highlighting the significance of reducing environmental footprint can be achieved by analysing and implementing PESTLE parameters. For any adaptive reuse, a structural audit shall be mandate to verify the conservation plan followed with the managerial plan of circular economy. To encourage tourism in Maharashtra, investment is being made in conservation and repairs of the infrastructure, local heritage and better local facilities to access them. The implementation of the circular economy in encouraging fort development plays an important role in its adaptive reuse. Adaptive reuse of the forts in Maharashtra will allow reduced pollution and waste, and help generate revenue; thus, making it self-sustainable. The application of strategies of circular economy will reduce air, noise, and land pollution and even preserve the historical values of Forts. It is can be used to evaluate the appropriateness of the reuse of re-functioned forts. The model studies and proposes a qualitative approach towards adaptive reuse of forts as per the PESTLE parameters of the related context.

Keywords: Circular Economy, Adaptive-reuse, Fort, Heritage, Managerial plan

Introduction

The objectives of State tourism to promote the growth and sustainable development of local people, to create employment opportunities and bring about socio-economic benefits to the community, especially in the interior and remote Maharashtra that could enrich and promote its cultural heritage-through preservation and protection of natural resources and environment. The first step towards consideration of an adaptive reuse project is to undergo a structural audit, that helps determining the strength of the building. This audit also helps us understand the external building condition, strength of the materials and methodology used when the structured was erected. A PESTLE analysis after the audit can be implemented to understand the government, social, technological, environmental, and economic interventions at various levels previously as well as in current situations.

Heritage can be identified as preserving traditions tangible as well as intangible for our future generations, provoking the sense of belonging. The National Heritage Conference Defined Heritage as "that which a past generation has preserved and handed on to the present and which a significant group of population hands on to the future." *JETIR2109404- adaptive reuse.pdf (JETIR2109404 Journal of Emerging Technologies and Innovative Research (JETIR) www.jetir.org)* Adaptive Reuse is defined as reuse of architecture for a new purpose or repurposing of an existing structure for new use. It represents a form of sustainable strategy to avoid waste of demolition of a building and constructing a new one. Although most typologies of built structures are eligible for such a transformation, this research focuses on historic hill- forts and structures, in Maharashtra that are valuable to their urban fabric. It can be noted that the adaptive reuse of such structures will benefit the culture, environment as well the economic fabric around them.

Linear economy emphasizes on recycling referring to the recirculating the toxic hazardous material that has poisonous repercussions on our ecosystems. The

linear economy is based on a cradle to grave approach: extraction, processing, production, use – and ends in huge amounts of products and material wasted. Circular economy is essential to provide opportunities to improve the environment. It can help deal with the triple planetary crisis, by keeping resources in loop for longer. The growing global population has increasing demands of raw materials, while the supplies are decreasing. Circular economy in India can help us independence from other countries with respect to the raw materials.

1. Linear and Circular Economy:

Image 1: circular-economy-unido-blog.jpg (beesmart.city)

Sustainable development requires an integrated approach concerning environment and resources along with their various systems, interconnections, long-term trends, limits, and economic development. Cultural heritage buildings are in urban skyline areas of Maharashtra, can be subjected to adaptive. Cultural heritage acts a resource for economic development, e.g., many districts in and around Pune help preserve cultural history and attract tourists.

2. Adaptive reuse:

Global carbon emissions can be reduced from the building sector through sensible retrofits and renovations. A project manager can help create a decision-making framework linking the functional service life of a building with its adaptive reuse. Adaptability is an extremely important factor in Asset Sustainability of Forts, in Maharashtra. In forts particularly, the asset is in the government ownership-sometimes with the local authority, hence only operation and maintenance remain to be taken care of for completing its lifecycle. Each type of stakeholder, architect, developer, owner, could benefit by being a part of any process of adaptive reuse work. Numerous advantages for adaptive reuse in Maharashtra Hill-forts leading towards circular economy are:

Environmental: In adaptive reuse, most the materials are reused as per their structural conditions and strength. This enables avoiding new construction or use of natural resources. In addition, the energy consumed by materials and labour is lesser or sometimes none. One of the leading environmental benefits of reusing forts is retaining the original fort's "embodied energy." New structures have much higher displayed energy costs than adaptively reused ones.

Social: Keeping and reusing historic forts in Maharashtra has long-term benefits for the communities that value them and stabilizing in their lives. Adaptive reuse can restore and maintain the heritage, cultural significance of the fort, help to ensure its survival and retaining its identity. Protecting any form of heritage ensures secure future for upcoming generations by acting as valuable sources of information and preserving that precinct's lifestyle, construction technique, and architecture.

Cultural: Societies are culturally diverse and preservation of heritage plays an important role for maintaining its intrinsic value and its contribution to the identity of a place. Architecture of a place is identified through local customs and socio-cultural traditions, and its extent and nature. Various facets of tourism promote different cultures and traditions of the society, indirectly contributing to the growth of the tourism market.

Economic: Adaptive reuse is a very economically sustainable concept. The cost of new construction is less or zero when the existing structure is retained, due to demolition costs avoided and further, the proposed new activity initiates revenue generation that covers the cost of restoration or renovation. Adaptive reuse of historic buildings often costs only two-thirds of the new construction. The remaining capital can be used for supportive jobs that the building requires for its maintenance rather than erecting the new one. The old forts were built with

local and traditional materials, with traditional methodologies and skillsets; hence, local materials and labour can be utilized when restoring and readapting the old buildings. This will generate employment in local people and reduce costs, besides meeting the social cause.

Example: Parvati Temple Complex, Pune
Located on the Parvati Hills (within the old Pune, at Sahakar nagar) was originally constructed in the 18th century by Peshwas. It consists of a temple complex housing various smaller temple to may Gods. The Parvati hill has a height of 2100 feet from the sea level (at 260 feet from city level) and It has 108 steps leading to the temple, atop the hill. Entire temple complex with all individual temples are constructed out of Black Basalt Stone. The Peshwa Museum was actually built as a palace meant to live in.

It was later converted into a museum. It houses now, Nanasaheb Peshwa Samadhi**,** paintings, manuscripts, coins, clothing and a lot of other artefacts dating back to the Peshwa. The refreshment area, shoe stand and open gym are the new additions made in 1900s. Revenue generated from these avenues and other forms of donations help sustain the premises.

The Trust has undertaken the following work to preserve and develop the Parvati complex: Development of temple complex, gardens and building of a protective wall around the complex

- Renovation of Peshwa Museum and setting up of an audio-visual system
- Development of Maratha history centre on 1.12 acre of land at the foot of Parvati hill
- Development of 1.4 acre of land into community hall and jogging track
- Energy conservation measures and use of non-conventional sources of power generation like wind energy, geothermal energy, tidal energy, wind energy and solar energy
- Tree plantation and discouraging the use of plastic bags in and around the complex

Example: Jadhavgadh Fort, Jadhavwadi, Mawal, Pune

Jadhavgadh fort is a Heritage fort of approximately 31,000 sqft. area, built in 1710 in Jadhavwadi area-Mawal Taluka on the old Pune - Satara Road on the height of 2511 ft above sea level.

The Fort - a fine example of Maratha craftsmanship - was built by Pillaji Madhavrao in 1710, a Maratha General in the army of Chatrapati Shahuji.

Around 2005, it came under private ownership of Dr. Vithal Kamat, who restored the fort and made additions of Aai Museum and hotel-room accomodations in less supporting areas outside the fort – stables and livestock housing.

In 2007, the restored and renovated hospitality fort-hotel was made open to public.

It offers 3 restaurants, temperature controlled-pool, spa, banquet area, conference room, temple, guest room accommodations with varying features such as open-to-sky shower, balconies facing lake, balconies facing mountains etc.

It offers venues for destination weddings, conferences, picnics and stays.

The revenue generated helps in organizational, operational costs and maintenance of the fort and its premises.

Since past 5 years, the fort premises has become completely self-sustaining with equipment housed such as the Organic waste converter (OWC), sewage treatment plant (STP), RO-water purifying and treatment plant. Earlier they also had the vermiculture processes followed in the part of the premises as well. The manure created is used for the landscaped areas and agriculture zone of the premises.

All necessary services required for the management system of the structure are provided, such as Central Cooling / Heating, Fire fighting systems, PA systems, plumbing and drainage.

To operate all the facilities, in-house specialists, experts, skilled and semi-skilled employees are available the service at all times.

1. The Mawal area: As per the Census 2011, Mawal Taluka of Pune district has a total population of 377,559.

It has 5 landmark structures apart from the Mastani Lake, with 25 kms of proximity.

S.No.	Structures	Type	Proximity from jadhavgadh fort	Geographical Location	Prior use	Current use	Charges	In-charge authority
1	Purandhar fort	Hill-fort	21 kms	Narayanpur	Residential	trekking, camping, Training Natinal Cadet Corps	25/-	CGI
2	Sardar Purandare wada	Hill-structure	7 kms	Narayanpur	Residential	trekking, film shooting	0	CGI
3	Sangameshwar temple	Hill-structure	7.5 kms		Religious structure	Religious structure	0	CGI
4	Jejuri temple	Hill-structure	23 kms	Jejuri	Religious structure	Religious structure	0	CGI
5	Malhargad killa	Hill-fort	16 kms	Kalewadi	Watch tower	trekking, historical display	25/-	CGI

These structures having no or nominal charge which does not suffice for its upkeep and maintenance. The previous examples of adaptive reuse explained, attempts to emphasize on importance of self-sustaining buildings and employment of locals.

Particulars	Density	Male Population	Female Population	Total Population
Rural	207/sq km	1,15,137	1,04,647	2,19,784
Urban	2246/sq km	83,350	74,425	1,57,775
Total	334/ sq km	1,98,487	1,79,072	3,77,559
As per Census India 2011				
	literacy rate	77.96%	65.82%	72.20%

Rural population	2,19,784
Urban population	1,57,775
Total households	3,77,559

	Total	Male	Female
Main Workers	139,759	103,333	36,426
Cultivators	31,509	19,677	11,832
Agriculture Labourer	11,582	5,715	5,867
Household Industries	3,905	2,637	1,268
Other Workers	92,763	75,304	17,459
Marginal Workers	17,639	8,675	8,964
Non Working	220,161	86,479	133,682

https://www.censusindia.co.in/subdistrict/mawal-taluka-pune-maharashtra-4191

In Mawal Taluka out of total population, 157,398 were engaged in work activities. 88.8% of workers describe their work as Main Work (Employment or Earning more than 6 Months) while 11.2% were involved in Marginal activity providing livelihood for less than 6 months. Of 157,398 workers engaged in Main Work, 31,509 were cultivators (owner or co-owner) while 11,582 were Agricultural labourers.
Availing management principles, creating correct responsibilities and duties, training and providing employment to the semi-skilled and/or unskilled population of the mawal area can help create circular economy.

Conclusion:

Implementation of strategies and technical output:

- The Project Manager or circular economy manager appointed is expected to enhance climate change synergies across the conservation including circular economy, nature conservation, sustainable economy, organizational engagement of the Adaptive-reuse-Fort Project.

- Providing strategic oversight to ensure timely and effectively delivery of project results/outputs

• Managing the development and monitoring of workplans and budgets; working closely with the finance manager on finance reporting and budget tracking

• Manage project consultants and team members to ensure successful delivery of projects (as relevant)

• Identifying project risks to oversee risk management and monitoring and evaluation framework

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How can Circular Strategies be Implemented in Real Estate Valuation AN EXPLORATORY RESEARCH

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ABSTRACT

The construction sector, as one of the world's greatest waste generators, is responsible for a cascade of events such as global warming, climate change, and natural resource depletion. Raw materials are continuously extracted from nature, and the rate at which they can refill is insufficient to meet demand. This system suffers significant losses across the value chain (Ellen MacArthur Foundation, 2013). On the contrary, the circular economy concept proposes a circular model of 'reuse-refurbish-recycle' that focuses on reducing waste and optimising resource value retention. The strategy is ideal to adopt in a high-growth, high-waste sector like the built environment. This research was taken up because a significant gap is seen within valuation practices. The current valuation methods, although efficient, collect data and provide property valuations based on previous studies. For example, when using a comparative method of property valuation, we compare one asset with a neighbouring one, that has similar features. This process incorporates the older values already provided to this old building, without accounting for innovations such as re-usability or adaptability of the components How different would the sector be if we incorporated the value of circular interventions to the original value determined, rather than looking back at older valuation standards? Will there be a significant difference, and, more importantly, would it impact the way real estate investors viewed circularity? In conducting the research, The primary hypothesis of this study was that there is a link between circularity and valuation and that this link can be incorporated within present valuation procedures. The thesis research explains how the connections can be made, as well as specific actual instances for each. The number of possible scenarios is endless.

Keywords: Circular Economy, Circular Design Strategies, Exploratory study, Sustainability, Delphi method & Real Estate Valuation

Introduction

The current prevalent economic design has its origins in the traditionally unequal distribution of resources by geographical area, according to the Ellen MacArthur Foun- dation (2013). Since developed regions could source con- sumers as well as materials quite easily, they became the hub for inexpensive materials as compared to the cost of human labour. Hence, business models have been adapted accord- ingly, wherein the producers were extensively dependent on the use of materials but economised on human labour (Sari- atli, F.,2017). The widespread lack of recycling, reusing, and exploitation of waste is the direct byproduct of inexpen- sive materials and expensive labour. The additional lack of regulatory measures and the usage of a “lock-in inertia” is what led to what is now called the linear economy (Sariatli, F.,2017). A linear model of consumption of resources follows a 'take-make-dispose' pattern (Ellen MacArthur Foundation, 2013a; Andrews, 2015). This means that the supply chain starts with companies extracting raw materials to manufacture products and ends with a customer who buys the product and disposes of it after its usage. Less importance is given to what hap- pens before and after these stages. This implies that there is a continuous extraction of raw materials from nature, while the pace at which it can replenish is not sufficient to sustain demand. This is a system that is mainly based on usage rather than focusing on the restorative use of natural resources and encounters substantial losses along the value chain (Ellen MacArthur Foundation, 2013). When focused primarily on the construction industry, it is seen that almost a quarter of the output produced by

this in- dustry consisted of waste. This excludes the approximately 11 billion kg produced by the demolition of old buildings (Berkel et al.,2019). The construction sector's waste output was higher than in any other industry in 2016, which means that half of the overall waste production was attributed to this sector. The Netherlands alone produced more waste per inhabitant than the EU's average (Berkel et al.,2019). The World Green Building Council reports that 39 per cent of global carbon emissions are accounted for by the building and construction industry. The built environment is respon- sible for the bulk of global greenhouse gases and the pro-duction of raw materials. Environment performance in cities cannot be increased simply by replacing old buildings with new ones, since both the phases of building and operation cause substantial use of resources and energy. This is already enough of a reason to dwell on the importance of introduc-ing a circular approach within this industry, where the focus is also given to what happens at the end of the economic life-cycle of a product, how they can be reused/ recycled, rather than being disposed of as waste.

Problem Analysis

The challenges faced by the construction and built environ-ment suggests that the industry is ideally positioned to take a lead in the global campaign towards circularity and sustain-ability. The ethical and environmental reason to do so has a strong stance (Acharya, Boyd, and Finch, 2020). Real es-tate investors and building clients are important members in helping the drive towards the transition to a circular built en-vironment because they have an opportunity at all stages of a project life cycle to set the course and design of their growth plans, ownership structures, and organisational models for each project. While the market for sustainable buildings has rapidly acquired momentum primarily in the design and con- struction phases of a project, not much has been done yet by the private sector to translate this demand into the develop-ment and investment phase (Myers, G., & Reed, 2007). Most organisations are designed and deeply rooted within the linear approach to growth. Therefore, to venture into circu-larity, new business cases and revenue models need to be de-veloped, which are free from linear thinking and can give rise to circular principles. For a stakeholder to be driven to accept these additions and reforms, he needs to have substantial rea-son to do so. The driving factors that would encourage them to adopt circular principles in the real estate sector are yet to be established. While current practices show that initial investment to incorporate circular practices might be more expensive, stakeholders will not be convinced of it if they do not know the benefits of a higher residual value of a property. To focus on one stakeholder as an example, a valuer is an im-portant member of the real estate industry. If there is a need to incorporate sustainable aspects within a property valua- tion, he must know how to do so. Hence this report focused on recommendations for a valuator, based on the parameters of valuation. Additionally, it is important to grasp that to reuse a product or a service, first, a market for that product must be created. To create this market, the value of the usable materials must be known. This is where there is a gap between traditional real estate valuation practices versus the ideal scenario where we can consider circularity. The current valuation methods, although efficient, collect data and provide property valua-tions based on previous studies. For example, when using a comparative method of property valuation, we compare one asset with a neighbouring one, that has similar features. This process incorporates the older values already provided to this old building, without accounting for innovations such as re- usability or adaptability of the components. In some cases, certain older properties are valued based on traditional de-preciation, wherein eventually, the building value will be de-preciated down to a lower rate, which may consequently dis- interest any potential buyers, and make it a non-profitable investment. On the other hand, if the concepts of circularity were consid- ered, where the primary focus is to close the loop and harvest materials, rather than to demolish the building and deem it as added construction waste, then this would make real estate a more sustainable/ wholesome practice. Rather than look- ing back at older valuation standards, how different would the sector be if we incorporated the value of circular inter-ventions into the original value already calculated? Would there be a drastic difference and most importantly, would it change the way real estate investors looked at circularity? The fact that the value of the property at the end of life is expected to be higher than expected (under normal circum- stances), was already incentive enough to consider this tran-sition. To stretch the concept of circularity within the pre- existing valuation methods, it was first vital to understand them well, decipher what lacks, and then create a matrix to see how these could accommodate values of circular prin- ciples. Would these be permanent incisions, or very case-specific, or would they have no impact at all? This led to the main

research question.

a. Research Question

This was exploratory research, and the prime objective was to realise how the Real Estate sector can incorporate Circu-larity within its existing framework, specifically within the valuation of real estate properties. It is important to under- stand why this research chose to focus on addressing cur- rent valuation methods, rather than aiming at providing a new methodology. To create a new methodology, there are vari-ous parameters to be considered, in terms of EU regulations, compliance, and discussions with different boards. The focus would then incline towards aligning thoughts and arriving at a final consensus with all stakeholders, which would take a long time. Hence, to enable a smooth transition, it was eas- ier to do so in a familiar domain for valuators, to make it effective and relatable.

For that, the first step was to understand the current methods of valuation and how accepting they would be of interven-tions that enhance circularity. Simultaneously, it was essen-tial to realise why the Real Estate domain has not already shown substantial progress in terms of making the switch from a linear to a circular model. Once this was established, the next task was to create a bridge between circular prin-ciples and valuation standards, to test (via literature, inter- views, and surveys) whether circularity could be established within valuation practices or not. Based on all these parame-ters, the research arrived at the following question.

How can Circular Strategies be implemented in current Real Estate Valuation practices?

Based on this, sub-questions were addressed, which build up to help answer the primary question of the research.

What is the Circular Economy, specifically within the Built Environment?

What are the current methods of Real Estate Valuation for commercial, and office properties, and what is the link with Circularity?

What kind of stakeholders are involved in the process of Real Estate Valuation, and what role do they play in this industry?

What are the primary opportunities and barriers encoun- tered in this transition?

These questions create a much-needed storyline to finally ar- rive at the main research topic. To know the impact of circu-lar design on real estate values, there first needs to be clarity about what the circular economy is, what are its principles as well as its applicability in the built environment. The re- search then dived into a theory about the Dutch investment market, followed by methods of valuation. It was from here that parameters for valuation were extracted and analysed. At this point, a link was created between the two main themes. Since the methodology was based on interviews, it was nec-essary to explore the type of interviewees and their role in this industry. All this led to a more thorough output for the final research question.

The Oretical Framework

The central idea motivating this research was the concept of Circular Economy (CE). Before delving into the application of CE in the context of Real Estate (RE), it was critical to first grasp the theory's meaning, associated concepts, and the need for such a transformation. This chapter begins with the analysis of CE theory as a basis, followed by a brief literature assessment of its relationship to the built environment and the real estate industry. Finally, the principles are expanded upon in order to make a link with the RE Valuation parameters, which will be discussed in the second half of the theoretical background.

Definition of Circular Economy

The UN's Sustainable Development Goals (United Nations Sustainable Development, 2018) have drawn international at- tention to the circular economy. The circular economy has the potential to allow for continued economic growth while minimising environmental impact. A shift from a linear to a circular economy has been proposed as a more sustainable model that maximises resource reuse and keeps materials flowing (Advisory Board, 2017; Ellen MacArthur Founda- tion, 2013). A paradigm shift is needed to transition from a linear to a circular economy. As a result, we must reconsider how we use, manufacture, and design.

Circular Economy (CE) in the built environment is a strategy for reducing waste production and resource depletion (Circle economy, 2017). It is important to carefully plan buildings so that materials always flow in a circular pattern. When it comes to CE in the built environment, it is important to recognise not only new or soon-to-be-built buildings but also existing supplies. According to reports, 75-90 per cent of the current building supply in northern hemisphere countries was still standing in 2015 due to their long lifespan.

Fig. 1: UN's Sustainable Development Goals (sustainabledevelopment.un.org

According to reports, approximately 80% of buildings were constructed before the 1960s, implying that the structures would last at least 60-90 years (Pomponi & Moncaster, 2017). As a result, focusing solely on greenfield developments would not suffice if CE were to be realised in buildings. This is where the circular economy will influence how things have been done previously. The figure below depicts how the CE in the built environment would look like.

Fig. 2: What is the Circular Economy; "What is the Circular Economy? | Rediscovery Centre"

Circularity is an economic system that does not allow for the wastage of any materials. Products are engineered and constructed such that they are part of a value network where continuous (re-) exploitation of resources is ensured by reuse and refurbishment at the product, component, and material levels. This is the definition of Circular Economy, as per the World Economic Forum, which is something that must be strived for, in all industries.

The circular economy offers a solution in terms of a circu- lar model of 'reuse-refurbish-recycle' that focuses on reduc- ing waste and maximising resource value retention. Within a high-growth and high-waste market, such as the built envi- ronment, the concept is ideal to implement. When we focus on the built environment, circularity is more than just about the materials that constitute a building. It also tries to incor- porate an economic structure where we are more sensitive to the global environment during and after construction, as well as having a focus on a social base.

Therefore, embracing circular economy approaches within the built environment provides a significant opportunity for developers and building clients to reduce lost value sources and thereby increase the financial return from built environ- ment assets, while also taking a significant path to achieve carbon production targets (Acharya, Boyd and Finch, 2020). Circularity is accompanied by concepts or principles, that help translate theoretical definitions into practical examples. There are four broad categories of principles that were iden-tified, which helped set the basis for the further subdivision, to arrive at practical, easy-to-comprehend principles of the Circular Economy that are applied in buildings to make them more sustainable. They are elaborated on below.

Using fewer products, components, resources, and energy during design and manufacture, as well as distribution, use, and recovery, is referred to as **Narrowing**. (Konietzko, J., Bocken, N., & Hultink, E. J.,2020). Translating this to the circular built environment, the term 'narrow' refers to a building's usage of fewer resources over its lifetime. In this regard, the early design phase is crucial, because design decisions have an impact on the performance of buildings and their operations in later stages (Çetin, Sultan & De Wolf, Catherine & Bocken, Nancy.,2021).

Slowing refers to using products, components, and materials longer (Konietzko, J., Bocken, N., & Hultink, E. J.,2020). Through design and operational techniques, the slowing re- source loops approach aims to slow down resource flows by intensifying their utilisation and extending their beneficial service life (Çetin, Sultan & De Wolf, Catherine & Bocken, Nancy.,2021).

When buildings reach the end of their useful lives, the closing resource loops principle tries to reintroduce resources into the economic cycle (Çetin, Sultan & De Wolf, Cather- ine & Bocken, Nancy.,2021).

Regenerating is a type of business that manages and sup- ports natural ecosystem services while also using renew-able and nontoxic materials and running on renewable en-ergy. Regenerative architecture is regarded to be the pin-nacle of architectural sustainability, going beyond green and sustainable building ideals to provide self-sufficient, continuous flows of resources, in which human-nature co-evolutionary systems are begun based on the features of the location (Çetin, Sultan & De Wolf, Catherine & Bocken, Nancy.,2021).

Fig. 3: Principles of the Circular Economy; Çetin, Sultan & De Wolf, Catherine & Bocken, Nancy.,2021

Each of these design strategies can further be sub-categorised into 8 building principles (Copper8, 2021).

Scenarios of how each of them was applied in the research are elaborated upon below as well.

Regenerate

Increase the quantity of (sustainable) bio-based materials

Maximize the potential for high-quality reuse, if materials are appropriate for reuse due to their high quality or lack of harmful substances, for ex- ample.

Narrow

Use as little material as possible to reduce the amount of raw resources consumed.

Reduce the amount of 'new' (virgin) material used.

Slow

Design for maximum functional life.

Design for optimal use and maintenance.

Close

Design for future life cycles.

Increase the amount of recycled material while re-taining the value of products and materials that have been discharged.

Although there are different ways in which principles can be worded, the above list is a comprehensive set of circu- lar building principles that are used in one or more ways in different sustainable projects. Each of them has already been analyzed to understand how they can be measured, and are practically oriented so they can be applied directly in projects. The principles focus on most parameters of de-sign, including the usage of adequate materials, flexibility, adaptability, building harvesting, an extension of usability, and re-usability, among others.

Real Estate Valuation

The second part of the literature review emphasised Real Es-tate in the Netherlands and its valuation practices. The focus was on Dutch Commercial Markets and their methods of val-uation. Once this was clear, a description of the importance of the inclusion of Circularity in this domain was elucidated.

What is a property and the Economic Role of Valuators in Real Property Markets?

Real property is a particular economic good that differs sig- nificantly from other economic goods. To start with, Real Estate is described as a specific piece of land on the Earth's surface, as well as the semi-permanently attached items such as houses, trees, soil, and subsoil assets such as underground storage tanks (Bartke, Stephan, 2015). Real property encom-passes all the interests that are linked to the property, in addi- tion to the real estate itself. Future usage rights, lease rights, and easements are examples.

The real estate industry is heavily regulated around the world. There is almost no other good whose property rights are so well-defined and closely regulated, such as by public zoning laws. The exclusivity and singularity of a piece of land within an ecosystem (that may change over time) deter- mine its usability, which affects its economic value.

Real estate is an economic good for which given property rights exist and are implemented in most parts of the world. As a result, for property to be exchanged between individu-als, a safe 'legal environment for real estate transactions is needed. This environment can be called a property market. According to its legal framework, the real estate sector can be divided into residential, commercial, and public interests, as well as different sub-markets.

Decentralised trade characterises all these markets, particu- larly when a piece of real estate is to be used for building or cultivation rather than just as a financial investment. Further-more, since real estate necessitates long-term, large-scale in-vestments, it is not purchased (or sold) daily, especially when compared to consumer goods. As a result, we have markets where trade occurs in a relatively irregular manner. As a re-sult, neither fair expectations nor a clear market point can be found among individual buyers or sellers; in other words, as-sets are

exchanged in multiple dispersed locations rather than a single central location like a stock exchange, and this trade is characterised by complexity.

The Dutch Investment Market

When focused on the Dutch Investment Market, within conti-nental Europe, the Netherlands is the third most popular des-tination for real estate investors. There are signals that for-eign investors will continue to favour the Netherlands. The openness of the Dutch real estate market, the country's strong economy, and the fact that prices remain competitive as com- pared to neighbouring countries all contribute to this ongoing interest.

Concerning sustainable real estate, investments have been gaining traction around the world, though the rate of adop- tion varies by country. For institutional investors, the value of impact investing and Environmental and Social Gover-nance (ESG) guidelines is growing, and Dutch players are at the forefront of this trend. Global awareness of the need to reduce CO2 emissions is increasing, and businesses and organisations in the built environment in the Netherlands are working to adapt. The demands to adapt to the challenges of climate change, climate adaptation is both a challenge and an opportunity.

To make considerable progress in the investment of sustain- able buildings, however, the investment industry requires substantial financial proof, which can only be achieved by modifying the valuation technique to appropriately analyse sustainable office buildings. Evidence on the economic ben-efits of sustainable property investment is needed to persuade business practices, educate public discourse, and transform sustainable building markets, according to Lorenz (2007a). Investors need to know their estimated return on investment, expected income stream, and market value or selling price of their asset (Myers, Reed, and Robinson, 2008). All these variables influence investment decisions.

Process of Valuation

A value can be assigned to any commodity. A valuation is the result of a process that determines its value. This can be rather simple in some cases. Most consumer products, for example, do not require an expert to determine their market value because they can be utilised right away and compared. In other situations, determining value necessitates a higher level of expertise and experience. When seeking to capture the value of a property, this is the case: no two buildings are exactly the same, and benefits from property ownership or interests are often realised over extended periods.

Even though valuations have become more sophisticated, and the underlying process has vastly improved in consistency and transparency, valuation purposes and methods have re-mained largely unchanged in recent decades; a valuer still typically provides a client with a single number, often an es-timate of market value, or an opinion of value, which is pro-vided under certain circumstances or scenarios and is often a variation of the market value.

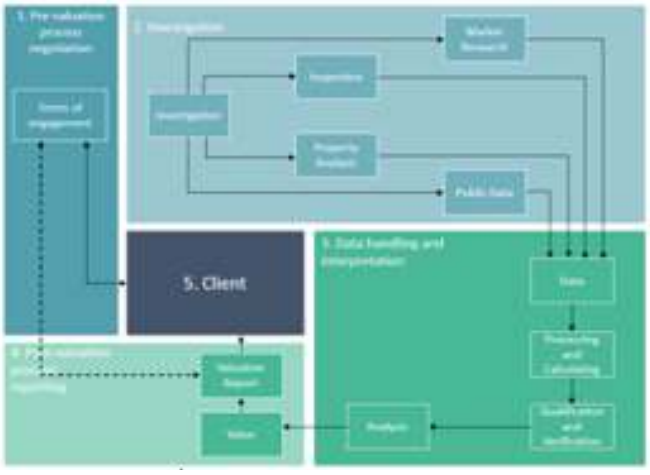

Fig. 4: Valuation process; own figure; Adapted from Scheurwater,

S. (2017). The Future of Valuations The relevance of real estate valuations for institutional investors and banks – views from a European expert group.Royal Institution of Chartered Surveyors
(RICS).

The valuation process begins when a client asks for one and ends when the value is determined and reported. The figure above depicts the many stages of the valuation process at a high level.

Parameters of Valuation

Although each method of valuation seems rigid, with no room for manoeuvre and inclusion of new elements, the key lies in extracting each valuation parameter, where the scope for interventions and broader definition could be applied. The purpose of

the research was not to suggest/alter the ex-isting methods of valuations as they have a strong basis but to broaden their scope of definition by selecting the right lo- cation to do so, which is via the parameters.

Every property valuation process is conducted based on cer-tain parameters that are analysed, which then leads to a fi-nal value for the property. These are the basis on which re- search is done, evidence is collected and finally interpreted by valuators. This indicates that the entire process is not au-tomated, but a significant weightage of a property value can be attributed to the characteristics and experience of a val- uator. He is the middleman and the one who interprets the parameters to arrive at a value.

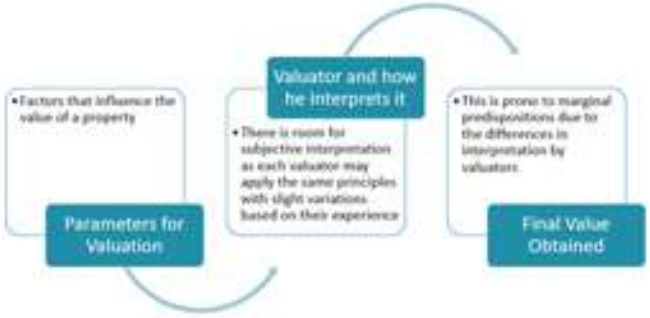

Fig. 5: Role of Valuator; own figure

Certain parameters are accounted for in all types of appraisal methods, but they may differ based on the type of appraisal done, the purpose of the appraisal, and sometimes on the ap-praiser themselves. These were important to identify because once there is an understanding of what drives the market value and on what basis is a property evaluation conducted, missing links or leeway to circular inclusions could be found. Additionally, this would provide a basis for exploring where the obstacles and opportunities to circularity lie within these parameters.

Research Method: Delphi Tech - Nique

Since in this project, the understanding of what already ex-ists played a vital role, the most appropriate way to decipher what real estate investors/valuators have to say about intro-ducing circularity was by conducting interviews and ques-tionnaires. This way, there is an understanding of what stage each company is at, along with what their interpretation of circularity is. Such interactions also enabled an evaluation of why certain methodologies have not been adopted yet or did not provide the desired output.

A data collection for decision-making among isolated, anonymous respondents is the Delphi method. The Delphi technique, named after the oracle Delphi, enlists the help of subject-matter experts (Sackman, 1975). The method aims to reach a consensus among these experts through sev- eral rounds of interviews and questionnaires (Campbell & Cantrill et al., 2001, p. 7). The RAND Corporation designed the system in the 1950s and 1960s to efficiently gather and synthesize expert opinions. It is used for future decision- making, planning, and policy analysis (Gordon & Pease, 2006). The approach is often used in cases where there is a lack of consensus or significant ambiguity (Sourani & So-hail, 2015). Furthermore, Sourani and Sohail (2015) defined this as a method for obtaining information that is expensive or even inaccessible, for dealing with complex problems, and for combining fragmented knowledge from various insights to achieve a collective understanding.

Discussion and Conclusion

This study investigated the problem of not being able to demonstrate a translation of circular interventions into a property valuation segment, and hence no influence on the final value. The findings of this study suggest that there may be a link between circular principles and property valuation characteristics. The main research question which has guided this study was: "How can Circular Strategies be implemented in Real Estate Valuation practices?"

The link between circular principles and valuations that are presented in the analysis is a first start to explore how Cir-cular Strategies be considered in Real Estate Valuation Prac-tices. Before this research, there have been methodologies and studies that reinstated the need for circular value, as well as elaborated on various circular business models that could potentially add value. The paper by the Arup and Ellen MacArthur Foundation, titled, "From Principles to Practises: Realising the Value of Circular Economy in Real Estate", was a key stepping stone to arriving at this research. The primary difference is that the paper by Arup focused on spe-cific business models of the circular economy, that when ap-plied to building practices, could have an advantage in terms of value. But the scope was limited to those selected cir-cular model strategies. In this research, the focus is on real estate valuation practices, and what the impact of circular principles would be on their fixed parameters of valuation. This provides opportunities for the expansion of different case scenarios of circularity, as once they are identified under one or

more circular strategies, the impact on the valuation parameter can be easily discovered. Below is a short descrip- tion of the findings related to each link.

While most valuators did see a potential link between most of the circular principles mentioned, the one where they still had their doubts was with respect to the link between inter- est and vacancy rates. To elucidate on one, from literature as well, the definition and the usage of interest rates for valua-tion purposes are varied. Usually, an increase in the interest rate means a drop in the property value. But fundamentally, the increase in the interest rate off late is a sign of economic growth, which means that it will lead to higher demand for spaces, and higher rents, and will then offset interest rates. Hence while the research has managed to exhibit a good ex- planation of how interest rates work, the link with circularity has not been so successful yet. Thus, as a further recommen- dation to the research, it would be valuable to align those connections in order, so that the list presented is then more complete.

With respect to the vacancy rate, it did not receive as much consent as the other parameters. But this means that there is more scope for research in terms of how vacancy rates can be positively impacted by the circular economy. According to the researcher, the vacancy rate is a prime parameter for calculating commercial properties using the income method, where the potential income of the building is assessed, to determine what the building should be valued at. A higher vacancy rate determines lower income, leading to a lower valuation of the property. On the other side, circular prin- ciples such as adaptability and maximising the number of life cycles enable the rapidly changing needs for meetings or spaces. Additionally, different tenants require different configurations, and this is where modular and re-organizable components will have an advantage, leading to shorter 'va-cant' periods between two rentals. Furthermore, there can be scenarios where tenants require flexible spaces for their mar-keting and image, for certain exhibits like 'popup shops' or 'weekly markets. Here, they would be willing to pay higher for the space, leading to a higher property valuation.

Conversely, other factors such as costs, higher rent/income, as well as time frame have managed to show connections with a few circular design strategies and received majority consent as well.
Another conclusion drawn from this research is that various companies that are involved in sustainable design are in it because they believe in the need for the transition, as well as the branding and image of the company. This is at present of higher value to them, as it has the potential to steer the econ- omy. They believe that the demand for sustainable buildings will raise its value until the industry can match up to these demands. At present, no one has visible financial incentives yet. For them, they are aware of ways in which the world is changing and advancing, and their priority is to be forerun- ners in the industry and to be prepared for the government legislation to arrive. They visualise that the future will head towards stronger sustainable principles, and they do not want to fall behind in this transition. Hence, a lot of sustainable as well as circular buildings are made to serve as prototypes for the future. Using these prototypes, financial implications can be sought, and the effect on the value of a property can have substantial proof and backing. They can view the progress live, along with issues faced, which can be addressed and serve as further information for future projects. Thus, even though there are no visible financial benefits yet, they will be available in the future, and the research enables valuators to keep a lookout for circular design strategies that can be implemented.

Additionally, when trying to realise the link between cir-cularity and valuation, we tend to forget that circularity is a component of sustainability, and if treated like that, it makes matters clearer for all stakeholders to comprehend and consider implementing. Each project or industry cannot be 100% circular yet, but it can be strongly sustainable, by ap- plying components of circularity that befit the project. This reduces the pressure and unawareness about implementing something unknown, with a modification in framing the def- initions.

With deeper introspection into the main theme and the con- clusions drawn from the analysis of each parameter, it was determined that valuation parameters can be divided into subjective and objective. Objective means data backed by substantial, tangible proof, whereas subjective considera- tions rely partially on the perspective of the individual evalu-ating the property. This was an interesting finding upon inter-acting with experienced valuators in the Netherlands. They emphasised the fact that although they try to make valuations as objective as possible, in the end, it is the signature of the valuator on the report. Hence, his

experience and expertise play a role in the evaluation process. The 'subjective' pa-rameters were verified by valuators before establishing con-nections with circular principles. The description of the links was also verified by several valuators across the Netherlands, and the validity and definitions of the circular principles were discussed and validated by Circular consultants from Cop-per8, who also have backgrounds varying from Architecture, Sustainability, and the Policy-making sector. This gives the outcome a higher weightage than it would without their opin- ions and input.

Additionally, because this report is intended for a valuator, it is important to address the implications for them. Although there are no specific skills needed to incorporate the recom-mended inclusions, it would be easier to incorporate them in practice if valuators are more susceptible to inclusions and are more accepting of them. The pattern of the focus of valuations changes slightly in terms of more elaborate dis-cussions in the subjective area. Deliberations either among themselves or with clients about how each parameter can be impacted can aid in perceiving the client's opinion of what a 'value' entails, or even what their opinion of the value is. There have been a few instances where investors purchased a circular building at a higher rate than the actual written value, only because they believed that the building had great poten-tial and would reap benefits. This higher value did not show in any financial institutions, but it will impact the way the market sees the value to be.

Although this research was intended for a valuator, the find-ings can be useful to developers as well. The same guidelines would prove beneficial for developers at the design and con-struction stage of the project since they will have some idea of the implication of circular design strategies on their trans-actional value post-construction. It can serve as an incentive for them to implement circular practices since they will now know that there are possibilities of seeing its worth. The research enabled developers with more confidence to take the risk of higher investments due to sustainable and circular practices. This research also helped in the shift from 'looking back' to older comparables and standards towards a more 'forward' outlook. The approach with which a property is valued is then more wholesome, keeping in mind the predictions for the future. This was one of the primary reasons the research was chosen because all valuators currently look back at sim- ilar, already valued properties. The current methods do not account for the changing standards and regulations that the government aims to incorporate. A live case where it came to light that looking back at comparables does not always help is with the onset of COVID-19. It shook the real estate market, and the usually high-demand commercial spaces fell vacant. This eventually reflected in the value as well, but it was not due to any analysis or comparables, but because of the unforeseen scenario. It nudged valuators to see that not all predictions can be perfect, and situations like this bring in some room for amendments.

Finally, as an 'end product' of the entire analysis and re- search, there is a short manual that has been prepared for Valuators. It briefly discusses each circular design principle, its impact on different parameters of valuation, an example of each, as well as a simple formula explaining the impact. This would serve as a quick checklist for valuators.

a. The link between Valuation parameters and Circu-lar Principles

	Calculation/ Financial Parameters					
		Interest Rate	Costs	Income	Vacancy Rate	Time Frame
Circular Principles	*Maximize the amount of sustainable bio-based materials*	Green loans (lower interest rates) allotted by banks	Higher investment costs, lower operational costs	Higher savings --> larger profit --> higher income		Longer duration of time needed to earn back investments
	Maximize the potential for high-quality reuse			Adaptability to client requirements implies lower vacancy rate , leading to more consistent income	Due to ease of adaptability to client requirements, vacancy rate is lower, leading to higher valuation	

	Design with minimum amount of materials		Lower costs due to lower materials to be purchased			
	Minimize the amount of new (virgin) materials	High interest rates lead to lesser amount of components.	Helps investor mitigate risks related to increasing costs of traditional materials (due to scarcity)			
	Design for maximum functional lifetime		Higher investment, but lower costs due to reduced need for relocation, renovation and repairs		Due to ease of adaptability to client requirements, vacancy rate is lower, leading to higher valuation	
	Design for optimum management and maintenance		Higher investment, but lower costs due to reduced need for relocation, renovation and repairs	Adaptability to client requirements implies lower vacancy rate , leading to more consistent income	Due to ease of adaptability to client requirements, vacancy rate is lower, leading to higher valuation	
	Design for multiple lifecycles		Higher investment, but lower costs due to reduced need for relocation, renovation and repairs	Design and usage for longer duration ensures steady income for a long period of time	Due to ease of adaptability to client requirements, vacancy rate is lower, leading to higher valuation	The time frame for valuation cash flows can be longer for adaptable structures. Hence , the influence of sustainable decisions can be visible
	Maximize the amount of reused materials	High interest rates lead to lesser amount of components.	Lower costs due to lower materials to be purchased			
To what extent is it agreed upon?		3,904761905	4,19047619	4,047619048	3,857142857	4,095238095

Fig. 6: Matrix describing how Circular Principles can have an impact on Valuation Parameters

I. Limitations and Recommendations

It should be noted that, as a relatively new concept, the circu-lar economy has a variety of definitions and interpretations. This can make it ambiguous for the user and lead to uncer-tainty about what the true principles of the circular economy are. The definition of the circular economy, as well as the principles that will be studied, has been elaborated in the theoretical background for this research. They encompass the practical domain of how Circular principles are used in real projects. This study investigates how valuators can evaluate circular design techniques given their present set of already existing parameters. Because the interpretation of valuators is so im- portant, the recommendations investigated may not be car- ried out in the same way as the researcher intended. As this is an exploratory study, the linkages offered are merely sug- gestions that the valuator can follow or use as a starting point for additional research in the field of circular values. The examples and scenarios provided are not intended to be fol-lowed exactly as written, but rather to help valuators, devel- opers, and investors familiarise themselves with the Circular economy and see the potential for a change in value. Concerning further recommendations, it might be worth-while to investigate creating a refined framework of all the strategies elaborated on, and then conduct action-based re-search to back up the solutions presented here. This study was an exploration, and while the suggested solutions have been validated by experts, putting them into practice requires additional layers before they are concretized. As a result, val-uators can begin by looking at case studies of circular build-ings to see how circular principles will affect their value re- ports. A strong recommendation would be to do a thorough inves-tigation into the government's circularity policies and their consequences for value and then make recommendations to them. The study uncovered several intriguing proposals for the government to implement sustainability rules. It would stimulate faster change dynamics if those were communi- cated to municipal bodies. Strict government regulations governing stakeholder recommendations in all sectors can aid in the adoption of the circular economy.

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BOOK REVIEW
'The Art & Science of Effective Mediation'
Alternate Dispute Resolution - ADR

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Mediation has been a part of conflict resolution in human relations since time immemorial and has evolved with civilizations. Mediation, as an ADR (Alternate Dispute Resolution) tool, is increasingly popular and widely used, even though the practice varies from one country to another mainly due to the cultural and legal differences existing in each jurisdiction. The process of mediation empowers self-determination while enabling the disputing parties an exceptional insight to each other's viewpoints. It is cost-effective, confidential, voluntary and less time-consuming as compared to other dispute resolution processes.

The authors, Dr. Farida Virani (India) & Mr. Ashraf Ramji (USA) draw on their decade and a half of work in mediation training, practice, research and assessment to present a comprehensive account of what it takes to be an effective mediator. The Art and Science of Effective Mediation' offers an overview of the field of mediation by acknowledging that it is both a "science" (the theory) and an "art" (the practice). The book under review is divided into 16 chapters besides preface, appendices, and references.

The absorbing insights in this book include:

- An outline of the dispute resolution landscape in addition to the principles, phases and different styles of mediation.

- A new and clearer presentation of the theory and practices providing a mediator's toolkit (questioning techniques, reading non-verbal body language, etc.), clarifying the various nuances and concepts of negotiation and revealing the use of subtle techniques of influence and persuasion during the mediation process.

- A persuasive insight into research-based techniques on managing emotions, understanding the different frames (cognitive shortcuts) and learning the art of reframing in mediation.

- A vivid picture of the various biases experienced during mediation and how to minimize them while also drawing upon the immense potential of apology and forgiveness in the mediation process.

- A deeper dive in mediation through the prism of diversity, pluralism and cultural competence, while also understanding why some mediation fail or 'impasse' (deadlocks) occur (functional, emotional and process) and the strategies to deal with them along with some tips on how to reflect upon and learn from them. Ethics plays an important role in mediation. It works as a trust factor on which both the parties to a dispute rely. The concept of Mediator Ethics is discussed in this context.

- A comprehensive personal guide on how to increase authentic gravitas invaluable for a mediator's success. The essentials of conducting successful online (virtual) mediation to help mediators align themselves with the changing times.

The book is comprehensive, all-inclusive with references to the latest research findings and will be a treasure trove for amateurs just beginning their mediation careers as well as seasoned mediators who wish to sharpen their skills. The book can be successfully used for self-instruction and as a training manual for students, HR professionals and business leaders.

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MET INSTITUTE OF MANAGEMENT

Call for Papers for Student Journal of MET Institute of Management "Indian Management Review" with ISSN

We invite good quality research papers from post graduate students on theme of **"Emerging Trends in Business Management" covering various functional areas such as Marketing, Finance, Human Resource Management, Operation, etc. as per the following guidelines.**

- The abstract should contain the full title of the paper, the Name of the author (s), and their institution name.
- The abstract should not exceed 400 words with 3 to 5 keywords.
- The manuscript should be in MS word format in Times New Roman, Font Size 12-point.
- A-4 size paper with 1-inch line spacing, and within 3000 words.
- APA citation style should be used for referencing.
- The papers should be related to the main theme.
- The format of the paper can be downloaded from http://bit.ly/3wld48C

The full Paper can be submitted on research_iom@met.edu

Eligibility

The author needs to be a Post Graduate Student of Commerce, Management & Social Sciences.

Following are the suggested Themes

General Management	Micro, Small and Medium Enterprises
Technology, System, Quality or Operation	Insurance, Banking and Finance
E-Commerce	Innovation in Business Management
Domestic, Trade and Global Trade	Environment and Ecological Management
Marketing and Advertisement Management	Human Resource Management
Corporate Social Responsibility	Marketing Management

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