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DISSERTATION

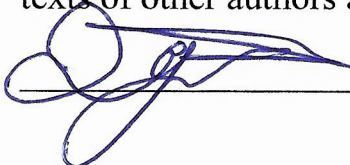
**GLOBAL WASTE MANAGEMENT AND
CORPORATE SOCIAL RESPONSIBILITY**

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The dissertation contains the results of my own research. The use of ideas, results, and texts of other authors are linked to the corresponding source.

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АНОТАЦІЯ

Ігор РІВІЛІС. Глобальне управління відходами та корпоративна соціальна відповідальність. – Кваліфікаційна наукова праця на правах рукопису.

Дисертація на здобуття ступеня доктора філософії за спеціальністю 073 «Менеджмент». – Західноукраїнський національний університет, Тернопіль, 2024.

У дисертації запропоновано нове вирішення важливого науково-прикладного завдання – обґрунтування теоретичних засад управління відходами та формування соціальної корпоративної відповідальності в контексті розробки прикладної моделі реалізації екологічних й стратегічних пріоритетів бізнесу.

В кваліфікаційній роботі досліджено генезис теоретичних підходів до вивчення концепції поводження з відходами, зокрема результати дослідження показали, що послуги з поводження з відходами є ключовими послугами в системі, які повинні бути доступні в усіх громадах. Досліджено, що відходи можуть проявлятися в різних формах, і їх класифікація може мати різні виміри. Як результат, для класифікації відходів використано декілька типових ознак, таких як їх фізичний стан, властивості, можливість повторного використання, здатність до біологічного розкладання, походження та масштаб впливу на навколишнє середовище. Зазначено, що теорія управління відходами пропонує концептуальну основу для розуміння практики поводження з відходами, визначення ключових концепцій і напрацювання методології ефективного поводження з відходами. Встановлено, що стале управління відходами значною мірою залежить від визначення і класифікації «відходів», які тісно пов'язане з діяльністю та способом життя людини. Акцентовано, що стратегії управління відходами спрямовані на запобігання утворенню відходів, адже найкращою альтернативою їх утилізації є запобігання їх утворенню. Встановлено, що представницькі стратегії охоплюють екологічно свідомі методи виробництва, такі як використання менш небезпечних матеріалів, впровадження сучасних

систем для моніторингу зберігання небезпечних матеріалів і впровадження інноваційних методів хімічної нейтралізації та збереження води.

В дисертації проведено теоретичну ідентифікацію теорій корпоративної соціальної відповідальності. Адаптовано піраміду корпоративної соціальної відповідальності Керролла до сучасних інфраструктурних умов соціальної відповідальності компанії щодо її взаємодії в глобальному вимірі. Охарактеризовано основні властивості та характеристики теорій КСВ, зазначено, що фірма має моральний обов'язок досягати соціальних та екологічних цілей на додаток до фінансової вигоди. Саме тому, інтереси стейкхолдерів повинні бути враховані в програмах корпоративної соціальної відповідальності, а використання теорії стейкхолдерів потребує прозорості в усіх бізнес-процесах.

Наголошено, що операційна практика бізнесу може мати негативні наслідки як для природного середовища, так і для здоров'я та добробуту людей, який не обмежується працівниками, а поширюється на місцеві громади та суспільство в цілому. Досліджено, що створення комплексної системи управління екологічною безпекою дозволяє підприємствам використовувати синергетичні переваги всіх її компонентів, таким чином оптимізуючи використання життєво важливих матеріалів і організаційних ресурсів. Запровадження такої системи в бізнесі глибоко впливає на економічні, соціальні та екологічні аспекти. Як результат, такий комплексний підхід передбачає дотримання виробничих стандартів, трудових норм, протоколів поводження з викидами та відходами, реалізацію ініціатив щодо збереження ресурсів. Підсумовано, щоб гарантувати життєздатність у довгостроковій перспективі, підприємства повинні надавати пріоритет екологічному захисту, ефективності використання ресурсів і суспільному благополуччю, особливо власній робочій силі.

В роботі досліджено концепцію екологічного менеджменту в системі поводження з відходами шляхом аналізу системи екологічного менеджменту; обґрунтування переваг впровадження екологічного менеджменту; розробку інструментів екологічного менеджменту. Наголошено, що впровадження

стратегій корпоративної соціальної відповідальності може дозволити організаціям зміцнити свою репутацію, соціальну значимість і довгострокову стійкість. Крім того, підтверджено, що ключова роль управління навколишнім середовищем полягає в покращенні фізичних, соціальних та економічних аспектів підприємства чи проєкту. Встановлено, що сфера управління навколишнім середовищем охоплює соціально-економічні, політичні та наукові аспекти, зосереджуючись на розробці рішень реальних проблем, пов'язаних із видобутком ресурсів, утворенням відходів та взаємодією людини з природою. Як результат, управління навколишнім середовищем фокусується на вирішенні фундаментальної проблеми – прогресу технології та мінімізації її впливу на природне середовище.

В кваліфікаційній роботі проаналізовано управління відходами в системі циркулярної трансформації, що дозволило окреслити рівні циркулярності, розробити варіанти співпраці муніципалітетів у сфері збору відходів та концепцію переходу від лінійного управління відходами до концепції циркулярного управління ресурсами. Встановлено, що сектор переробки перетворився на глобальне підприємство, що охоплює міжнародні ринки та заплутані мережі постачання і транспортування. Проте необхідно визнати ключову роль неофіційних збирачів сміття, в країнах із низьким і середнім рівнем доходу, у сфері поводження з відходами. Досліджено, що неформальний сектор відіграє вирішальну роль в управлінні відходами громад, зустрічається з особливими проблемами та потребує урядової підтримки.

Доведено, що управління твердими відходами є серйозною проблемою як у розвинених країнах, так і в країнах, що розвиваються. Швидка урбанізація створює тиск на муніципалітети, щодо відповідального поводження з відходами, враховуючи соціальні та екологічні наслідки. Розробка ефективних стратегій управління відходами залежить від розуміння місцевих характеристик відходів, на які впливають культурні, кліматичні, соціально-економічні фактори та інституційні можливості. Встановлено, що тенденції управління відходами мають регіональний характер. Розвинені країни зазвичай здійснюють офіційний

нагляд за відходами на муніципальному чи регіональному рівні через більші обсяги їх утворення, а менш розвинуті країни де обсяг утворення відходів є меншим і здебільшого органічним, навпаки, залучають до управління відходами офіційних і неформальних учасників.

Зауважено, що проводячи політичні реформи, пропонуючи фінансову підтримку та формуючи громадський дискурс, уряди мають потенціал для створення сприятливого середовища для широкого впровадження безвідходних систем. Головним кроком до досягнення цієї мети є мобілізація глобальної мережі однодумців і визначення пріоритетів відповідальної політики поводження з відходами. Основні напрямки повинні включати забезпечення як міжнародного, так і місцевого фінансування систем безвідходного виробництва, розробку комплексних дорожніх карт і нормативно-правової бази для сприяння їх реалізації, а також інтеграцію цілей безвідходного використання в місцеві та національні кліматичні стратегії, такі як ініціативи щодо зменшення викидів метану.

Зауважено, що екологічні зусилля варто спрямувати не лише на управління відходами, а й на стимулювання системних перетворень у різних галузях, сприяння співпраці для обміну ідеями, тематичними дослідженнями, продуктами та матеріалами, що стосуються принципів циркулярної економіки. З точки зору суспільних очікувань, для компанії вкрай важливо визначити пріоритети своїх зусиль у визначенні та задоволенні соціальних потреб суспільства. Аналізуючи бізнес-операції, варто відзначити, що соціально відповідальні компанії надають пріоритет розвитку своїх співробітників, спрямовуючи на це близько 10% своїх ресурсів. Як результат, досягнення цілей сталого розвитку може забезпечити значні економічні вигоди для компаній, які інвестують у розробку інноваційних рішень і трансформаційних змін.

В дисертації проаналізовано рівень викидів в умовах глобальної транснаціоналізації. Обґрунтовано, що виконанню корпоративної відповідальності у сфері поводження з відходами часто перешкоджають регуляторні бар'єри та відсутність стандартизованих методів управління

відходами. Складнощі для компаній, які прагнуть підтримувати відповідальність і послідовність у своїй діяльності створюють регіональні відмінності в правилах та стандартах. Наголошено, що технологічний прогрес відіграв вирішальну роль у зміцненні практик сталого поводження з відходами. Як результат, компанії можуть використовувати такі технології, як «розумні» контейнери для ефективного збирання сміття, а також передові методи переробки, щоб покращити процеси управління відходами та зменшити вплив на навколишнє середовище. Доведено, що споживачі все більше усвідомлюють екологічні наслідки своїх рішень про покупку та активно шукають компанії, які надають пріоритет екологічним методам утилізації відходів. Ця зростаюча тенденція спонукає компанії бути прозорими щодо своїх ініціатив поводження з відходами та активно брати участь у екологічно відповідальних практиках.

В кваліфікаційній роботі розроблено модель управління відходами в системі корпоративної соціальної відповідальності, яка базується на способах реалізації екологічного менеджменту та напрямках корпоративної соціальної відповідальності; включає інструменти вдосконалення системи управління відходами; враховує підходи до процесу розвитку КСВ як стратегії управління; визначає складові стратегії реалізації корпоративної соціальної відповідальності та напрями КСВ в умовах кризи. В роботі зауважено, що підприємства можуть інтегрувати різні стратегії управління відходами, щоб створити найбільш ефективну систему управління відходами. У той час як економічна ефективність є основним критерієм, ефективні стратегії управління відходами охоплюють зменшення, повторне використання та переробку. Переробка особливо ефективна для утилізації неорганічних відходів, таких як пластик, скло та метали.

Встановлено, що у сучасному бізнес-ландшафті надійна система управління відходами стає все більш важливою, адже із зростанням населення світу та зростанням попиту на продукти та послуги, підприємства утворюють більшу кількість небезпечних та безпечних відходів. Обґрунтовано, що прийняття стратегії сталого управління відходами є життєво важливим для пом'якшення несприятливого впливу на навколишнє середовище, підвищення

ефективності роботи та зниження витрат. Доведено, що створення ефективної системи управління відходами потребує оцінку поточних процедур поводження з відходами, зокрема типів і кількості утворених відходів, а також застосовуваних методів обробки. Крім того, важливо розробити план поводження з відходами, який окреслює цілі, задачі та тактику, необхідні для успішного управління відходами.

Встановлено, що дослідження систем управління відходами актуалізує впровадження нових технологій. Так, застосування технології блокчейн для управління відходами представляє інноваційний підхід до вирішення проблем екологічної стійкості та підзвітності в сучасному світі. Блокчейн має потенціал для революції в управлінні відходами, впроваджуючи маркери цифрових активів, наприклад маркери безпеки, які пов'язуються з відходами в розумних містах для їх відстеження. Ці токени відіграють важливу роль у моніторингу перероблених відходів і значною мірою допомагають урядовим установам скорочувати витрати на управління відходами при оптимізації бізнес-процесів.

Зауважено, що перед ефективним впровадженням соціальних ініціатив будь-яка організація повинна мати чітку стратегію корпоративної соціальної відповідальності, яка може допомогти їй досягти основних цілей на ринку. Так, правильно реалізована стратегія корпоративної соціальної відповідальності може підвищити репутацію будь-якої компанії та сприяти зміцненню зв'язків із суспільством. Обґрунтовано, що впровадження стратегії корпоративної соціальної відповідальності в діяльність організації може бути більш ефективним з використанням штучного інтелекту. ШІ може допомогти компаніям відстежувати та звітувати про ефективність корпоративної соціальної відповідальності, а також виявляти та усувати будь-які прогалини та ризики. Доведено, що ШІ відіграв вирішальну роль в оптимізації процедур утилізації відходів, дозволяючи організаціям мінімізувати утворення відходів і посилити роботу з переробки.

З метою ефективного аналізу та контролю показників соціального забезпечення, а також раціонального та цільового використання коштів

соціального страхування рекомендовано здавати управлінський облік до центру відповідальності. Аргументовано, що успішне впровадження екологічно відповідальних практик транснаціональними компаніями веде до підвищення стійкості бізнесу шляхом покращення відносин із зацікавленими сторонами, зменшення екологічних ризиків і підвищення конкурентоспроможності продукції.

Доведено, щоб підвищити ефективність екологічно свідомих практик у рамках корпоративної соціальної відповідальності, потрібно: інтегрувати екологічні принципи в систему стратегічного управління, створити спеціальну команду менеджерів для реалізації екологічних ініціатив, провести регулярний екологічний аудит з умовою забезпечення пріоритетності бізнес-інтересів в цих проектах. Крім того, розробка моделі поводження з відходами в системі корпоративної соціальної відповідальності допомагає компаніям ефективно та відповідально досягати своїх цілей.

Ключові слова: управління відходами, інновації, зелені технології, бізнес-модель, використання та споживання ресурсів, ієрархія відходів, корпоративна соціальна відповідальність, соціальні ініціативи, екологія і довкілля, екологічний менеджмент, екологічна безпека, забруднення, антикризове управління, циркулярна економіка, сталий розвиток.

ANNOTATION

Igor RIVILIS. Global waste management and corporate social responsibility. – Qualifying thesis manuscript copyright.

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The dissertation offers a new solution to an important scientific and applied task – substantiating the theoretical foundations of waste management and the formation of social corporate responsibility in the context of developing an applied model for implementing environmental and strategic business priorities.

In the qualifying work, the genesis of theoretical approaches to the study of the concept of waste management was investigated, in particular, the research results showed that waste management services are key services in the system that should be available in all communities. It has been studied that waste can manifest itself in different forms, and its classification can have different dimensions. As a result, several typical features are used to classify waste, such as its physical state, properties, reusability, biodegradability, origin and extent of environmental impact. It is noted that the theory of waste management offers a conceptual basis for understanding the practice of waste management, defining key concepts and developing a methodology for effective waste management. It has been established that sustainable waste management largely depends on the definition and classification of “waste”, which is closely related to human activity and lifestyle. It is emphasized that waste management strategies are aimed at preventing the generation of waste, because the best alternative to its disposal is to prevent its generation. Representative strategies were found to include environmentally conscious production methods, such as the use of less hazardous materials, the implementation of modern systems for monitoring the storage of hazardous materials, and the implementation of innovative methods of chemical neutralization and water conservation.

In the dissertation, a theoretical identification of theories of corporate social responsibility is carried out. Carroll's pyramid of corporate social responsibility has been adapted to modern infrastructural conditions of the company's social

responsibility regarding its interaction in the global dimension. The main properties and characteristics of CSR theories are characterized, it is stated that the firm has a moral obligation to achieve social and environmental goals in addition to financial benefit. That is why the interests of stakeholders must be taken into account in corporate social responsibility programs, and the use of stakeholder theory requires transparency in all business processes.

It is emphasized that business operating practices can have negative consequences for both the natural environment and the health and well-being of people, which is not limited to employees, but extends to local communities and society as a whole. It has been studied that the creation of a comprehensive environmental safety management system allows enterprises to use the synergistic advantages of all its components, thus optimizing the use of vital materials and organizational resources. The introduction of such a system in business has a profound effect on economic, social and environmental aspects. As a result, such a comprehensive approach involves compliance with production standards, labor standards, emission and waste management protocols, implementation of resource conservation initiatives. In summary, to ensure long-term viability, businesses must prioritize environmental protection, resource efficiency and social well-being, especially for their own workforce.

The paper examines the concept of environmental management in the waste management system by analyzing the environmental management system; substantiating the benefits of implementing environmental management; development of environmental management tools. It is emphasized that the implementation of corporate social responsibility strategies can allow organizations to strengthen their reputation, social significance and long-term sustainability. In addition, it has been confirmed that the key role of environmental management is to improve the physical, social and economic aspects of an enterprise or project. It has been established that the field of environmental management covers socio-economic, political and scientific aspects, focusing on the development of solutions to real problems related to resource extraction, waste generation and human interaction with nature. As a result,

environmental management focuses on solving the fundamental problem of advancing technology and minimizing its impact on the natural environment.

The qualification work analyzed waste management in the system of circular transformation, which made it possible to outline the levels of circularity, develop options for cooperation of municipalities in the field of waste collection and the concept of transition from linear waste management to the concept of circular resource management. It has been established that the processing sector has evolved into a global enterprise spanning international markets and complex supply and transportation networks. However, the key role of informal waste collectors in low- and middle-income countries in waste management needs to be recognized. It has been studied that the informal sector plays a crucial role in community waste management, faces special challenges and needs government support.

Solid waste management has been proven to be a serious problem in both developed and developing countries. Rapid urbanization puts pressure on municipalities to manage waste responsibly, taking into account the social and environmental consequences. The development of effective waste management strategies depends on an understanding of local waste characteristics, which are influenced by cultural, climatic, socio-economic factors and institutional capacity. It has been established that waste management trends are of a regional nature. Developed countries usually carry out official supervision of waste at the municipal or regional level due to larger volumes of waste generation, and less developed countries where the volume of waste generation is low and mostly organic, on the contrary, involve official and informal participants in waste management.

It is noted that by implementing policy reforms, offering financial support and shaping public discourse, governments have the potential to create an enabling environment for the widespread adoption of zero-waste systems. Mobilizing a global network of like-minded people and prioritizing responsible waste management policies is a key step towards achieving this goal. Key areas should include securing both international and local funding for zero-waste production systems, developing comprehensive roadmaps and regulatory frameworks to facilitate their implementation,

and integrating zero-waste goals into local and national climate strategies, such as initiatives to reduce methane emissions.

It was noted that environmental efforts should be directed not only to waste management, but also to stimulating systemic transformations in various sectors, promoting cooperation for the exchange of ideas, case studies, products and materials related to the principles of the circular economy. From the perspective of societal expectations, it is imperative for a company to prioritize its efforts in identifying and meeting the social needs of society. Analyzing business operations, it is worth noting that socially responsible companies give priority to the development of their employees, directing about 10% of their resources to it. As a result, achieving the Sustainable Development Goals can provide significant economic benefits for companies that invest in the development of innovative solutions and transformational change.

The dissertation analyzes the level of emissions in the conditions of global transnationalization. It is substantiated that the fulfillment of corporate responsibility in the field of waste management is often hindered by regulatory barriers and the lack of standardized waste management methods. Regional differences in regulations and standards create challenges for companies seeking to maintain accountability and consistency in their operations. It is emphasized that technological progress has played a crucial role in strengthening sustainable waste management practices. As a result, companies can use technologies such as “smart” containers for efficient waste collection, as well as advanced recycling methods to improve waste management processes and reduce environmental impact. It has been proven that consumers are increasingly aware of the environmental consequences of their purchasing decisions and actively seek out companies that prioritize environmentally friendly waste disposal methods. This growing trend encourages companies to be transparent about their waste management initiatives and actively engage in environmentally responsible practices.

The qualification work developed a model of waste management in the system of corporate social responsibility, which is based on the methods of implementing environmental management and directions of corporate social responsibility; includes

tools for improving the waste management system; takes into account approaches to the CSR development process as a management strategy; determines the components of corporate social responsibility implementation strategies and CSR directions in crisis conditions. The paper notes that enterprises can integrate different waste management strategies to create the most effective waste management system. While cost-effectiveness is the primary criterion, effective waste management strategies encompass reduce, reuse and recycling. Recycling is particularly effective for disposing of inorganic waste such as plastic, glass and metals.

It has been established that in today's business landscape, a reliable waste management system is becoming increasingly important, because with the growth of the world's population and the increase in demand for products and services, businesses generate more hazardous and non-hazardous waste. It is well established that adopting a sustainable waste management strategy is vital to mitigating adverse environmental impacts, improving operational efficiency and reducing costs. It has been proven that the creation of an effective waste management system requires an assessment of current waste management procedures, in particular the types and amounts of waste generated, as well as the applied treatment methods. In addition, it is important to develop a waste management plan that outlines the goals, objectives and tactics required for successful waste management.

It has been established that the study of waste management systems actualizes the introduction of new technologies. Thus, the application of blockchain technology for waste management represents an innovative approach to solving the problems of environmental sustainability and accountability in the modern world. Blockchain has the potential to revolutionize waste management by introducing digital asset tokens, such as security tokens linked to waste in smart cities to track it. These tokens play an important role in monitoring recycled waste and greatly help government agencies reduce waste management costs while optimizing business processes.

It is noted that before the effective implementation of social initiatives, any organization must have a clear corporate social responsibility strategy that can help it achieve its main goals in the market. So, a correctly implemented strategy of corporate

social responsibility can increase the reputation of any company and contribute to strengthening ties with society. It is substantiated that the implementation of the strategy of corporate social responsibility in the activities of the organization can be more effective with the use of artificial intelligence. AI can help companies track and report on CSR performance, and identify and address any gaps and risks. AI has been proven to play a critical role in optimizing waste disposal procedures, enabling organizations to minimize waste generation and increase recycling efforts.

For the purpose of effective analysis and control of social security indicators, as well as rational and targeted use of social insurance funds, it is recommended to submit management accounting to the responsibility center. It is argued that the successful implementation of environmentally responsible practices by multinational companies leads to increased business sustainability by improving relations with stakeholders, reducing environmental risks and increasing product competitiveness.

It has been proven that in order to increase the effectiveness of environmentally conscious practices within the framework of corporate social responsibility, it is necessary to: integrate environmental principles into the strategic management system, create a special team of managers to implement environmental initiatives, conduct regular environmental audits with the condition of ensuring the priority of business interests in these projects. In addition, the development of a model of waste management in the system of corporate social responsibility helps companies to effectively and responsibly achieve their goals.

Key words: waste management, innovations, green technologies, business model, resource use and consumption, waste hierarchy, corporate social responsibility, social initiatives, ecology and environment, environmental management, environmental safety, pollution, crisis management, circular economy, sustainable development.

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INTRODUCTION

Actuality of theme. The social responsibility behaviour of individuals, businesses, and governments is the defining characteristic of normal functioning of social relations and a prerequisite for sustainable development of a country. Currently, unresolved issues of rational nature management and environmentalization of domestic industrial production, reduction of material intensity of domestic products, and stabilization of resource provision of production are observed. As a result, there is a decrease in the number of domestic enterprises, deterioration of the environmental state of production, accompanied by a significant level of environmental pollution, negatively affecting the deterioration of the nation's health. At the business level, the healthcare crisis has made it possible to introduce the practice of corporate social responsibility, which has prompted the adaptation of business strategies, thus contributing to the mitigation of social and environmental problems.

In times of crisis, socio-economic processes become unstable, social risks increase, and intensify and deepen. It is important to ensure a balance of social processes through the coordination of the interests of economic entities and society, the balancing of social proportions, and the achievement of defined priorities in order to prevent the accumulation of social distortions. In this aspect, the issue of social responsibility of economic entities through the formation of a favourable business environment becomes particularly important. As a result, the study of the process of corporate social responsibility as a tool of international corporate management in times of crisis is relevant today. The current waste disposal process is linked to rising operational expenses, which include the costs associated with waste collection, transportation, and processing. The primary factors contributing to these high costs are fuel prices, labor costs, and maintenance expenses. Consequently, the waste management process operates under intricate and unstable conditions, which is evident in waste disposal, recycling, and environmental protection. Ineffective waste management, ranging from inadequate waste collection systems to inefficient waste disposal methods, results in pollution of the air, water, and soil. Open and unsanitary landfills further contribute to the contamination of drinking water, leading to infections

and the spread of diseases. This issue is particularly relevant for developing and low-income countries. The accumulation and dispersal of waste pollute ecosystems, while hazardous substances from electronic waste or industrial waste pose risks to the health of urban residents and the environment.

This problem actualizes the problem of global waste management and corporate social responsibility and requires the development of integrated solid waste management systems.

Analysis of recent research and publications. Waste management issues within the framework of social corporate responsibility are being investigated by several scholars. It has been discovered by researchers that handling solid household waste poses a significant challenge to society, resulting in local issues with global repercussions, such as poor management potentially hastening detrimental environmental and socio-economic problems. Conversely, solid waste management strategies represent positive practices that contribute positively to the attainment of sustainable development objectives. Key problems in organic waste management have been pinpointed by researchers, who have argued that incentivizing and paying more attention to waste are effective methods for addressing the issue, with waste disposal fees, environmental conduct, and obligations impacting consumer and household choices.

The concept of corporate social responsibility (CSR) emerged towards the end of the 20th century and is currently in the process of gaining acceptance. In various advanced frameworks, the term social responsibility is being substituted with alternative definitions, such as "corporate social activity" and "business ethics." The responsibility of a businessperson entails implementing policies, making decisions, and adopting a course of action that aligns with society's objectives and values. Public responsibility is recognized as one of the eight crucial factors for attaining business objectives. Business social responsibility involves adhering to the economic, legal, ethical, and philanthropic expectations set forth by society during this era.

Separate issues of waste management and social corporate responsibility, including in the context of environmental management and investment activities, are

highlighted in the works of a number of scientists, in particular: R. Anjum, H. Bowen, A. Carroll, B. Chen, Yu. Danko, O. Dluhopolskyi, P. Drucker, M. Friedman, N. Goyal, N. Horbal, Sh. Khan, S. Kharola, A. Krysovaty, C. Liu, E. Lopez-Maldonado, S. Mangla, G. Monastyrskyi, F. Munshi, J. Qin, D. Pant, M. Ram, S. Raza, M. Tanvir, L. Villarreal-Gomez, M. Umar, K. Wang, C. Xu, S. Yakubovskyi, M. Zhyvko, I. Zvarych, R. Zvarych.

At the same time, the mentioned studies and publications do not sufficiently reveal the process of waste management in the environmental management system, which determines the relevance of this scientific study.

Connection of research with scientific programs, plans, topics. The dissertation is a component of scientific research of the West Ukrainian National University, in particular: fundamental state budget funding researches “National concept of eco-security of society and inclusion of the circular economy in the conditions of the pandemic” (state registration number 0121U109485); “Concept of recovery and green reconstruction of Ukraine” (state registration number 0124U000003); implementation of the international project (Erasmus+ Module Jean Monnet) “European inclusive circular economy: post-war and post-pandemic module for Ukraine (EICEPPMU)” 2022-2024, registration number 101085640); business funding research on the topic “Transformation of business in conditions of sustainable development of the global economy” (Contract No. MEV-33-2023 dated 05/10/2023); business funding research on the topic “Scientific and professional consulting of the enterprise on issues of social responsibility and organization of recycling” (Contract No. MEV-81-2021 dated 01/10/2021); business funding research on the topic “Formation of the company’s ecological brand in foreign markets” (Contract No. MEV-37-2024 dated 25/04/2024).

The purpose and objectives of the research. The purpose of the dissertation is the scientific substantiation of the theoretical concepts of waste management and the formation of social corporate responsibility in the context of the development the applied model for the implementation the environmental strategic priorities of business.

Based on the purpose of the research, the following objectives are set in the research:

- to research the genesis of theoretical approaches to research waste management concept;
- to define theoretical identification the corporate social responsibility theories;
- to research the concept of environmental management in the system of waste management;
- to analyse the waste management in the system of circular transformation;
- to evaluate the features of corporate social responsibility under instability;
- to analyse the level of emissions under global transnationalization;
- to propose the key areas of waste management system improvement;
- to define the ways of implementation of corporate social responsibility management strategy;
- to elaborate the model of waste management in the system of corporate social responsibility.

The object of research is a process of waste management and corporate social responsibility.

The subject of research is a set of theoretical and applied aspects that determine the process of waste management in terms of corporate social responsibility.

Methods of research. To achieve the defined purpose, the dissertation thesis used a set of research methods (theoretical, historical, empirical, and others), the unity of which made it possible to fulfil all the outlined tasks. The following methods are used in the dissertation: the method of theoretical generalization – for generalizing the genesis of theoretical approaches to research waste management concept; the historical method for defining theoretical identification the corporate social responsibility theories; the method of dialectical cognition – to research the concept of environmental management in the system of waste management; the method of analogies and comparative analysis – to analyse the waste management in the system of circular transformation; methods of induction and deduction – for formulating hypotheses, their

verification, generalization of results and substantiation of conclusions; methods of analysis, synthesis and data processing – to evaluate the features of corporate social responsibility under instability; monitoring method – to analyse the level of emissions under global transnationalization; method of visualization of data, main provisions and research results.

The informative and factual basis of the dissertation is statistical data and analytical materials of the United Nations, Eurostat, Environmental assessment Agency (Hague), Dutch Parliament, World Bank, UN World Food Program, World Trade Organization (WTO), UN Conference on Trade and of Development (UNCTAD), the International Monetary Fund, the World Economic Forum, other international organizations and analytical centers, national green strategies, legislative acts of developed countries on waste management, scientific articles by scientists, monographs, Internet resources.

Scientific novelty of the research results consists in establishing the theoretical foundations of waste management and the formation of social corporate responsibility in the context of the development of the applied model for the implementation of the environmental strategic priorities of business.

The following most important scientific results were obtained in the research:

for the first time:

– developed the model of waste management in the system of corporate social responsibility, which is based on ways of implementing environmental management and directions of corporate social responsibility; includes the instruments of waste management system improvement; takes into account the approaches of development process of CSR as a management strategy; determines components of corporate social responsibility implementation strategy and interdirections of CSR under crisis;

improved:

– the concept of environmental management in the system of waste management by analysis of environmental management framework; justification the advantages to undertaking environmental management; and development of environmental management tools;

- terminology, in particular, the essential characteristics of waste management are detailed and the concept of waste is substantiated; the term “waste hierarchy” justified by options that are ranked in order of preference for waste minimization;
- evaluation of the features of corporate social responsibility under instability by selecting stages and approaches of social responsibility of business; and outlining problems and threats of corporate social responsibility;

further developed:

- main properties and characteristics for CSR theories due to key components such as strength of the theory; benefits of applying the theory and challenges in applying the theory;
- characterization of types of corporate social responsibility by selection external and internal focus of CSR; and theoretical identification the corporate social responsibility theories by classification the evolution of CSR theories by three main phases;
- analysis the waste management in the system of circular transformation; and analysis of the level of emissions under global transnationalization; which allowed to outline levels of circularity; elaborate waste collection collaboration options for municipalities; and develop concept of transition from linear waste to circular resource management concept.

The practical value of the results. The practical significance of the results of the dissertation is that the main theoretical provisions of the study of the key areas of waste management system improvement and the ways of implementation of corporate social responsibility management strategy can be used in the practical activities of business units and in further scientific developments.

Personal contribution of the applicant. Dissertation work is self-exploration research. The theoretical propositions, proposals and results presented for defence were obtained by the author personally. From the scientific publications published in co-authorship, the work uses only those provisions that are the result of the author's personal research.

Approbation of the results of the dissertation. The main results of the dissertation were discussed at international scientific and scientific-practical conferences: International scientific and practical conference of young scientists and students “Innovative processes of economic and socio-cultural development: domestic and foreign experience” (Ternopil, 2022); International scientific and practical conference of young scientists “Economic and social development of Ukraine in the XXI century: national vision and challenges of globalization” (Ternopil, 2023); International scientific and practical conference of young scientists and students “Innovative processes of economic and socio-cultural development: domestic and foreign experience” (Ternopil, 2023); International scientific and practical conference of young scientists and students “Innovative processes of economic and socio-cultural development: domestic and foreign experience” (Ternopil, 2024).

The main scientific developments regarding the model of waste management in the system of corporate social responsibility will be approved by the Department of International Economic Relations in a scientific and technical report based on the results of: fundamental state budget funding research “Concept of recovery and green reconstruction of Ukraine” (state registration number 0124U000003); and business funding research on the topic “Formation of the company’s ecological brand in foreign markets” (Contract No. MEV-37-2024 dated 25/04/2024).

Publications. The main results of the dissertation research were published in 11 articles with a total volume of 7.6 p.s. (of which the author personally owns 3.2 p.s.), including: 3 – publications in Journals indexing in Scopus; 3 – publications in Journals of category “B” of the List of scientific and specialized publications of Ukraine by specialty: 073 “Management”; 1 – publication in foreign Journal; 4 – publications in Conference Paper Collections.

The structure and volume of thesis. The dissertation consists of an introduction, three sections, conclusions, a list of reference, and annexes. The total volume of the dissertation is 179 pages, of which 142 pages are the main text. The thesis contains 2 tables, 35 figures and 4 annexes on 19 pages. The list of reference includes 177 sources on 18 pages.

CHAPTER 1

THEORETICAL AND METHODOLOGICAL BASIS OF THE RESEARCH WASTE MANAGEMENT AND CORPORATE SOCIAL RESPONSIBILITY

1.1. The genesis of theoretical approaches to research waste management concept

The generation of waste is a common occurrence in most human activities (P. Brunner and H. Rechberger, 2014) [47]. Despite this fact, the issue of waste production has always been a significant concern since ancient times (A. Chandler, 1997) [48]. In recent years, there has been a noticeable increase in both the rate and quantity of waste being generated. With the rise in waste volume, there has also been an increase in the variety of waste produced (S. Vergara and G. Tchobanoglous, 2012) [49]. Unlike ancient times, when waste was considered a mere nuisance that needed to be disposed of, proper waste management has now become a critical issue due to the larger population and limited land availability. In the past, the environment was able to easily absorb the waste without any negative impact (G. Tchobanoglous, 1993) [50].

During the sixteenth century, there was a significant increase in the amount of waste being generated. This was primarily due to the migration of people from rural areas to cities as a result of the industrial revolution (D. Wilson, 2007) [51]. As the population in cities grew rapidly, there was a corresponding surge in the volume and variety of waste being produced. This included the emergence of materials like metals and glass in large quantities within the municipal waste stream (P. Williams, 2005) [52]. Unfortunately, the large population in cities also led to indiscriminate littering and the creation of open dumps. These dumps became breeding grounds for rats and other pests, posing serious risks to public health. The improper waste management practices of that time resulted in numerous outbreaks of epidemics, causing a high number of deaths. Consequently, in the nineteenth century, public officials began implementing controlled waste disposal methods to protect public health (G. Tchobanoglous, 1993) [50].

Developed nations have experienced a phase of environmental development in their history. Presently, these countries have successfully tackled a significant portion of the health and environmental pollution concerns linked to waste production. Conversely, emerging countries undergoing rapid urbanization and advancements are now encountering a recurrence of the same challenges that developed nations previously had to confront (D. Wilson, 2007) [51].

Waste constitutes the useless byproduct of human activities, containing the same substances as the useful product, albeit in a different physical form (White et al., 1995). Waste has also been defined as any product or material that is useless to the producer (R. Basu, 2009) [53]. G. Dijkema et al., (2000) highlighted that waste refers to materials individuals would seek to dispose of even if they had to pay for their disposal. [54]. While waste is an inevitable product of human activities, it often stems from inefficient production processes, leading to the continuous loss of valuable resources (N. Cheremisinoff, 2003) [55].

A substance regarded as a waste to one individual may be a resource to another. Therefore, an item is only considered waste when the owner deems it as such (G. Dijkema, 2000) [54]. Despite the subjective nature of waste, it is crucial to clearly define what qualifies as waste. This classification will serve as the basis for implementing regulations to protect both the public and the environment during waste processing and disposal.

It is widely accepted that waste management services are crucial services that should be available in all communities. However, there is a lack of understanding regarding the definition of waste. It is important to recognize that the perception of waste can vary greatly from person to person, as what may be considered waste by one individual could be seen as a valuable resource by another. Therefore, establishing clear guidelines on what can be classified as waste is essential.

Waste can manifest itself in various forms, and its categorization can be described in multiple ways. Several common characteristics are employed to classify waste, including its physical states, physical properties, potential for reuse, biodegradability, source of production, and the extent of its environmental impact

(A. Demirbas, 2011) [56]. According to P. White et al. (1995) [57], waste can be broadly classified into three main types based on its physical state: liquid, solid, and gaseous waste. However, it is important to note that different countries may have their own classifications. The following are the most commonly used classifications.

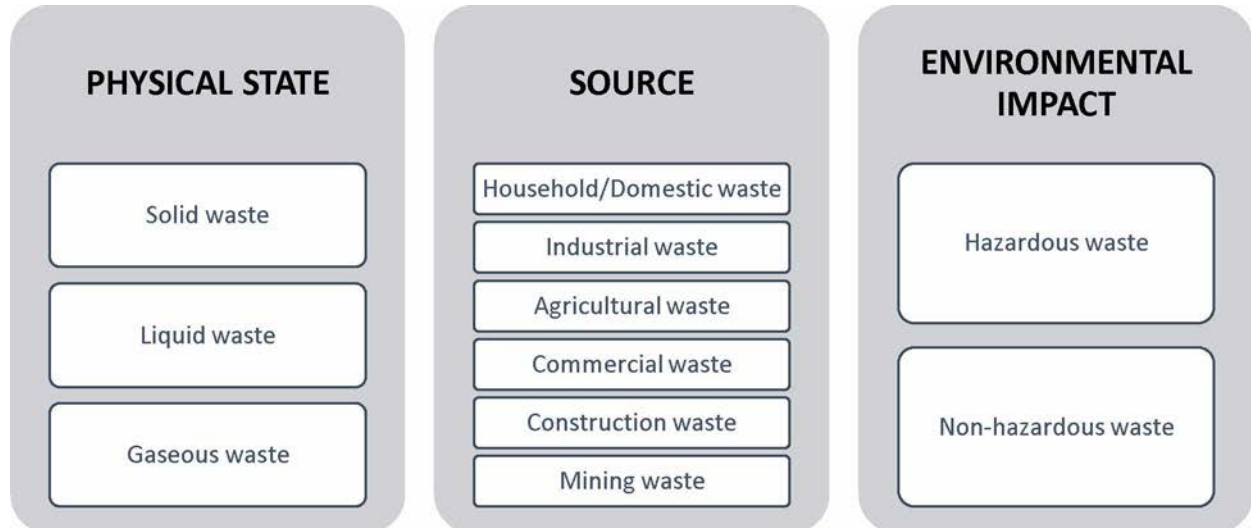


Fig. 1.1. Waste classification [57]

G. Tchobanoglous and colleagues (1993) [50] define solid waste as the byproduct of human activities that exists in solid or semisolid form and is discarded as unwanted items. In contrast, W. Beranek (1992) [58] asserts that solid waste encompasses a wide range of materials generated from different activities like agriculture, landscaping, and domestic and commercial processes. He stresses that solid waste is separate from wastewater and gas emissions, stating that they are materials typically suitable for disposal on land. R. Basu (2010) [53] mentioned that solid waste is comprised of municipal waste, certain biomedical waste, electronic waste, and some hazardous waste. Basu pointed out that solid waste can be either putrescible or non-putrescible. In a similar vein, M. Kaseva and S. Gupta (1996) [59] observed that solid waste consists of waste materials from municipal, industrial, and agricultural activities. G. Tchobanoglous (1993) [50] concluded that, unlike other types of waste, solid waste does not easily decompose. They contended that wherever solid waste is disposed of today is where it will remain in the future.

It is crucial to briefly analyze the different forms and types of solid waste due to the fact that it comprises several types of waste. Municipal solid waste (MSW) is a significant waste stream and has been extensively studied. According to P. White

(1995) [57], MSW carries various implications. They argue that due to its direct contact with people, the collection, treatment, and disposal of MSW are considered crucial services by politicians and local governments. M. Kaseva and S. Gupta (1996) [59] define municipal solid waste as the waste collected by city authorities, encompassing refuse from households, non-hazardous solids from industries, businesses, institutions, and non-pathogenic hospital waste. W. Buah (2007) [60] describe MSW as waste collected by local authorities from both domestic and commercial sources. P. White (1995) [57] further elaborate on MSW, stating that it comprises waste generated by households and commercial establishments, emphasizing that it represents only a small portion of the overall solid waste generated. S. Vergara and G. Tchobanoglous (2012) [49] observe that MSW reflects the lifestyles and customs of the people who produce it. They also highlight that improper management of MSW can have a negative impact on public well-being and the environment.

The European Union has established a legal definition of municipal waste for legislative purposes within the Directive on the Landfill of Waste 1999/31/EC. According to this directive, municipal waste encompasses waste originating from households, along with any other waste that shares similar characteristics or composition with household waste. This inclusive definition extends to waste generated from commercial establishments if it resembles household waste in its nature or composition. According to P. White (1995) [57], managing MSW can be challenging due to its diverse components, which include metal, paper, glass, and other organic materials mixed together. Likewise, M. Berkun (2011) [61] conducted a study that found the characteristics of MSW vary depending on the source. However, in certain countries, putrescible materials make up a substantial portion of MSW, while recyclable constituents like cardboard, paper, glass, and plastics contribute significantly to the overall municipal solid waste.

N. Dixon and D. Jones (2005) [62] stated that municipal solid waste is comprised of various materials, including soil, garden and food waste, wood, paper, ashes, plastics, textiles, and rubber. They concluded that this waste primarily originates from households and commercial sources. Similarly, W. Buah (2007) [60] stated that

Municipal Solid Waste (MSW) predominantly comprises food and garden waste, textiles, paper or cardboard, plastics, glass, and metals. They argued that due to the composition of MSW, it can be easily utilized for energy recovery or fuel production. In contrast, P. White (1995) [57] argued that, unlike other waste streams, which have a more uniform composition with a significant percentage of each material, municipal solid waste exhibits diversity and is subject to variations from city to city and country to country.

The construction industry is a major contributor to solid waste in many countries. According to C. Poon et al. (2001) [63], Hong Kong alone produces approximately 30 thousand metric tons of construction waste per day. This waste consists of both inert and non-inert materials. Additionally, L. Jaillon (2009) [64] highlighted that the limited availability of land in Hong Kong contributes to the significant volume of solid waste generated by the construction industry. In 2005, the construction of multi-story buildings in the city resulted in the production of approximately 21.5 million tons of construction waste.

In a study conducted by B. McDonald and M. Smithers in 1998 [65], approximately 15% of solid waste landfilled in Australia is generated from construction activity each year. The research by O. Faniran and G. Caban [66] in the same year revealed that the significant amount of waste produced by the construction industry in Australia contributes to the overall cost of construction projects, primarily due to the stringent landfill regulations in the country. O. Faniran and G. Caban [66] also identified various sources of construction waste, including design/detailing errors, design changes, packaging waste, and unused scrap materials. Similarly, A. Barros (1998) [67] observed that a considerable portion of construction waste in the Netherlands consists of plastics, metal, wood, and stones, primarily resulting from demolition and reconstruction activities. Additionally, A. Barros found that, apart from other construction waste, approximately 1 million tons of sand is generated as waste annually, with some of it being recycled.

U. Ngoc and H. Schnitzer (2009) [68] defined industrial waste as the byproduct of processing raw materials to manufacture new products. They highlighted that this

waste can originate from factories, mines, or mills. According to P. Shafiqh (2014) [69], a significant portion of solid waste in Malaysia, Indonesia, and Thailand comes from palm oil processing. The study revealed that Thailand generates approximately 3.2 million metric tons of solid waste annually from the palm oil sector. In comparison, Malaysia and Indonesia produce 47 million tons and 40 million tons, respectively. The waste from this industry is comprised of bunches, fruit shells, and palm fiber. U. Ngoc and H. Schnitzer (2009) [68] also identified that some of the various types of waste generated by industries are toxic while others are non-toxic.

Agricultural solid waste encompasses a wide range of materials, as mentioned by G. Tchobanoglous (1993) [50], including those generated from livestock rearing, plant cultivation, and milk production. According to P. Williams (2005) [52], examples of agricultural waste materials are animal manure, different crop residues, and silage effluent. This waste can be effectively repurposed in the energy and industrial sectors. Nonetheless, T. Seadi and J. Holm-Nielsen (2004) [70] warned that improper handling of agricultural waste could pose environmental risks, such as water pollution from excessive manure application on land.

Commercial solid waste encompasses solid or semi-solid waste generated from a range of activities conducted in establishments such as stores, restaurants, markets, offices, hotels, motels, print shops, service stations, and auto repair shops, among others. According to the Environment & Heritage Service, commercial and industrial activities in Northern Ireland generated approximately 1.8 million tons of solid waste in 2017. The commercial activities alone contributed to over 50% of the total solid waste generated during that year. Similarly, a survey conducted by in England revealed that commercial waste constituted around 12% of the total waste generated in 2020 by industrial and commercial businesses. Likewise, the retail, wholesale, hotel, and restaurant sectors in Scotland were responsible for generating the largest amount of commercial waste in 2006-2016. Regions with a higher concentration of businesses produced a greater quantity of waste compared to areas with fewer businesses. Notably, Glasgow and Clyde generated a higher proportion of waste in comparison to other

regions. The commercial sector contributed approximately 29% of the total controlled waste volume generated in Scotland in 2009-2016.

Commercial solid waste refers to solid or semi-solid waste that is generated as a result of various activities conducted in establishments such as stores, restaurants, markets, offices, hotels, motels, print shops, service stations, and auto repair shops, among others. Although commercial waste is often categorized under municipal solid waste, P. Williams (2005) [52] pointed out that information regarding the breakdown of waste into domestic and commercial categories is not readily available in most cases. W. Buah (2007) [60] argued that solid waste generated from both commercial and domestic activities shares similar components. However, it was noted that in the UK, this waste is not collected together for disposal. Typically, the commercial sector generates a diverse array of waste, encompassing consumer electronics, batteries, tires, white goods, paper, cardboard, metal, plastics, food waste, wood, glass, and various other materials.

Traditional markets, commonly referred to as open markets, are prevalent in many developing nations, serving as venues for buying and selling various goods. According to M. Sridhar and G. Adeoye (2003) [71], the products sold in these markets range from textiles, household items, and food products to herbal medicines, pharmaceuticals, electrical appliances, building materials, and stationery. B. Adekunle (2012) [72] pointed out that while these markets contribute to the growth of the local economy, the improper waste management in these areas leads to environmental degradation. L. Aye and E. Widjaya (2006) [73] highlighted that market waste is the second largest source of municipal solid waste in Indonesia, following household waste. Research conducted in India by K. Rajeshwari (2001) [74] found that the waste generated in these markets is typically high in organic content. However, K. Rajeshwari noted that these organic materials are often disposed of haphazardly. M. Sridhar and G. Adeoye (2003) [71] observed that a significant portion of the solid waste in these traditional markets consists of food waste.

The hotel sector has the potential to harm the environment through the significant amount of solid waste it generates (N. Scanlon, 2007) [75]. A study on the

solid waste management practices of small hotels in the UK (H. Radwan, 2010) [76] found that many hotel operators lack environmental awareness; most hotels do not engage in waste reuse. Consequently, they contribute to environmental deterioration due to the substantial volume of solid waste they produce daily. Similarly, N. Erdogan and E. Baris (2007) [77] noted that a majority of hotels surveyed in Ankara, Turkey, do not segregate or recycle their waste. They also mentioned that some hotels that do segregate their waste have inadequate systems for waste separation. A study conducted in Hong Kong (W. Chan and J. Lam, 2001) [78] revealed that the hotel industry's reluctance to reuse waste is partly due to the expenses associated with purchasing recycling materials. Moreover, the study showed that the lack of awareness regarding the environmental impact of hotels' solid waste further discourages waste reduction efforts. A. Kasim (2007) [79] highlighted that, on average, hotels generate more solid waste than households. He also mentioned that the type and quantity of waste produced by a hotel depend on the number of rooms in the hotel and their involvement in hosting events.

The retail industry encompasses a wide range of business operations, including the sale of vehicles and household items both within and outside physical stores. The majority of waste generated in this sector consists of non-metallic materials, which can vary from packaging materials to organic waste, such as animal and vegetable matter. The nature of the materials being sold directly impacts the type of waste that is produced. A study conducted on grocery stores in Quebec, Canada, by J. Norrie (1997) [80] found that a significant portion of waste in these stores is comprised of items such as fruits, baked goods, seafood, packaging materials, and other frozen products.

In the UK, the retail sector alone generated approximately 2 million tons of packaging and food waste in 2014. According to a report by the Environment & Heritage Service, commercial activities in Northern Ireland, including retailing, wholesaling, public administration, real estate, and other business activities, produced around 500 thousand tons of waste annually. J. Norrie [80] in 1997 highlighted that a supermarket chain in Quebec spends approximately \$6 million on waste disposal. Therefore, A. Ochoa et al. (2010) proposed that supermarkets should consider

implementing recycling and reusing practices as a waste management strategy to recover some of their operational costs.

Waste has always been produced as a result of human activities and interactions with the environment. However, according to L. Giusti (2009) [82], until people started residing in communities, waste management and production were not significant problems. According to S. Vergara and G. Tchobanoglous (2012) [49], as the global population and purchasing power grow, more items are created to meet the rising demand, which results in increased waste generation. N. Marchettini (2007) [83] noted that the environment was being overburdened by these ongoing streams of trash brought on by human activity. According to S. Vergara and G. Tchobanoglous (2012) [49], effective planning and management are necessary to stop trash from having a harmful effect on the ecosystem. G. Ghiani (2014) [84] further stated that, as a result, organizing solid waste management properly has become crucial to protecting the ecosystem. According to W. Beranek (1992) [58], the availability of an effective solid waste management system is becoming just as crucial as the presence of other necessities like electricity, airports, and roadways. As noted by R. Basu (2009) [53], this is due to the increasing amount of garbage. It is not sustainable to continuously dispose of rubbish in landfills. Therefore, Basu contends that treating garbage is an essential step in preserving public health.

Waste management, according to A. Demirbas (2011) [56], is the process of collecting, moving, and processing waste before disposing of any leftover residue. In a similar vein, G. Tchobanoglous (1993) [50] defines solid waste management as the efficient oversight and management of waste, including its handling, keeping, collection, conveyance, treatment, and disposal in a way that protects the public and the environment. Tchobanoglous et al. noted that in order to handle waste management challenges on a daily basis, solid waste management must draw on expertise and information from a variety of disciplines, including legal, financial, and administrative. According to A. Demirbas (2011) [56], maintaining a safe environment is the primary goal of waste management.

A. Troschinetz and J. Mihelcic (2009) [85] highlighted that certain waste management approaches are frequently favored over others. For example, methods like reuse, recycling, composting, and energy generation from incineration are often prioritized over landfills. However, G. Dijkema (2000) [54] argued that even these preferred methods can sometimes result in the production of hazardous materials, such as incineration residue. According to Strange (2002), landfilling is typically the final destination for most waste generated by waste treatment and processing facilities. Strange further noted that other technologies primarily serve to reduce volume or treat waste before its final disposal. N. Cheremisinoff (2003) [55] stated that various methods exist for waste management. He also mentioned that waste streams with varying characteristics may necessitate distinct management strategies. For example, industrial waste could potentially contain more dangerous substances compared to municipal waste streams. Consequently, the management of these two types of waste streams could vary. S. Vergara and G. Tchobanoglous (2012) [49] discovered that while waste management approaches may differ among nations, there are fundamental processes or guidelines that must be adhered to in waste management.

There are many concepts of waste management that are different between countries or regions. Among the most prevalent and all-encompassing ideas are:

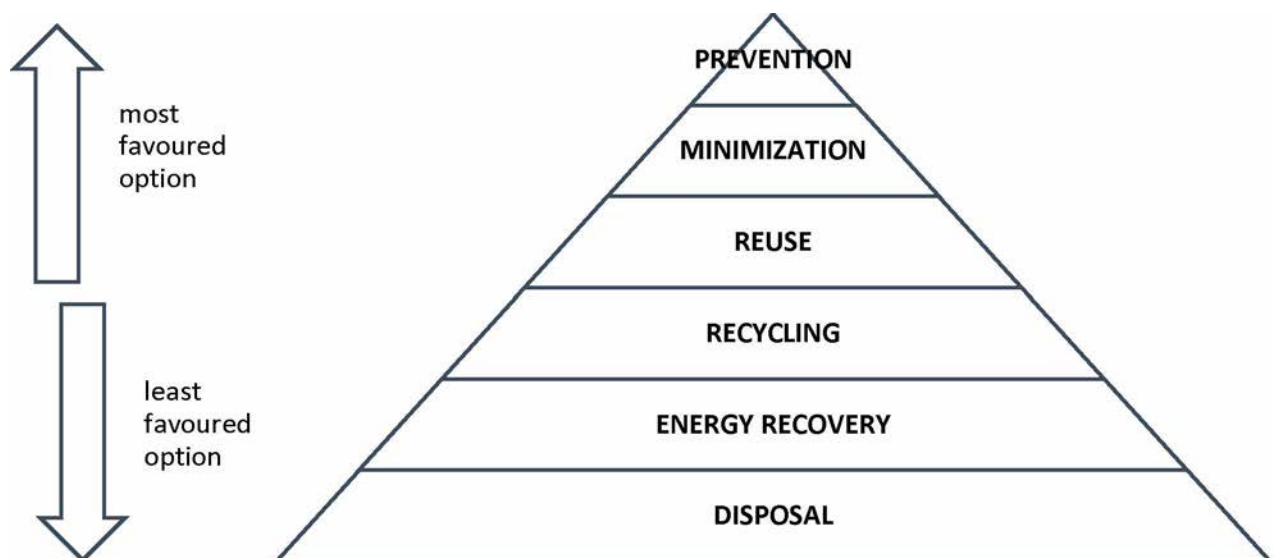


Fig. 1.2. Waste hierarchy [46]

The term “waste hierarchy” (Figure 1.2) refers to the reduce, reuse, and recycle options that are ranked in order of preference for waste minimization. The majority of

waste minimization techniques continue to be based on the waste hierarchy. The waste hierarchy seeks to produce the least amount of trash while maximizing the useful advantages of items. Reducing waste at its source is known as waste minimization. This often refers to actions like: *reuse* resources in their original form to the greatest extent feasible; *separate* waste into multiple streams at the point of origin prior to collection for recovery and recycling; *divert* waste from landfills using the proper facilities and processes; *facilitate* the processing or handling of any waste that can be recycled, in an economic and environmentally sustainable manner.

Extended Producer Responsibility (EPR) is a strategic approach designed to encompass all expenses linked to products across their entire life cycle, encompassing disposal costs at the end of their usefulness, thereby factoring them into the product's market price. Extended Producer Responsibility (EPR) places accountability throughout the life cycle of products and packaging introduced to the market. Firms involved in manufacturing, importing, and selling products are mandated to take responsibility not only during production but also after the products have reached the end of their useful life. The Polluter Pays Principle dictates that the party responsible for pollution must bear the costs of the environmental impact they have caused. In the context of waste management, this principle entails that the entity generating the waste is responsible for covering the costs associated with its proper disposal. The Talloires Declaration is a declaration for sustainability, addressing the unmatched scope and rapidity of environmental pollution and deterioration, as well as the depletion of natural resources. Local, regional, and global air pollution, the accumulation and dispersal of toxic wastes, the degradation and depletion of forests, soil, and water, the thinning of the ozone layer, and the release of "greenhouse" gases not only endanger human survival and the survival of numerous other species, but also compromise the integrity of the Earth and its biodiversity, threaten national security, and jeopardize the legacy of future generations.

Inadequate waste management, spanning from absent waste collection systems to ineffective waste disposal methods, results in pollution of air, water, and soil. Open and unsanitary landfills contribute to the contamination of drinking water, cause

infections and spread diseases. The problem is quite relevant for developing and low-income countries. The accumulation and dispersion of garbage contaminates ecosystems, and hazardous substances from e-waste or industrial waste harm the health of city dwellers and the environment. This issue underscores the global challenge of waste management and necessitates the development of comprehensive integrated solid waste management systems.

Problems of waste management in the environmental management system were considered by a number of domestic and foreign scientists. In particular, researchers (A. Khan et al., 2022) [86] studied that solid household waste is a reflection of the culture that generates it and has a negative impact on human health and the environment. The authors concluded that the world is rapidly urbanizing, and these changes impose on cities the burden of proper waste management at both social and environmental levels. Scientists (E. Lopez-Maldonado et al., 2022) [86] established that solid waste generation has increased rapidly due to population growth around the world, urbanization, and industrialization. Scientists have found that solid waste management is a serious challenge for society, which creates local problems with global consequences, in particular, poor management can accelerate harmful environmental and socio-economic problems. Researchers (Sh. Kharola et al., 2022) [87] identified barriers to organic waste management decisions from the decision-maker's point of view and studied their causal relationships to overcome the problem of organic waste management from a systems perspective. The study identified key issues in organic waste management and noted that incentives and increased attention to waste are an effective approach to solving the problem, and that waste collection fees, environmental behavior and obligations influence consumer and household decisions.

Proper waste management, geared towards repurposing resources for the future, holds significant importance in attaining environmental sustainability and fostering the shift towards a circular economy (M. Tanveer, S. Khan and M. Umar, 2022) [88]. The authors identified the following categories: e-waste, transition to a closed-loop economy, plastic waste, bio-based waste disposal, life cycle assessment, and

environmental impact, as well as construction and demolition waste disposal. Scientists have developed conclusions for politicians, specialists and practitioners regarding waste management and technological innovations towards a circular transition. Waste management theory is a conceptual description of waste management that defines concepts related to waste and proposes a methodology for waste management. The premise of waste management theory posits that achieving sustainable waste management hinges significantly on how we define the concept of "waste". The concept of "waste" is related to a person and his life activities. Populations, households, and economies depend on constant flow of air, water, food, raw materials, and fossil fuels. Waste is constantly generated or released into the air and dumped on/into the ground. The concept of "technical inefficiency" is closest in meaning to the traditional use of resources and the generation of waste. "Technical inefficiency" means that managers of an organization fail to minimize costs or maximize output because they are not using the best available technology (R. Zvarych and I. Rivilis, 2023) [89].

According to the Waste Directive of the European Council, waste management encompasses the collection, transportation, and disposal of waste, along with the oversight and maintenance of disposal sites. From this definition it follows that waste management is only the process of manipulating unnecessary materials, and waste management is an activity on these materials. As a result, this definition does not cover all waste management activities and is therefore not sufficient. The term "management" refers to the manipulation of activities and gives the hope that waste management will encompass more than the elimination of waste. The basis of sustainable waste management is the minimization and reduction of waste (E. Pongracz, 2002) [90]. As a result, it is worth noting that the waste management process also involves (see Fig. 1.3): strategic planning; prevention of environmental pollution and conservation of resources; minimization of the amount and toxicity of waste generation; choosing the best prevention option while taking into account legislation; assessment of effects and consequences; and decision-making.

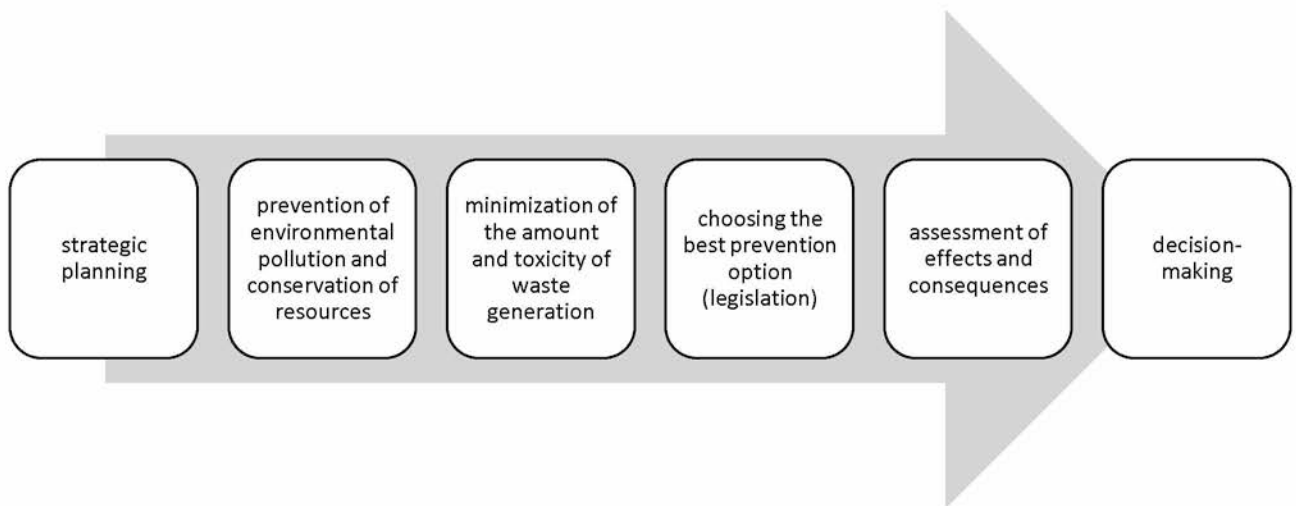


Fig. 1.3. Waste hierarchy [Author]

The “5R” waste management system covers a set of principles aimed at reducing the impact of waste on the environment. (1) *Refuse* unnecessary items such as single-use plastics or excess packaging. (2) *Reduce* the use of resources and increase conscious consumption. (3) *Reuse* items or durable goods that have a longer service life. (4) *Repurpose*, i.e. give items a new purpose or use items with a long service life. (5) *Recycle* used materials into new products, reducing the need for raw materials thus reducing the overall impact on the environment. In general, these principles are aimed at responsible waste management and encouraging individuals and enterprises to be more attentive to their consumption and disposal habits (N. Reznikova et al., 2019) [91]. The best alternative to waste disposal is to prevent its generation. This is why waste prevention is the goal of all waste management strategies. Various technologies can be employed at different stages of a product's life cycle-production, use, or post-use-to mitigate waste generation, consequently lessening or averting environmental pollution. Several exemplary strategies encompass environmentally conscious production methods, such as employing less hazardous materials in manufacturing, implementing advanced monitoring systems for hazardous material storage, adopting innovative techniques for chemical neutralization, and integrating technologies aimed at conserving fresh water.

Waste management involves gathering discarded materials to recycle them, reducing their impact on health, the environment, and quality of life. Practices differ among developed and developing nations, urban and rural areas, and between

residential and industrial sources. The waste management process includes monitoring, collection, transportation, processing, disposal, or recycling, allowing companies to manage waste output responsibly and positively impact the environment. The increase in waste generation per person is projected to persist due to the expanding global population, rising wealth, and increased consumerism. Implementing scalable and sustainable solutions to address this waste issue could lead to a model where waste is utilized as a resource in the creation of goods and services, thereby transforming waste management into a profitable venture. The conversion of waste into energy presents an opportunity to serve as an additional raw material for the rapidly growing biofuels industry. Various innovative technologies are currently being utilized and developed to convert waste into heat, power, fuels, or chemical feedstock.

1.2. Theoretical identification: the corporate social responsibility theories

Over the past few decades, corporate social responsibility (CSR) has garnered significant attention from researchers in the field of management. In fact, most of them have developed different models and theories on the concept of CSR, leading to different approaches to CSR. From this point, it is enough to outline the similarities and differences between different theories of CSR in order to find a common way of implementing CSR that also reflects the interests of shareholders and society. Many scholars have studied the definition, theory and model of corporate social responsibility. R. Safar zad defines the concept of corporate social responsibility as a legal requirement for a company that includes an ongoing commitment to the community. He added that the company's main objectives are to improve operational efficiency and productivity, and maximize profits for shareholders. However, this all must be achieved by integrating the ethical and environmental expectations of the community into the company's economic processes [1]. M. Friedman completely rejected the above-mentioned concept of corporate social responsibility and believed that company management has only one responsibility, which is to maximize the profits

of owners and shareholders. He believes that social problems should be solved independently through the mechanisms of the free market system [2].

J. Brousseau offers two definitions of corporate social responsibility. Firstly, it serves as an umbrella term for any corporate theory that emphasizes the responsibility to make money and to deal ethically with the surrounding community. Secondly, corporate social responsibility is a specific concept that creates profits for the company and plays a role in public interests [3]. J. Brousseau continued with a CSR theory, that firms have four obligations: (1) *economic responsibility* – to generate revenue; (2) *legal responsibility* – to follow laws and regulations; (3) *ethical responsibility* – to act morally, even when it is not mandated by the letter or spirit of the law; (4) *philanthropic responsibility* – to support charitable endeavours in society, regardless of the specific firm involved.

Carroll's Pyramid of CSR, developed by management professor A. Carroll, integrates James Brousseau's definitions of corporate social responsibility. Initially, Carroll's four components of CSR were defined as follows: Corporate Social Responsibility (CSR) encompasses the economic, legal, ethical, and philanthropic standards set by society for a company. Later, he created the CSR pyramid using it as the foundation. Carroll's perspective holds that corporate social responsibility (CSR) responsibilities should be addressed in the following order: economic, legal, ethical, and philanthropic. A company can proceed to the next duty if the first is completed effectively [4]. Stakeholder theory and corporate social responsibility (CSR) are two key ideas in business ethics that E. Freeman examined. Stakeholders, according to E. Freeman, are groups that possess a claim or an interest in the company. By stakeholder, he meant any organization or individual with a relationship to, or claim against, the company in either their personal or professional life. According to E. Freeman, the stakeholders are the parties that have the right to be involved in shaping the future course of the company in which they have a stake and who should not be viewed as a means to an end [5]. Thus, in E. Freeman's opinion, CSR needs to take stakeholder goals into account.

E. Garriga and D. Mele attempted to categorize the primary ideas of corporate social responsibility and associated methodologies into four groups in their well-known paper “Corporate Social Responsibility Theories: Mapping the Territory”: (1). The first group is known as the instrumental theories group, and they hold that a corporation is the sole tool available for wealth creation, with its social actions only serving to further its economic and financial objectives. (2). The second group is the political theories group, which holds that a corporation must use its influence in politics. Encouraging organizations that work to combat corruption in society, advance women’s rights, labor rights, and human rights culture enhances political theories and offers transparency for real CSR principles. (3). The third group, known as integrative theories, focuses on how a corporation satisfies ethical and social requirements. Contributions to charitable organizations and welfare establishments, such as youth and sports facilities, senior centers, and orphanages, are examples of social development. (4). The ethical theories group, which is founded on the ethical responsibilities of corporations to society, makes up the fourth group. To be ethically responsible means a company should pledge to uphold the moral standards of its community. For instance, businesses ought to think about trustworthiness and openness with their stakeholders [6].

In practice, each CSR group has different dimensions in terms of profits, political performance, environmental requirements, social requirements and moral values. The diversity and fragmentation of theoretical classifications of CSR hinder companies from implementing useful CSR approaches. S. Waddock defines *Corporate Responsibility (CR)* as a set of acceptable behaviors for various stakeholders, arising from a company's sense of responsibility towards the societal impact of its operations within the communities it serves. (2003) [18] and P. Hohnen (2007) [19]. Thus, the concept of CR can clearly be seen to be an implicit relationship between the organisation and its society, based on the moral commitment of the rights and duties granted to the stakeholders, whether internally or externally by R. Mitchell (1997) [20], A. Friedman and S. Miles (2006) [21]. Similarly, W. Pride and O. Ferrell (2006) [22]

argue that business responsibility comprises a collection of "principles and standards that delineate acceptable conduct in business, as determined by diverse stakeholders".

Indeed, research indicates that corporate responsibility (CR) is typically associated with ethical behaviour through the descriptive part of accountability, which describes business activities or inactions that could have an impact on society in either a positive or negative way by J. Fischer (2004) [23] and A. Friedman, S. Miles (2006) [21]. Based on the notion that all of these behaviours should eventually be rewarded or sanctioned, it can be identified as an assessment function of corporate actions – A. Hassan (2012) [24]. Corporate Financial Responsibility (CFR) and Corporate Social (and Environmental) Responsibility (CSER) are the two primary duties that fall under the umbrella term of Corporate Responsibility (CR), according to M. Hopkins (2006) [25]. H. Bowen describes CSR as the responsibilities of businesspersons to adopt policies, make decisions, and pursue actions that align with the objectives and values of society, both socially and environmentally (1953) [26]. Therefore, a more specific definition of CSR strategy would be corporations' conscious decision to identify and address social and environmental issues through the sustainable advancement of the organization's objectives (J. Lynes and M. Adrachuk, 2008) [27].

While H. Bowen (1953) [26] presented a clear definition of CSR, other research has offered differing perspectives on this idea. The perspectives of various stakeholders, whether driven by financial or non-financial interests in a business entity, can shape their views (J. Harrison and R. Freeman, 1999) [28]. According to the stakeholder theory, some researchers argue that CSR is a fundamental aspect of societal rights, with companies having numerous responsibilities towards the society they operate in (D. Silberhorn and R. Warren, 2007) [29]. On the other hand, some believe that CSR is simply a voluntary effort to benefit society and the environment (M. Van Marrewijk, 2003) [30]. A third perspective considers CSR as a means of ensuring legitimacy and survival. Furthermore, CSR is often viewed as a social contract between a firm and its stakeholders, reflecting mutual interests (R. Gray, 1995) [31]. Moreover, it has been contended that a managerial perspective of CSR exists. This perspective necessitates a shift in mindset towards acknowledging the concerns of employees,

managers, and owners, in addition to suppliers, customers, and the local community (R. Freeman, 1984) [32]. R. Freeman's assertion regarding the importance of recognizing various external stakeholder groups alongside shareholders was pivotal in shaping the concept of CSR (A. Belal, 1999) [33]. This shift in perspective fundamentally offers a fresh approach to reconsidering how to identify different stakeholder groups and aligning companies' actions with stakeholder interests (A. Carroll and K. Shabana, 2010) [34].

In all the perspectives presented above, the concept of CSR can be viewed as a way to enhance performance and positive engagement within the community and the environment. Simultaneously, it aims to minimize the social and environmental harm caused by commercial activities (E. Garriga and D. Mele, 2004) [35]. On the contrary, several researchers have interpreted the concept of CSR based on its responsibilities. They categorize it into three fundamental concepts: "Profit Responsibility, Stakeholder Responsibility, and Social Responsibility" (M. Van Marrewijk, 2003) [30]. Taking a broader perspective on CSR, A. Carroll (1991) argues that that CSR includes economic, legal, ethical, and humanitarian responsibilities.

Furthermore, CSR has been defined as the embrace of transparent and accountable business practices across four principal domains: environment, workplace, community, and marketplace. (R. Said, 2011) [36]. While there may be variations in the definitions mentioned above, they all reflect a growing movement that aims to integrate social and environmental concerns into organizational behavior. Through this interaction and communication between financial and non-financial interests, corporations strive to maintain their legitimacy, foster communication and negotiation with the community, and uphold their profitability (D. Hawkins, 2006) [37]; (A. McKinley, 2008) [38]. Consequently, corporate responses to such social and environmental interactions form the philosophical foundations of CSR theories (D. Mele, 2008) [39].

To simplify the understanding of the concepts mentioned above, the evolution of CSR theories can be categorized into three primary phases: (1) starting and growth; (2) crystallization and (3) expansion and prosperity. A. Carroll (1999) highlighted the

significance of the “CSR footprints” in previous literature, such as the works of Adam Smith, which depicted self-interested individuals coexisting harmoniously in the moral and economic realm (D. Brown and W. Forster, 2013) [40]. The concept of CSR today took shape during the 1920s (W. Frederick, 1994) [41]. Its origins can be traced back to 1919 in the United States, when the Ford Company, following a Supreme Court ruling, chose to distribute all its profits to shareholders instead of serving society (J. Hood, 1998) [42]. This decision created a negative perception among the American public, who viewed it as an unwarranted interference by the Supreme Court in internal company affairs (G. Lantos, 2001) [43]. The public’s reaction to the detrimental impact of organizations on society, particularly the working class, prompted Professor Wallace, the Dean of Harvard Business School, to emphasize the importance of business ethics and civil rights in 1929 at North Western University (B. Spector, 2008) [44].

A. Carroll developed a specific theory about the way companies interact with their surrounding communities and the wider world. This theory is now known as Carroll’s Pyramid of Corporate Social Responsibility (Figure 1.4). Carroll’s theory consists of four commitments that provide the foundation or infrastructure for a company’s social responsibility.

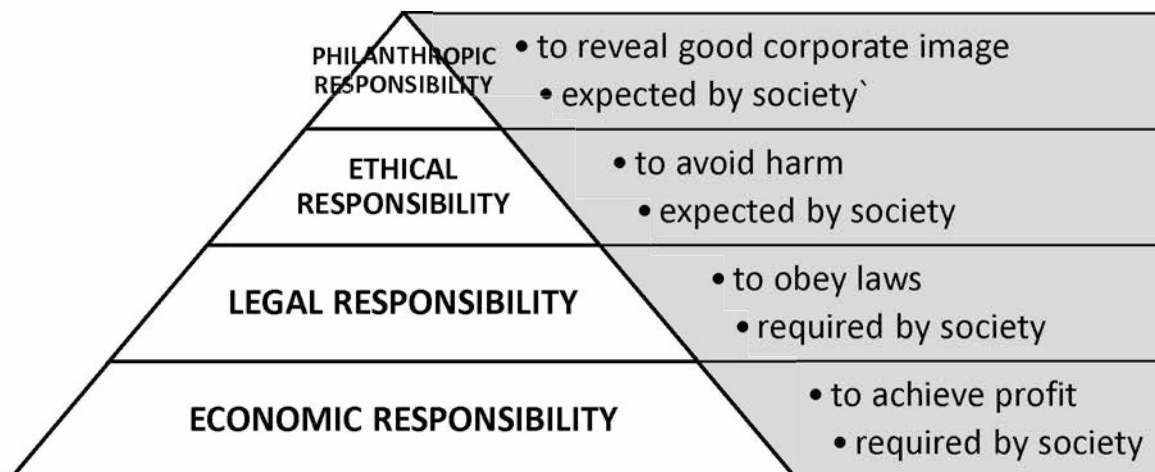


Fig. 1.4. Carroll Pyramid for CSR [4]

Economic responsibility. Making money is the job of a business organization. A. Carroll places economic commitment at the bottom of the CSR pyramid because it is critical to a company’s survival. Any business or organization, even a non-profit as

a charity, needs assets to succeed and survive. A. Carroll believes that the first step in practicing corporate social responsibility is to participate in corporate operations and obtain profits. Profits are necessary to reward investors and owners. Additionally, profits must be reinvested to sustain business growth. Economic responsibility is demonstrated by the company through investments, marketing strategies, business operations and long-term financial strategies with different stakeholders. For example, when a company starts operations, it needs to hire a certain number of employees and work with various stakeholders such as vendors, marketing consultants, shareholders, investors, insurance companies, banks, and financial institutions. When a company makes a profit, every stakeholder is positively affected, which economists call the win-win theory. Stakeholders benefit, capital circulation improves, and companies successfully fulfill their corporate social responsibility and economic responsibilities.

Legal responsibility. Companies must comply with laws and regulations. According to Carroll's pyramid theory, legal responsibility is located at the second level of the corporate social responsibility pyramid. A responsible company is one that accepts the rules of the fair business game. A responsible company complies with the law because it believes that fair business practices have a positive impact on the economy and society as a whole. If a company engages in tax evasion, money laundering, or even produces toxic products, it is illogical to assume that it has CSR values.

Ethical responsibility. Companies must behave like good citizens in society. Even if not required by law, this responsibility enables companies to do good things for society. A. Carroll noted that companies must respond to the spirit of the law, not just the letter. In other words, ethical responsibility includes the fair activities that society expects of a company. Civil society and associations play an important role in defining corporate ethical controls until these controls become actual law.

Philanthropic responsibility. It is a voluntary activity guided by the company's desire to engage in social activities that are neither mandatory nor required by law nor generally considered ethical in business. Therefore, philanthropic responsibility is a pure donation to society, an activity or project initiated by a company and specifically

dedicated to meeting the expectations of the community. At the philanthropic level, commercial enterprises can fulfill the aspirations of society. In order to fulfill their philanthropic responsibilities, companies engage in various forms of donations, such as sponsoring sports activities like annual marathons, and allowing employees to participate in volunteer activities. The value of charitable activities lies in establishing a good corporate citizen image and enhancing the company's reputation.

Carroll's Pyramid emphasizes the importance of implementing CSR initiatives in a sequential manner. Companies are expected to first focus on economic goals to ensure sustainability and profitability. Subsequently, they should progress to complying with regional and international laws and regulations. Following this, the third level involves adhering to ethical standards. Finally, at the highest level, companies are encouraged to fulfill philanthropic responsibilities towards society and the environment. When A. Carroll initially conceptualized his CSR framework in 1979 and later illustrated it in pyramid form in 1991, it was tailored specifically to American society. However, Crane and Matten noted in 2007 that all levels of CSR depicted in Carroll's pyramid are relevant in Europe and are interconnected in some way [7]. Similarly, Visser examined Carroll's pyramid in developing countries/continents, particularly in Africa, and argued that the order of CSR layers differs from the traditional pyramid. Visser highlighted that in developing countries, economic responsibility remains the top priority, followed by philanthropy, legal responsibility, and then ethical responsibility [8]. Consequently, corporations must consider additional factors such as the nature and circumstances of the surrounding environment and community before adopting Carroll's CSR framework. To fully leverage the benefits of CSR, businesses should take into account the needs of the surrounding society and implement projects that are suitable for it.

The concept of the Triple Bottom Line theory (TBL), introduced by J. Elkington in his book "Cannibals with Forks: The Triple Bottom Line of 21st Century Business" [9], emphasizes the incorporation of three dimensions of performance – economic, social, and environmental – within a CSR framework. J. Elkington stresses the importance of sustainability in achieving results across these three dimensions. In order

to attain continuous profits and undertake long-term social and environmental projects, companies must adopt the TBL approach. Consequently, numerous corporations and nonprofit organizations have embraced the TBL sustainability framework to carry out their CSR initiatives. The TBL theory highlights the significance of the economic dimension. According to this theory, companies should prioritize achieving continuous profits in the long run rather than solely focusing on maximizing profits. As a result, businesses are increasingly adopting the TBL CSR framework, which involves strategic planning, careful financial calculations, assessment of market conditions, and risk mitigation. By thoroughly investigating these components, sustainable profits can be attained.

The social aspect is crucial for businesses, alongside their financial matters. In order to achieve social sustainability, corporations must prioritize it within the TBL CSR framework. However, since societies vary from one region to another, each corporation needs to gather data from national authorities regarding social affairs such as unemployment rates, human rights, female labor force participation, health services, and educational services provided by the government. Once the community priorities are identified, shareholders must make decisions that aim to fulfill the social needs to the greatest extent possible. Therefore, for a business to maintain long-term stability, the social activities of the corporation must strive to meet the needs of the surrounding society as much as possible.

The ecological aspect is crucial for the Triple Bottom Line framework. Neglecting the environmental dimension could jeopardize the future quality of life for our descendants. It is imperative for businesses to adhere to environmental regulations, monitor resource consumption, and transition to renewable energy sources to reduce reliance on traditional ones like oil, gas, and coal. Furthermore, companies must safeguard air and water quality and dispose of hazardous waste responsibly to ensure environmental sustainability.

The TBL concept's adaptability enables companies to effectively incorporate social and environmental strategies in a sustainable manner. Nevertheless, T. Slaper, an economic research analyst, highlights the obstacles in implementing the TBL theory

[10]. These obstacles encompass the measurement of each category, identification of relevant data, and determination of policy's impact on sustainability. By overcoming these challenges, companies can make informed decisions for long-term success.

The Stakeholder Theory, as defined by Freeman and Reed, encompasses any identifiable group or individual that has the ability to impact or be impacted by an organization's goals [11]. In his renowned article "Strategic Management, A Stakeholder Approach", Edward Freeman emphasizes that corporations have stakeholders, referring to groups and individuals who are connected to the corporation's actions and benefit from them [11]. Therefore, stakeholder theory asserts that a corporation's objectives can only be accomplished by safeguarding and balancing the interests of various stakeholder groups. This theory serves as a descriptive framework for understanding the nature of corporations, corporate management, and how board directors consider the interests of corporate constituents [12]. Additionally, from an instrumental standpoint, the theory is utilized to establish the relationship between stakeholder management and the approach to corporate social responsibility (CSR) [13].

Once stakeholder theory and its connection with CSR have been defined, the primary concern arises regarding its implementation. To address this, corporations, particularly corporate directors and leaders, can enhance their responsiveness to the broader societal interests by involving stakeholders in the corporation's board of directors. Essentially, each stakeholder should have representation on the board to ensure their interests are taken into account. Subsequently, the board of directors will devise a strategy to align the goals of both the corporation and its stakeholders.

To effectively implement The Stakeholder Theory and uphold stakeholder ethics, it is crucial for top managers to involve all stakeholders in the decision-making process of a corporation. However, this requires stakeholders to have a comprehensive understanding of both the internal and external environment of the company. Unfortunately, there have been instances where directors in corporations have concealed vital information, such as income details or hazardous operations within their factories. However, it is important to acknowledge the inherent risk in The

Stakeholder Theory. There is a possibility that corporate directors may align themselves solely with stakeholders who prioritize profit maximization, neglecting the interests of other stakeholders such as the local community and those directly impacted by the business operations.

The similarities between the Triple Bottom Line Theory and the Carroll Pyramid Theory on the financial responsibility of corporate social responsibility are now apparent. Furthermore, the Stakeholder Theory places a strong emphasis on the shareholders' economic obligation to maximize business profits. As a result, there are disagreements and moral quandaries regarding other obligations among the three systems.

Table 1.1

Main properties and characteristics for CSR theories [4]

CSR Theory	Characteristics of CSR Theories		
	Strength of the Theory	Benefits of Applying the Theory	Challenges in Applying the Theory
<i>The Carroll Theory</i>	<ul style="list-style-type: none"> – Taking into account four main responsibilities for CSR approach: economic, legal, ethical and philanthropic – Arranging the four responsibilities in the order of the hierarchy 	<ul style="list-style-type: none"> – Revealing good citizen image for corporation – Improving the reputation of corporations 	Before implementing the Carroll CSR theory, external social and environmental situations must be studied; it will take more time and effort to apply the theory
<i>The Triple Bottom Line Theory</i>	Taking into account three main responsibilities for CSR approach: economic, social and environmental	Supporting the corporation to achieve sustainability	When using the approach any corporation has to balance between the three CSR responsibilities in order to achieve sustainable goals in society and ecology
<i>The Stakeholder Theory</i>	Taking into account the interest of various stakeholders' groups	Allowing the corporation to maintain a strong interrelation and interconnection with community and business components. If the aim is achieved, the company will gain the trust and loyalty of all stakeholders	When using the approach any corporation has to balance the interests of all stakeholders and adopt a transparent policy with them

According to The Carroll CSR Pyramid Theory, companies should focus on conducting business in an ethically, legally, and philanthropically responsible manner. However, there is a chance that businesses will overlook a wide range of other outside influences, particularly those related to society and the environment. Prior to implementing the Carroll CSR approach, a corporation must do an analysis of the social and environmental demands of the community it serves, as these elements have the potential to alter the relative importance and hierarchy of the duties assigned to it.

Businesses need to use the TBL theory to perform similarly to the Carroll Pyramid Theory in terms of social and economic considerations. However, the TBL paradigm included environmental considerations as a critical component for attaining business sustainability. The difficulty in putting the TBL CSR theory into practice is striking a **balance** between the three duties. A firm now has a moral obligation to accomplish social and ecological goals in addition to financial gain.

The interests of all stakeholders must be duly considered in corporate social responsibility programs, according to The Stakeholder Theory. It is crucial to remember that complete transparency of all business processes with all stakeholders is necessary for the use of The Stakeholder Theory. In order to maximize profits, company managers may be able to ignore community demands and abuse their influence if there is a lack of openness. It has been discovered via this investigation that the three CSR theories share a few characteristics in common. Therefore, corporations should focus on these common aspects when implementing any CSR theory. The implementation process of CSR theory can be divided into two levels: the endogenous level (inside the firm) and the exogenous level (outside the firm).

Internally, the CSR implementation process should:

- Respect human rights within the organization and meet the demands of employees.
- Comply with environmental conditions and laws, incorporating them into the production line and utilizing renewable energy sources like solar panels.
- Ensure adherence to quality standards within the facility.

Externally, the CSR implementation process should:

- Maintain transparency with all stakeholders by publishing income statements and project milestones through media and internet networks.
- Sponsor social activities outside the organization that directly contribute to the welfare of the community, such as schools, sports institutions, hospitals, and nursing homes.
- Ensure that products and services provided to consumers do not pollute the environment.

Every company should establish a specialized committee for the CSR implementation process (Figure 1.5). This committee's role is to select the appropriate corporate social responsibility theory and develop an initial plan for its implementation. Additionally, the committee should regularly review the milestones and feedback of the CSR implementation process.

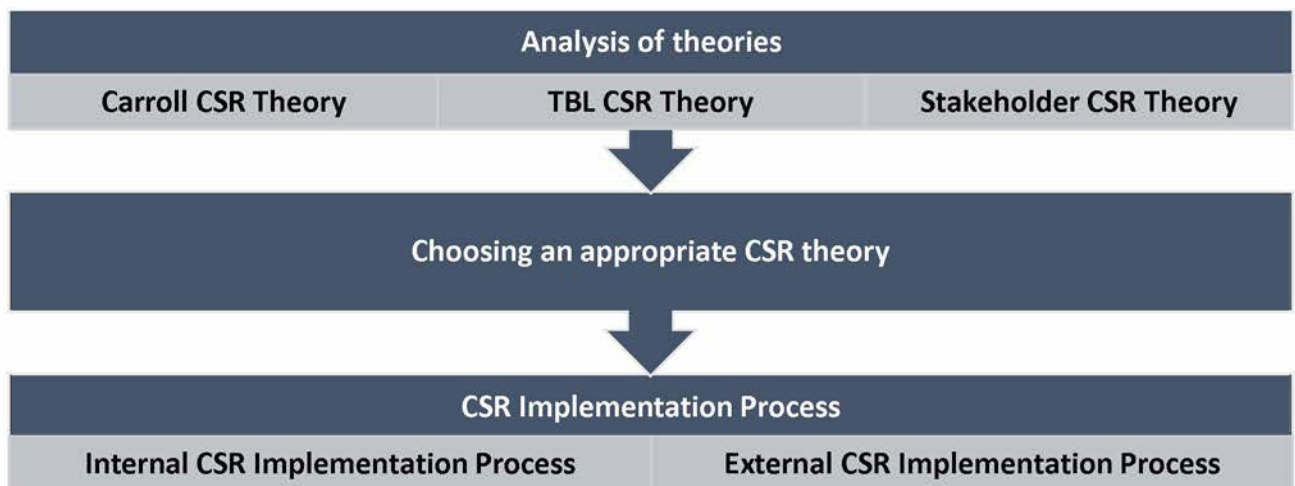


Fig. 1.5. Decision making process for implementing of CSR [14]

The operational activities of businesses have the capacity to negatively impact both the natural environment and human health and well-being. This influence extends beyond employees to encompass local communities and society as a whole. By implementing a comprehensive environmental safety management system, businesses can leverage the synergistic effects of all its components, resulting in the optimized use of vital materials and organizational resources. The integration of such a system within a business exerts a significant influence on economic, social, and environmental dimensions alike. This entails the adoption of production standards, adherence to labor

regulations, implementation of emissions and waste management policies, adoption of resource conservation measures, and more. For a business to ensure long-term viability, it must prioritize environmental preservation, resource efficiency, and the well-being of society, with particular attention to its workforce.

To effectively execute and actually realize corporate social responsibility (CSR) concepts, it is imperative to incorporate both the external and internal components of CSR. An understanding of social responsibility that is more profound and intricate is made possible by the convergence of these two elements inside the CSR paradigm. This strategy makes it possible to apply CSR concepts more thoroughly and in a balanced manner into organizational operations. Each category of corporate social responsibility action is described in terms of both internal and external orientations in the Table 1.2.

Table 1.2

Characterization of Types of Corporate Social Responsibility (CSR) [45]

CSR Type	Characterization	
	External Focus of CSR	Internal Focus of CSR
<i>Philanthropic Responsibility</i>	Supporting charitable organizations, aiding during crises and natural disasters	Developing corporate culture, employee support, social initiatives
<i>Techno-Technological and Digital Responsibility</i>	Implementation of new technologies, digital initiatives	Protection of digital infrastructure, employee digital skills training
<i>Ethical Responsibility</i>	Adhering to ethical norms in interactions with partners, clients, the public	Forming ethical corporate culture, internal control
<i>Innovative Responsibility</i>	Development of new products, technologies, and practices, investing in research	Promoting employee creativity, stimulating innovative ideas
<i>Organizational-Economic Responsibility</i>	Ensuring sustainability, interaction with investors, clients	Effective resource management, financial stability, risk management
<i>Socio-Cultural Responsibility</i>	Supporting cultural and social initiatives, collaborating with NGOs	Development of diverse social programs, creating a favorable work environment
<i>Legal Responsibility</i>	Compliance with legislation and regulatory requirements	Internal control over law compliance and establishment of corresponding procedures
<i>Environmental Responsibility</i>	Environmental consciousness, reducing environmental impact	Implementation of environmental standards, resource optimization

Organizations can improve their reputation, social relevance, and long-term sustainability by implementing both internal and external CSR strategies. This will benefit society overall in addition to their own success. This approach emphasizes how corporate social responsibility is changing to meet local demands as well as global trends, ultimately promoting a positive and mutually beneficial relationship between businesses and the communities they serve. Each indication is evaluated from the viewpoint of an enterprise stakeholder or set of stakeholders.

Corporate social responsibility not only serves as a public relations strategy but also enhances a company's competitiveness. The advantages of corporate social responsibility for businesses are as follows:

1. *Stronger brand image, recognition, and reputation* (CSR contributes to the value of companies by establishing and maintaining a positive corporate reputation and brand equity).

2. *Increased customer loyalty and sales* (customers of companies that engage in CSR feel that they are contributing to good causes by supporting the company).

3. *Operational cost savings* (investing in operational efficiencies leads to cost savings and a reduced environmental impact).

4. *Retaining key and talented employees* (employees are more likely to stay longer and be more dedicated to their company when they know that it practices CSR).

5. *Easier access to funding* (many investors are more inclined to invest in companies that practice CSR).

6. *Reduced regulatory burden* (strong relationships with regulatory bodies can help reduce the regulatory burden on a company).

The sustainable enterprise development model encompasses multiple spheres of the external environment that the enterprise engages with, utilizing corresponding management tools grounded in corporate social responsibility principles. This model encompasses organizational-economic, technical-technological and digital, ecological, legal, socio-cultural, ethical, innovative, and philanthropic responsibilities to be integrated within the enterprise. Businesses can better allocate efforts and resources towards achieving sustainable development by considering stakeholder requirements

and the specifics of their activities, aided by insights gleaned from the analysis and categorization of CSR types. Implementing social responsibility practices yields numerous benefits for management enhancement, including risk mitigation, increased market share and sales volume, enhanced reputation, investor trust, boosted employee morale, improved financial performance, strengthened relationships with government and society, and environmental preservation. Consequently, this fosters the long-term viability of the business.

1.3. The concept of environmental management in the system of waste management

The field of environmental management (EM) integrates socioeconomic, policy, and scientific aspects. Its main focus is on developing solutions to real-world issues that arise from resource extraction, waste creation, and human coexistence with nature. Environmental management, in a strictly anthropocentric sense, revolves around addressing the fundamental problem of how to continuously develop technology to evolve while minimizing the extent to which this process modifies the natural environment. Therefore, concerns about maintaining fair and equitable resource distribution, sustainable economic growth, and protecting natural resources for future generations are strongly related to environmental management. As a response to human activity, environmental management takes into account the growing gravity and importance of the catastrophic effects that humans are currently having on natural ecosystems. It is reassuring to know that, in a world with fewer people and less widespread technology use, the environment might be able to recover from human misuse and abuse on its own. However, since people have placed a higher value on economic growth than the preservation of natural ecosystems, it is now widely acknowledged that, in many cases, positive intervention is required for the environment to recover.

However, there is a great deal of dispute and dispersion regarding the direction that such intervention should take, leading to a multitude of methods for environmental

management. Deep ecology first emerged in the 1960s, alongside a surge of movements opposing technological advancement and criticizing the political foundations of authoritarianism and power. But shallow ecology, and by extension shallow ecologists, aimed to reach a consensus with those who maintained that the development of new technologies is the only way to address the planet's environmental issues. Therefore, environmental managers fit within a wide range that includes technocrats and conservationists, as well as those who would expand human interference in nature to steer natural processes in a benign direction. It is envisaged that conservationists and developers will come together to address the need for sustainable economic development that is not hindered by long-term damage to natural resources and critical habitats. Nevertheless, the degree to which it has altered the direction of environmental management globally has been severely constrained by underfunding and a lack of commitment at the national level. Any business or developmental endeavor has a considerable influence on the environment.

1. The production of goods involves extracting natural resources from the environment and transforming them into marketable items. Consequently, the production process generates different types of waste (solid, liquid, and gaseous) that find their way into the environment.

2. The activities associated with the manufacturing process, such as maintaining facilities and infrastructure, as well as packaging and transporting goods, all contribute to environmental impacts.

3. Furthermore, the products that are manufactured will eventually be discarded and become waste that enters the environment.

4. The provision of services carries a substantial environmental footprint. Service-oriented companies consume various products and energy in delivering their services, leading to the release of waste into the environment. Furthermore, the provision of services often entails resource exploitation, contributing to further environmental destabilization.

To put it simply, the environment serves as a primary source of raw materials for industrial processes and as a destination for the disposal of waste. While all companies

or organizations generate waste, not all of them extract raw materials from the environment. This responsibility lies with the companies at the initial stages of the supply chain. These raw materials undergo various processing methods as they progress through the supply chain. Eventually, products are produced and distributed to wholesalers and retailers. However, if raw materials are excessively extracted from the environment and waste is overloaded onto it, the environment becomes degraded and unstable. The goal of environmental management is to find ways to conduct business activities that minimize or stop this degradation. By doing so, we can enjoy a healthier environment and ensure its preservation for future generations.

The environment plays a vital and crucial role in our daily lives. By guaranteeing appropriate management in many areas of our lives, environmental management provides us with a higher standard of living. There are many different kinds of forces in the environment, including intellectual, physical, political, social, moral, and emotional forces. The environment is the culmination of all these outside factors that have an impact on a living thing's life, characteristics, behavior, and stages of growth, development, and maturation. Stated differently, the environment is the entirety of the circumstances around a location in space and time. Furthermore, the goal of environmental management is to limit how humans interact with the environment and affect it in, order to protect natural resources. Its main objective is to raise human welfare for both current and future generations. Basically, an environmental management framework is plan, do, check and act with a continuous cycle (see fig. 1.6).

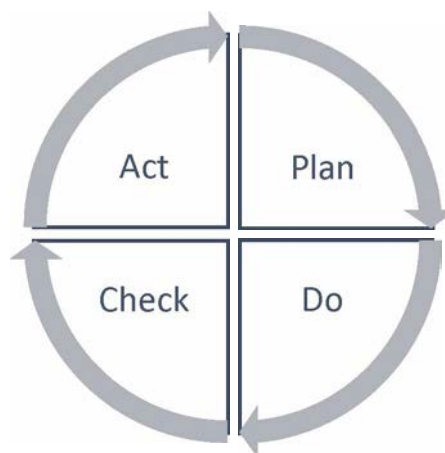


Fig. 1.6. Environmental management framework [92]

A system of environmental management is a group of actions made to guarantee that environmental problems are handled. It performs the following functions:

- adhering to environmental laws consistently;
- enhancing environmental performance as a whole;
- handling the environmental risk resulting from recent or historical actions;
- increasing funding for environmental issues;
- incorporation of environmental goals into the overarching mission and commercial goals;
- offering a workplace that is safe for the environment.

The lifetime of environmental management can be divided into three main categories:

- 1) The construction environmental management plan.
- 2) The operations environmental management plan.
- 3) The decommissioning environmental management plan.

These can be shown as follows (see fig. 1.7):

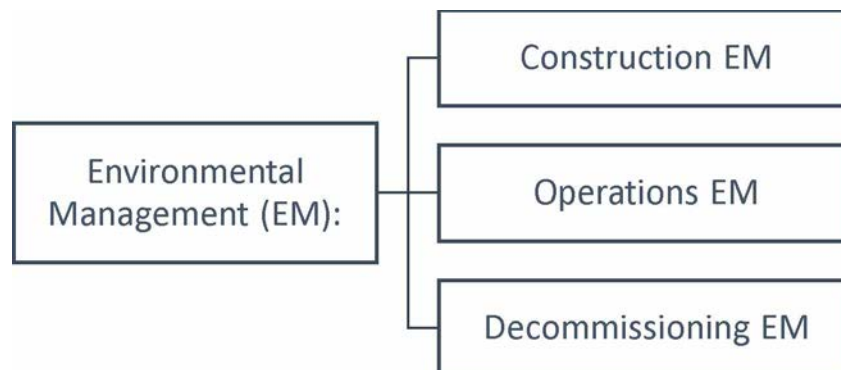


Fig. 1.7. Environmental management framework [92]

The building stage environmental management plan offers detailed environmental guidelines for a project's implementation and building stages. Its goal is to make building operations easier to manage and lessen their negative effects on the environment. These effects include those from the beginning (such as clearing the land and setting up the construction camp) and the ongoing work (such as noise, dust, erosion, and contamination of waterways). The following categories usually apply to the information supplied in the environmental management plan [92]:

- Identify the particular activity or potential impact that necessitates management;
- Decide on the measures for mitigation to be put into action;
- Identify the performance indicator;
- Identify who would be responsible for implementation;
- Identify who would be responsible for monitoring.

The environmental management plan during the operational phase includes specific guidelines for operational activities related to the specific development. The environmental management plan defines roles and responsibilities for mitigation, monitoring, and evaluation throughout the development lifecycle. Decommissioning presents opportunities for positive environmental outcomes, including land restoration for alternative uses and the cessation of impacts associated with operational activities. Yet, depending on the nature of operational activities, the necessity for risk management and addressing potential residual impacts may endure even after the cessation of activities. Examples of potential residual impacts and risks include soil and groundwater contamination, abandoned stockpiles (such as oil drums, scrap equipment, and old chemicals), and derelict structures. The decommissioning stage of the environmental management plan includes specific guidelines for managing environmental risks associated with the decommissioning phase of the project. The decommissioning phase environmental management plans are commonly found in industries like mineral mining and oil and gas extraction.

Environmental management plays a crucial role in enhancing the physical, social, and economic aspects of an enterprise or project. By promoting planned investments at the beginning of the production chain, it prevents the need for costly clean-up efforts later on. The significance of environmental management can be summarized as follows:

- To clarify modern environmental concepts like how to conserve biodiversity;
- To understand a more sustainable lifestyle;
- To utilize natural resources with greater efficiency;
- Understanding how organisms behave in natural environments;

- Understanding the interrelationship among organisms within populations and communities;
- Raising awareness and educating people about environmental issues and challenges at local, national, and international levels.

Environmental management is essential for aligning socio-economic development projects with environmental safety standards, thereby ensuring sustainable economic growth. It facilitates long-term planning and management, enabling the implementation of effective measures for both environmental management and conservation.

There are several benefits associated with implementing environmental management practices. It is important to emphasize that Environmental Management is not only a responsible choice but also a strategic decision that can enhance the overall business performance.

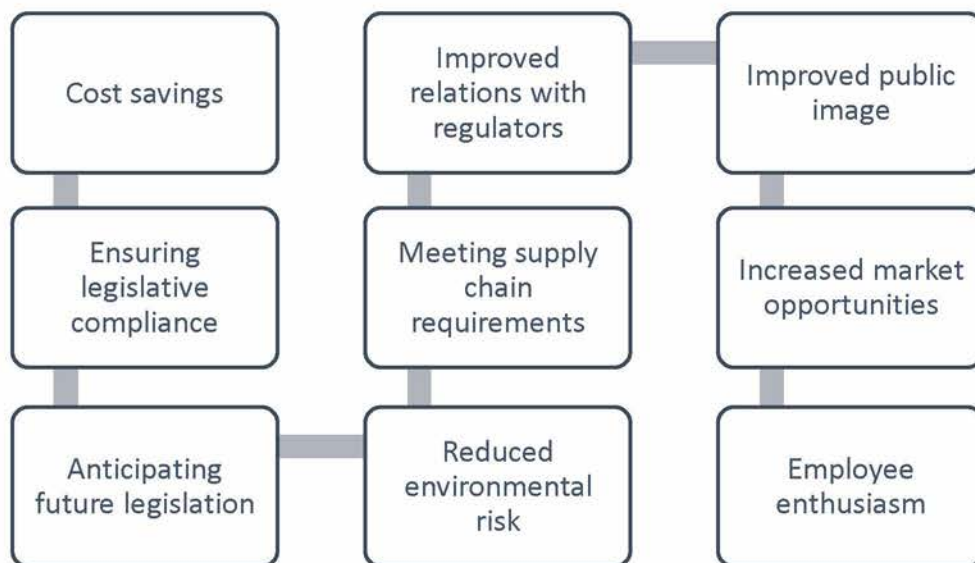


Fig. 1.8. Advantages to undertaking environmental management [92]

The majority, if not all, of individuals, aspire to safeguard the environment. Nevertheless, numerous enterprises are apprehensive that enhancing their environmental performance to protect the environment will result in financial expenses. They worry that there will be a clash between their inclination to preserve the environment and their aspiration to minimize costs and operate a prosperous enterprise. Fortunately, numerous businesses have realized that contrary to their

concerns, enhancing environmental performance actually leads to cost reduction. Several companies have discovered that by improving their environmental performance, they can often save substantial amounts of money. Cost savings within a company can be achieved through changes in such areas as:

- ✓ process efficiency;
- ✓ product design;
- ✓ waste disposal;
- ✓ sourcing of raw materials;
- ✓ infrastructure;
- ✓ packaging and transport.

Optimizing the efficiency of current procedures results in a decrease in the consumption of raw materials and energy, as well as a reduction in waste generation. This reduction in resource usage and waste production not only benefits the environment but also proves advantageous for businesses by lowering resource costs and waste disposal expenses. Ensuring proper maintenance of equipment is crucial as it effectively minimizes expensive downtime and resource wastage typically linked to shutdown and start-up periods. The implementation of innovative and enhanced procedures not only improves resource utilization but also minimizes waste generation. Numerous companies have successfully achieved significant cost reductions by minimizing their consumption of raw materials, energy, and water. It is conceivable to revamp a product's design in order to decrease the quantity of resources it encompasses, while still upholding its service quality. By enhancing process efficiency, the volume of waste generated can be diminished. After waste is generated, there is often an opportunity to repurpose it or transfer it to other companies that can utilize it, thereby avoiding the expenses associated with waste disposal.

Changing the origin of raw materials utilized in a specific process can lead to financial savings. Companies have the potential to achieve significant cost reductions by opting for recycled wool over virgin wool for their manufacturing needs, or by choosing recycled paper instead of manufactured paper, thereby preserving a substantial number of trees. Efficiency enhancements to infrastructure, such as the

installation of energy-efficient lighting, building insulation, and the optimization of heating systems, can also contribute to cost savings. Furthermore, cost savings can be realized in the packaging and transportation of goods, while simultaneously enhancing environmental performance. By ensuring compliance with pertinent environmental regulations, companies can mitigate the risk of fines imposed by regulatory bodies for noncompliance, as well as the negative media attention and public backlash that often accompany such penalties.

Being informed about possible changes in environmental legislation helps companies to plan ahead and make well-thought-out investment decisions. Without awareness of impending laws, investments made could end up being futile once the new legislation is implemented. Conversely, discovering a legislative change last minute may result in hurried investments to comply with the new regulations. Having prior knowledge of expected changes allows for a longer preparation period to make the required investments and prevent potential cash flow problems. Many companies face a significant hidden risk in the form of environmental hazards. By incorporating environmental risk assessment into their environmental management process, these companies can mitigate the likelihood of events that may result in adverse environmental impacts. Banks, insurance companies, and investors heavily rely on risk assessments to make informed decisions. The higher the risk, the less inclined banks are to provide loans, investors are to invest, and insurance premiums are likely to increase. Consequently, reducing environmental risk will be positively perceived by all these stakeholders, enabling companies to secure loans, insurance coverage, and attract investments more easily.

Large organizations are increasingly demanding that their suppliers show evidence of strong environmental management practices, and they are willing to remove those suppliers who do not comply. Merely having an environmental policy is not enough to prove sound environmental management; companies must provide evidence that they are actively working towards meeting the goals outlined in their policies. Therefore, implementing effective environmental management practices will become increasingly crucial for suppliers to obtain or retain their status with large

organizations. By showcasing effective environmental management practices, companies can potentially influence environmental regulators to adopt a more lenient approach toward regulations. This could result in a decrease in the frequency of required inspection visits. Moreover, when a company promotes its efforts to enhance environmental performance, it can enhance its reputation among the public, ultimately strengthening its position in the market. Additionally, by demonstrating responsible environmental management, a company can instill confidence in the local community regarding its operations, fostering positive community relations.

Undertaking environmental management within a company can promote a great deal of enthusiasm among employees, as it provides them with a practical means to express their environmental concerns and contribute towards enhancing environmental performance. This, in turn, can lead to lower production costs and a positive public image, ultimately resulting in increased sales and a larger market share for the company. Given the importance of sound environmental management, investing in environmental management is worthwhile. It is crucial for companies and organizations to understand how to approach this task. To successfully undertake any endeavor, one must have the appropriate tools. To effectively manage their environmental and social responsibilities, companies and organizations can employ various environmental management tools. In the early 1990s, recognizing the need for standardization in this area, the International Organization for Standardization (ISO) established a committee in 1993 with the aim of developing standards for these management tools (see fig. 1.9).

An environmental policy is a written document that clearly outlines the overall goals and intentions of a firm or company regarding the environment. Creating an environmental policy is frequently the initial action taken by firms or companies that aim to engage in environmental management. An environmental policy demonstrates a dedication to environmental management and can pave the way for additional environmental management endeavors. Environmental auditing serves as a crucial tool in ensuring that a firm or organization is in compliance with environmental regulations and best practices. For example, a legislative compliance audit verifies that the firm's

activities align with environmental legislation, while an environmental audit assesses whether waste management practices adhere to industry guidelines. Auditing is a key component of environmental management systems, as outlined in ISO 14001 and EMAS standards.

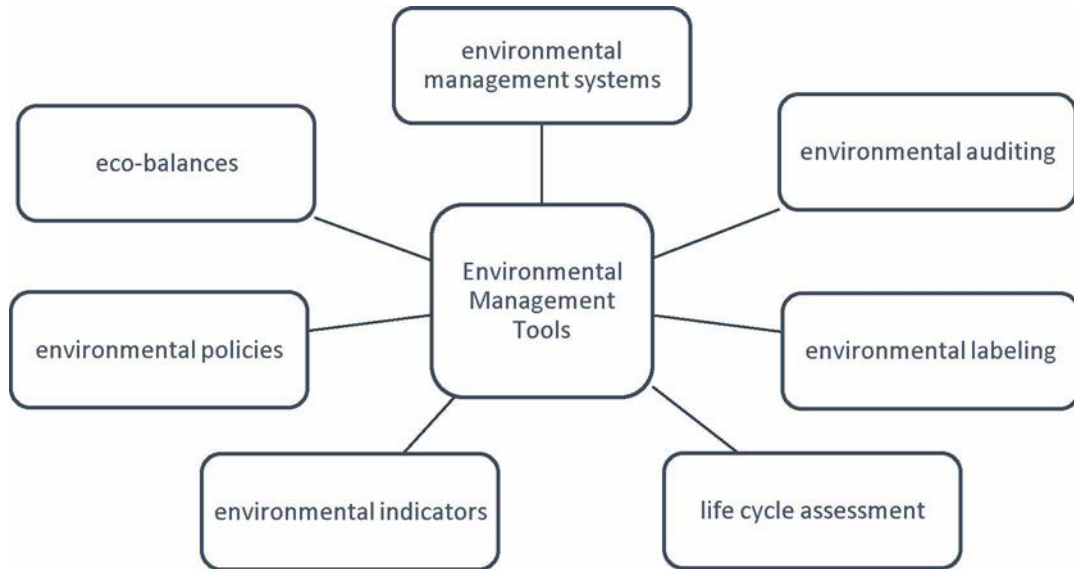


Fig. 1.9. Environmental Management Tools [92]

Environmental indicators are essential tools for companies to evaluate their environmental performance and efforts to enhance it. These indicators are not only useful within an environmental management system to monitor target achievements but can also be utilized by companies without an EMS. On the other hand, a company's eco-balance provides a detailed account of all raw materials, energy, resources, products, and wastes entering, stored at, and leaving the company within a specific timeframe. By understanding the flow of inputs and outputs, a company can analyze the environmental impacts associated with them. Consequently, an eco-balance facilitates a thorough environmental assessment as required by ISO 14001 and EMAS, enabling the establishment of targets for enhancing environmental performance.

Life cycle assessment (LCA) serves as a valuable instrument in identifying and evaluating the diverse environmental consequences linked to a specific product. LCA adopts a comprehensive perspective, examining the impacts of the product from its inception to its ultimate disposal, encompassing the acquisition of raw materials (the "cradle"), the production and utilization stages, and the final disposal (the "grave"). By

employing LCA, manufacturers can effectively explore methods to minimize the environmental footprint of their products throughout their lifecycle, while substantiating their claims regarding the environmental impact of their offerings.

Environmental certification programs provide an environmental seal of approval to products that are deemed to have less negative impact on the environment compared to others in the same category. Companies interested in obtaining this certification for their products must submit an application to the program administrator. In order to receive the certification, a product must adhere to a specific set of environmental standards established by the program administrator for its product category. These standards encompass the entire life cycle of the product and are developed using Life Cycle Assessment (LCA). The criteria are designed in such a way that only a limited percentage of products within a category, typically 20-30%, can qualify for the certification. Therefore, environmental labels can serve as effective marketing tools by indicating that a product is among the most environmentally friendly options in its category. Having implemented a range of environmental management strategies to enhance its environmental practices, a company or organization might want to share the outcomes of these efforts with the public. One effective method is by releasing an environmental report. The publication of an environmental report can enhance a company's reputation and foster better connections with stakeholders. While traditionally larger companies have been the ones to publish such reports, smaller and medium-sized companies could also benefit from utilizing environmental reporting as a valuable tool. Various environmental charters and guidelines are available for firms or organizations to adhere to, showcasing their dedication to sustainable environmental management.

An environmental policy is a formal document created by a company or organization that outlines its objectives and intentions regarding the environment. It serves as a guiding principle for the company, demonstrating its dedication to responsible environmental management. The policy must be approved by senior management and made accessible to the public. It should be seamlessly integrated into

the company's overall business strategy and align with other policies such as those on quality, health, and safety.

There are multiple justifications for developing and formulating an environmental policy. Outlining your objectives and intentions regarding the environment serves as a crucial initial step toward achieving efficient environmental management. Once this is accomplished, a company can proceed to implement the necessary measures to attain these goals. By implementing effective environmental management practices, such as adopting appropriate actions, a company can reap the benefits that come with such management. Establishing an environmental policy can significantly enhance a company's reputation among external stakeholders, including customers and the local community. Absolutely, tangible evidence of a company's commitment to its environmental policy is crucial for safeguarding its reputation. It's not just about having a policy in place, but also demonstrating through actions that the organization is dedicated to fulfilling its environmental objectives and intentions. This transparency and accountability help build trust and credibility with stakeholders.

Large corporations are growing more concerned about ensuring that their suppliers adhere to acceptable environmental management standards. Consequently, it is becoming increasingly common for these corporations to demand that their suppliers have an environmental policy in place. As a responsible company, one cannot afford to simply contemplate whether or not to develop an environmental policy. If a significant number of customers demand such a policy, the company must comply in order to avoid losing business. Instead of waiting to be asked, it is prudent to proactively prepare an environmental policy. This way, the company will be ready to meet the requirements of any customer that may request one. Prior to commencing the development of a policy, it is crucial to secure the support of senior and executive management of the company. This step will guarantee the successful implementation of the policy once it is finalized. A method to demonstrate management's dedication is to have the policy endorsed by key figures such as the company's chairman or chairwoman, as well as the chief executive officer or managing director.

A system is a collection of interconnected elements working together towards a specific goal. In the context of environmental management, an environmental management system (EMS) is comprised of various interconnected elements that collaborate to achieve the goal of effective environmental management. Many large companies have implemented EMS for several years, tailoring their systems to meet their specific requirements, resulting in a wide range of system configurations. The International Organization for Standardization (ISO) has developed a common model for EMS, outlining the essential elements that should be included. This standardized model is globally applicable to organizations of all sizes and types, as detailed in the ISO standard. It is essential for all employees whose tasks could have a notable effect on the environment to undergo the necessary training. They should be informed about the significance of complying with the EMS requirements, the environmental consequences of their work, and the advantages of enhancing their individual performance, duties, and responsibilities in ensuring the EMS operates effectively. Staff members carrying out activities that could result in significant environmental impacts must be considered competent. Their competence is evaluated based on their education, training, and experience.

The company should develop and uphold appropriate communication procedures within the organization concerning the EMS. Additionally, it should create mechanisms for receiving and addressing pertinent communications regarding its EMS from external entities. The company is obligated to identify activities linked to the significant environmental aspects outlined in its goals and targets. Subsequently, it must formulate documented operational procedures for these activities to ensure that the objectives and targets are achieved even in the absence of established procedures. Furthermore, the company must set up procedures concerning the significant aspects of the goods and services utilized by the company. All relevant procedures should be conveyed to suppliers and contractors. The company is required to create and uphold documented protocols for regularly monitoring and assessing the areas covered by the objectives and targets. This is done to determine if the objectives and targets have been achieved. Additionally, the company must establish and maintain a documented

procedure for periodically evaluating compliance with relevant environmental laws and regulations. The organization must also establish and maintain procedures for identifying, maintaining, and disposing of its environmental records. These records should include training records, audit results, and management reviews. Additionally, the management of the company must conduct periodic reviews of the environmental management system to ensure that it continues to meet the company's needs. During these reviews, the potential need for changes to the company's policy, objectives, and other elements of the environmental management system should be addressed.

The dedication to ongoing enhancement and pollution prevention necessitates the establishment of fresh objectives and targets. As circumstances evolve, such as the launch of new products and processes, the development of new procedures and the assignment of new roles and responsibilities will be imperative. An EMS not only mandates that companies establish targets, but also guarantees their achievement. Companies must create a management plan to reach their targets, ensure the availability of resources for implementation, monitor environmental performance to assess target achievement, and take corrective measures if necessary.

Thus, dedication to ongoing enhancement and pollution prevention necessitates the establishment of fresh objectives and targets. As circumstances evolve, such as the launch of new products and processes, the development of new procedures and the assignment of new roles and responsibilities become imperative. The rise in complexity has also led to the emergence of new terms and ideas, such as sustainability and sustainable development, corporate social responsibility and corporate governance, as well as innovative concepts to environmental management. Environmental management has seen advancements in various areas, including a shift from advocacy to goal-oriented strategies, a move from top-down to bottom-up approaches, a transition from reactive to proactive methods, a focus on regional and global issues rather than just local ones, and a shift towards interdisciplinary collaboration.

Conclusions to chapter 1

Thus, the results of this study are shown that it is widely accepted that waste management services are crucial services that should be available in all communities. Waste can present itself in diverse forms, and its classification can take on various dimensions. Several typical traits are utilized to categorize waste, such as its physical state, properties, potential for reuse, biodegradability, origin, and its environmental impact magnitude.

Waste management theory offers a conceptual framework for understanding waste management practices, defining key concepts and proposing methodologies for effective waste handling. Central to this theory is the premise that sustainable waste management hinges significantly on how we define and categorize "waste." The notion of "waste" is intricately tied to human activities and lifestyles. Communities, households, and economies rely on a continuous supply of air, water, food, raw materials, and fossil fuels.

The best alternative to waste disposal is to prevent its generation. That's why all waste management strategies aim for waste prevention. Various technologies can be deployed throughout a product's life cycle – from production to use to post-use – to eradicate waste and, consequently, mitigate or prevent environmental pollution. Representative strategies encompass environmentally conscious production methods, such as employing less hazardous materials, implementing modern systems to monitor hazardous material storage, and adopting innovative techniques for chemical neutralization and water conservation.

Indeed, the operational practices of businesses can have negative repercussions on both the natural environment and human health and well-being. This impact isn't limited to employees but extends to encompass local communities and society as a whole. Establishing a comprehensive environmental safety management system allows businesses to leverage the synergistic benefits of all its components, thus optimizing the use of vital materials and organizational resources. The adoption of such a system within a business profoundly influences economic, social, and environmental aspects.

This comprehensive approach involves adhering to production standards, labor regulations, emissions and waste management protocols, implementing resource conservation initiatives, and more. To guarantee long-term viability, businesses must prioritize environmental stewardship, resource efficiency, and societal well-being, especially that of their workforce.

Implementing corporate social responsibility (CSR) strategies can enable organizations to bolster their reputation, social relevance, and long-term sustainability. Additionally, this study confirms the pivotal role of environmental management in enhancing the physical, social, and economic aspects of an enterprise or project. By advocating for planned investments at the outset of the production chain, it helps prevent the necessity for expensive clean-up efforts later on.

The field of environmental management encompasses socioeconomic, policy, and scientific dimensions, with a primary focus on devising solutions to real-world challenges stemming from resource extraction, waste generation, and human interaction with nature. In a strictly anthropocentric context, environmental management revolves around tackling the fundamental issue of continuously advancing technology while minimizing its impact on the natural environment.

The main scientific results were published in the following scientific articles: 89; 168; 169; 170; 171; 172; 173; 174; 175; 176; 177.

CHAPTER 2

RESEARCH OF GLOBAL WASTE MANAGEMENT AND CORPORATE SOCIAL RESPONSIBILITY

2.1. Analysis of waste management in the system of circular transformation

There has always been waste. This was accepted as a part of life in rural civilizations. Trash used to be dumped right outside the house and would break down quickly. However, as urbanization increased, social and public health issues emerged. The first cities in Europe to focus on enhancing hygienic conditions and hygiene were Roman and Ottoman cities. Nevertheless, their efforts were unable to keep up with the medieval cities' rapid expansion. Diseases spread more rapidly due to the waste issue, indicating the need for further expansion of waste management efforts. Waste accounts for 20 percent of methane emissions caused by human activities worldwide. With a potency 80 times higher than carbon dioxide, these emissions will continuously cause detrimental effects on the environment and economy, and, if not addressed, will create a major obstacle to the achievement of the United Nations Sustainable Development Goals.

The cholera outbreaks during the mid-19th century led city authorities to recognize the need for improvements in drinking water, sewage systems, and waste disposal. By 1900, most European cities had incorporated city cleaning into their responsibilities. Initially, waste was disposed of in open dumps just outside city limits, with informal workers salvaging the discarded materials for income. In the early 20th century, waste management in Western countries advanced with the introduction of motorized collection, standardized household bins, and regulated dumpsites. Despite efforts to address environmental and health concerns, urban expansion brought residents closer to these dumpsites, leading to issues such as odor, pests, and pollution. Although measures like fencing and daily coverage were implemented, the challenge of waste management persisted. This problem continues to affect communities

worldwide, with waste often being disposed of in open dumps, resulting in environmental and health hazards.

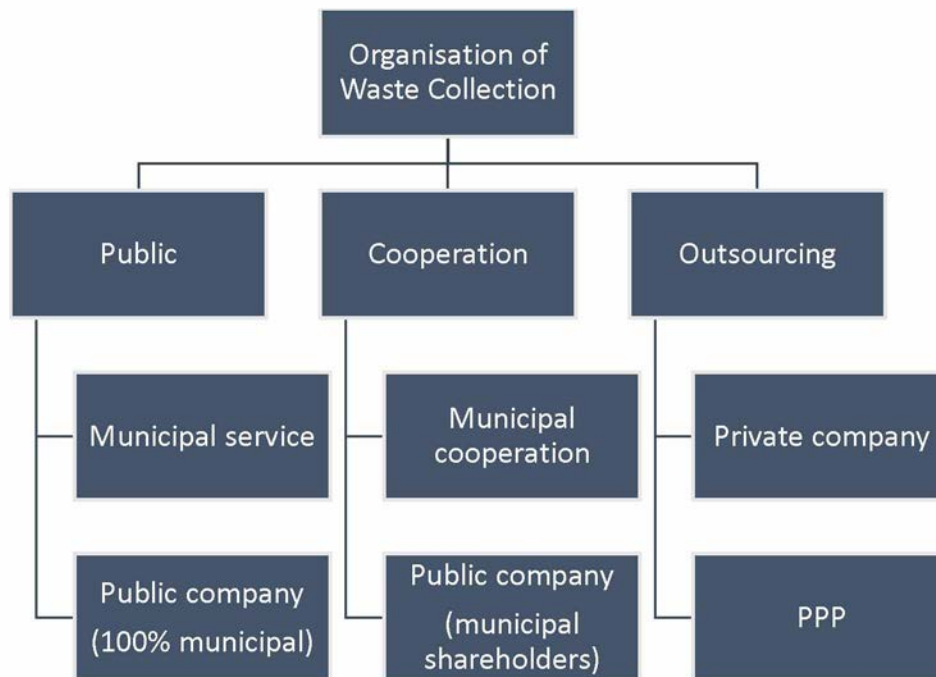


Fig. 2.1. Waste collection collaboration options for municipalities [97]

Due to the growing scarcity of available space, metropolitan authorities implemented waste incineration. Moreover, an alternative method was devised that involved moving garbage over further distances – sometimes even to neighboring municipalities – by train and boat to alternate disposal sites. After many instances of harmful discharges from incinerators and leaking landfills, waste disposal management progressively improved. There were different attempts made to reduce the emissions and pollution caused by disposal sites. In order to reduce the dangers to leachate and groundwater, bottom floor liners were installed, and landfill biogas was recovered. Dioxins were discovered when garbage incinerators' emissions were examined. These dangers demonstrated the need for significant increases in expenditure and waste disposal expertise to safeguard the environment. It became apparent that handling waste disposal solely at the municipal or provincial level was no longer adequate. The efficiency of sanitary landfills and waste incineration plants relied heavily on increasing their capacities. As a result, neighboring municipalities began collaborating

to achieve economies of scale. In certain instances, public authorities partnered with private companies to ensure sufficient financing and effective operations.

In Western Europe, there was a decline in the number of landfills while the prevalence of larger incinerators concurrently increased. This resulted in extended transportation distances for waste and intensified local impacts at these facilities. To mitigate the negative effects caused by these methods, policies were implemented to enhance environmental safeguards and reduce waste volumes through recycling. The options for sustainable waste management expanded further with the introduction of separate waste collection, organic waste composting, landfill bans, and landfill taxes. Additionally, the 'waste hierarchy' (Ladder van Lansink), which was introduced by A. Lansink, a member of the Dutch Parliament, in 1979, provided a prioritized list of waste treatment alternatives. This hierarchy begins with waste prevention and concludes with disposal. This led to significant price and tax increases, followed by greater recycling and waste prevention. The volume of trash directed to landfills decreased significantly, driven by the private sector and individual municipalities' adaption of recycling efforts.

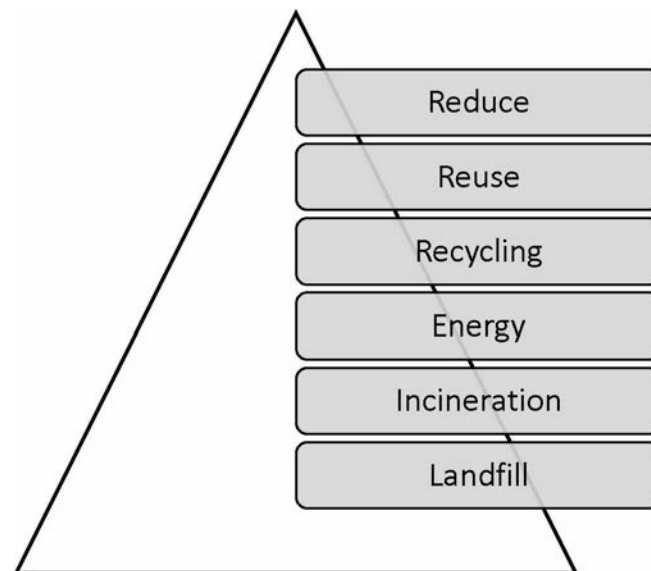


Fig. 2.2. Waste hierarchy [106]

Legislation has been introduced in the EU to encourage member nations to improve the organization of their waste systems. The Waste Framework Directive,

which established waste regulation at the EU level, progressively increased recycling targets and established distinct collection guidelines for various waste streams. It also brought in new regulations that discourage waste from being disposed of in landfills or incinerators. In Art. 4, the Directive established a legally obligatory framework for decision-making that prioritizes avoidance and reuse (the waste management hierarchy).

The Waste Shipment Regulation governs the cross-border transport of waste within the EU. It establishes the guidelines for waste transportation between different member countries, setting a minimum standard for waste management practices and promoting fair competition. This facilitated the development of a regulated market, thereby increasing the intra-EU trade of various types of waste for treatment, including household and hazardous waste. Additionally, the implementation of landfill taxes by European governments played a crucial role in steering economic activities towards more sustainable waste management practices. By increasing the cost of landfilling waste, these taxes incentivized the use of more environmentally friendly treatment options, gradually shifting societal behavior towards more sustainable waste management practices.

Subsequently, the concept of Extended Producer Responsibility (EPR) was introduced to enforce the "polluter pays" principle. This approach requires producers and importers to bear the financial and operational responsibility for the collection, recycling, and safe disposal of their products. By shifting the cost burden from municipalities to consumers, particularly for items like packaging waste, batteries, car tires, and electronic equipment, EPR aims to encourage producers to offer more sustainable products. The revenue generated from EPR has facilitated the development of essential waste management infrastructure that would have been challenging to fund through public budgets.

In certain nations, significant investments have been made by both public and private sectors in waste incineration capacity, commonly known as energy-from-waste or waste-to-energy plants, when combined with energy recovery. These facilities, which require substantial initial investments and have a lengthy pay-back period, must

operate continuously. State-of-the-art facilities extract the energy content from waste in the form of electricity and heat. Metals and non-ferrous metals are reclaimed from the bottom ashes, while a portion of the ashes are transformed into aggregates for the construction sector. Careful planning of waste incineration capacity, not exceeding the projected future non-recyclable waste fraction, is crucial to prevent them from hindering efforts to increase recycling rates [107]. In countries like the Netherlands, where landfilling is limited and waste incineration rates are relatively high, an incineration tax has been implemented to encourage recycling alternatives.

The global waste management situation is unprecedented. Currently, only 67% of the world's solid waste is properly collected, while 33% is disposed of in the open. Waste production has seen a significant increase in recent years.

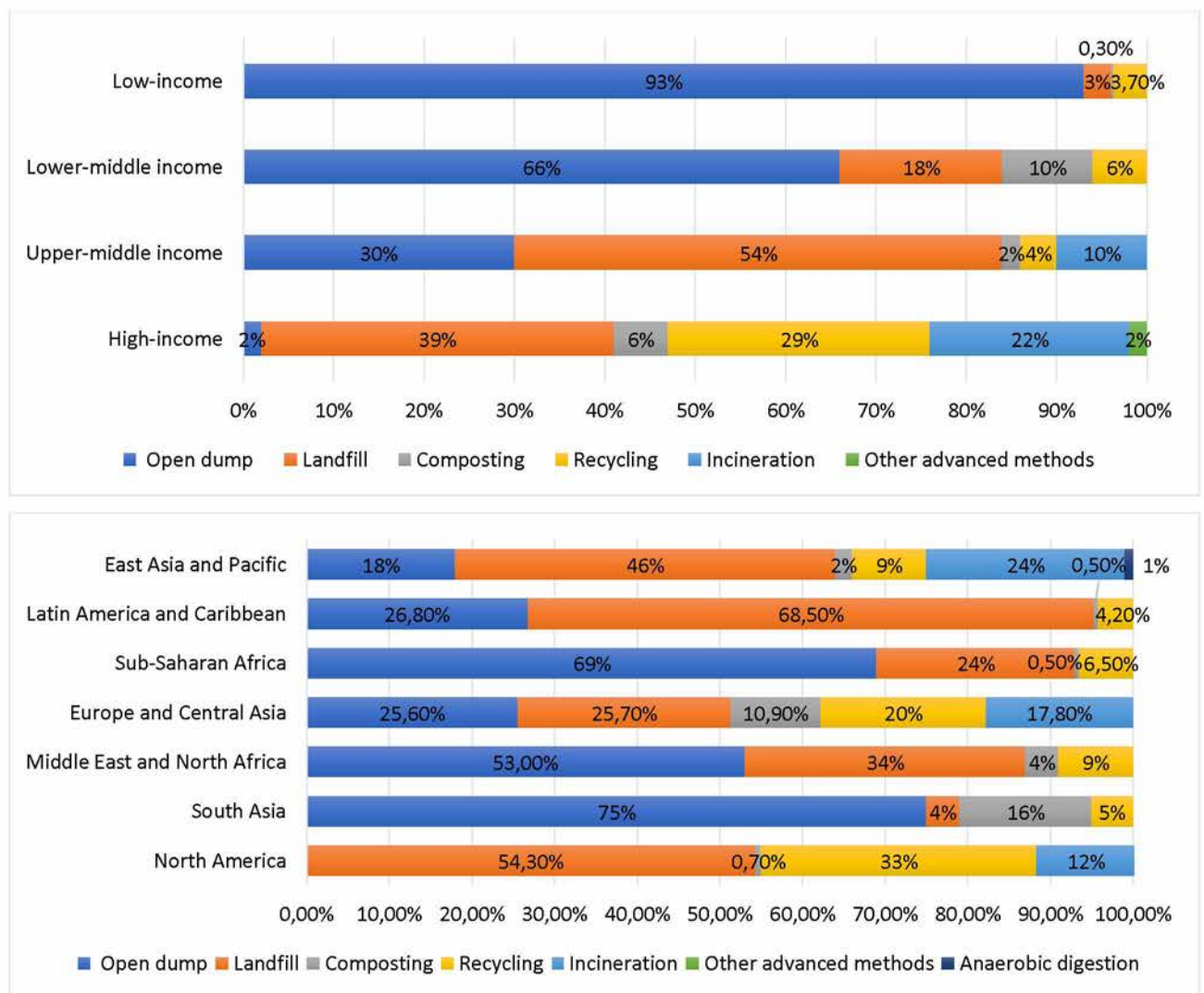


Fig. 2.3. Disposal methods by Income [93]

In 2016, approximately 2 billion tons of municipal solid waste were produced, a figure that is projected to rise to 3.4 billion tons by 2050 if current trends continue. By 2050, it is anticipated that waste production will be 70% higher than in 2020 [94]. The situation is particularly concerning in low-income countries, where waste generation is expected to more than triple by 2050 due to increased production and consumption. This poses challenges for authorities at all levels. From a circular economy perspective, over 90% of resources extracted from the planet end up as waste, with only around half a trillion tons of virgin materials re-entering the economy each year. Overall, our world is currently only 8.6% circular.

Over 90% of waste in low-income countries is still burned or dumped, despite municipalities in these nations allocating, on average, 20% of their budgets to waste management. European nations continue to face waste issues as well, with many still placing a strong emphasis on energy recovery and disposal over recycling and other more circular methods. Annual global spending on solid waste management is expected to rise from today's US\$205 billion to over US\$380 billion by 2027. Operating expenses for integrated waste management – which include collection, transportation, treatment, and disposal – typically surpass \$100 per ton in high-income nations. Lower-income nations spend less on waste operations – an average of \$35 per ton, sometimes more – but they have a far harder time recovering their expenditures [95].

The recycling industry has evolved into a worldwide enterprise with global markets and intricate supply and transportation systems [96]. Nevertheless, it is crucial to acknowledge that the waste management industry heavily depends on the dedication of over two million informal waste pickers, especially in low and middle-income nations. This informal sector encounters unique obstacles and should receive backing from governmental policies, as it plays a vital role in providing waste management services to communities. Policy alternatives exist that can empower and legitimize the informal waste sector, but they must be executed with caution and inclusivity to ensure the sustainability of livelihoods for individuals.

When discussing waste, individuals tend to concentrate on Municipal Solid Waste, commonly referred to as household waste. However, it is imperative to

acknowledge that household waste represents just a small portion of the total waste generated by a nation.

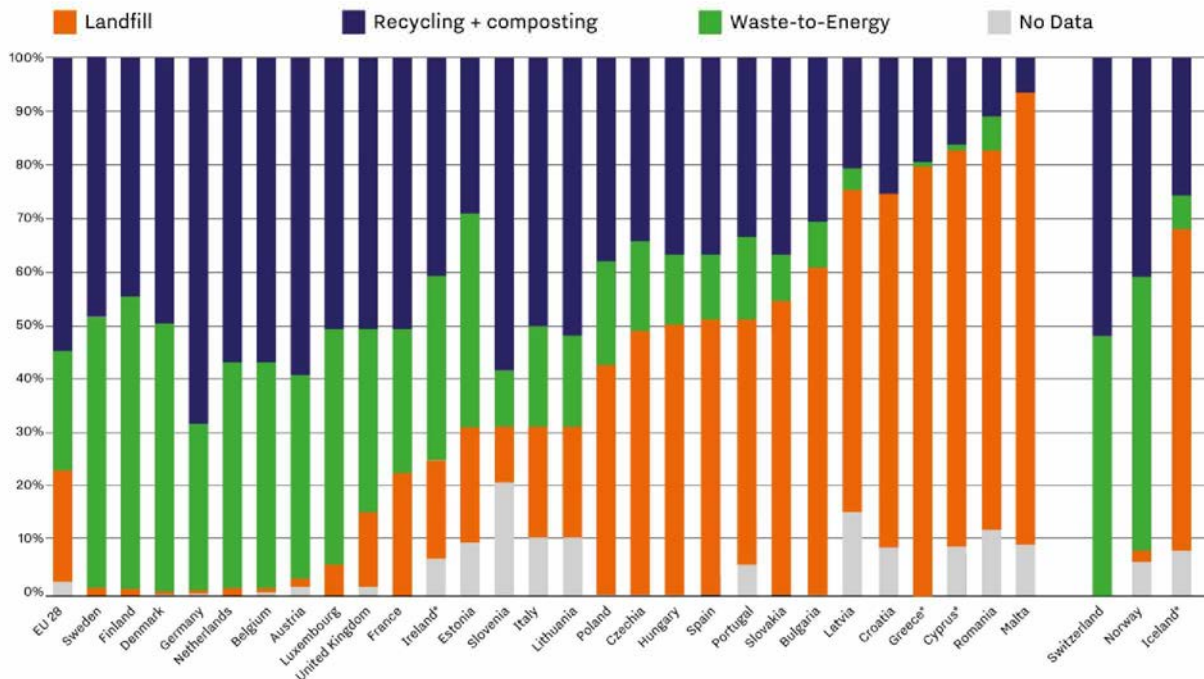


Fig. 2.4. Municipal waste treatment, 2018-2022 [97]

The composition of municipal solid waste varies depending on the country's waste segregation system. In regions without proper waste management, organic matter, such as garden and kitchen waste, can account for over 60% of the total waste by weight. Different types of waste require specific attention:

Electronic waste: This category is experiencing the fastest growth rate and is projected to increase by 38% from 2019 to 2030. Currently, only 17.4% of electronic waste is collected and recycled [100].

Plastic waste: Approximately 32% of plastic waste ends up leaking into the environment. Out of the total plastic waste, 40% is landfilled, 14% is incinerated, and 14% is recycled [101].

Plastic pollution in the oceans: An estimated 3% of global plastic waste finds its way into the oceans [102].

Food waste: Despite 811 million people facing hunger worldwide, one-third of all food produced is lost or wasted, resulting in an annual financial loss of around US\$ 1 trillion [103].

Improper waste management can be viewed as a situation where a valuable resource has been misdirected, primarily due to the absence of effective enforcement of public policies. In the absence of proper regulations, waste tends to follow the path of least resistance, leading to illegal dumping as the most cost-effective disposal method. Mismanaged waste, especially municipal solid waste, not only contributes significantly to marine litter but also adds to greenhouse gas emissions by 5% [104].

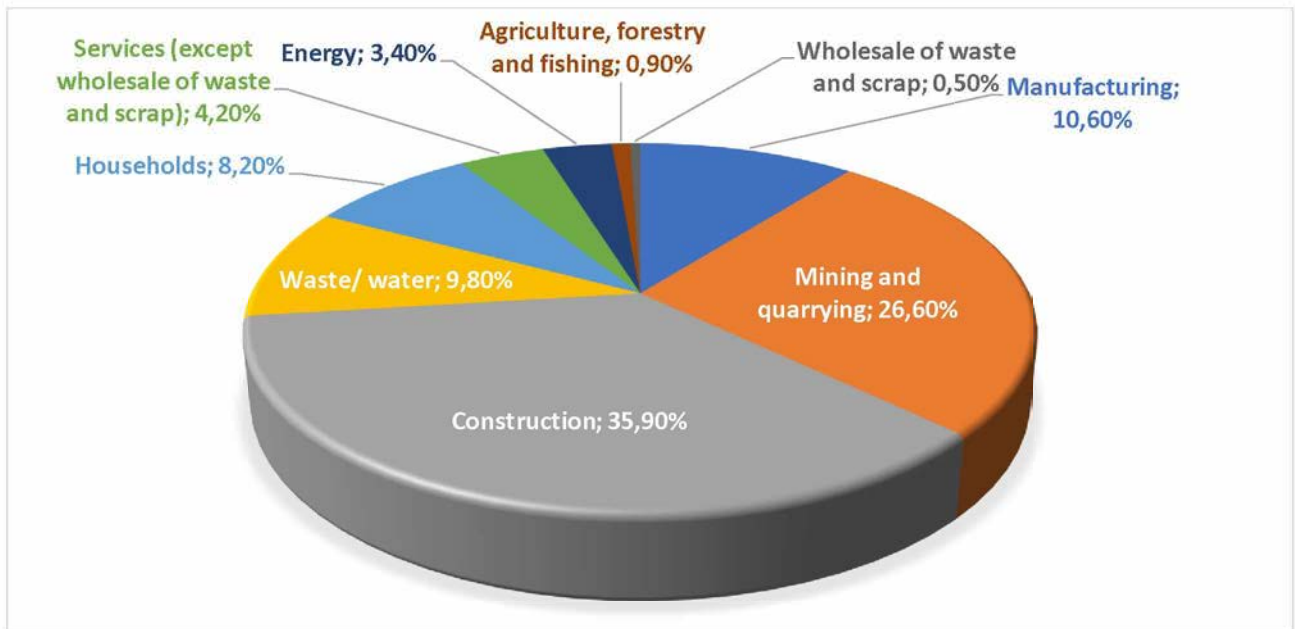


Fig. 2.5. Waste generation by economic activities and households, EU, 2020 [98]

Several waste flows can be distinguished, often referred to by different names: 1) Municipal Solid Waste (made up of source-separated waste and residual waste) or Household waste; 2) Commercial and Industrial waste; 3) Construction and Demolition waste; 4) Hazardous waste (for example from the chemical industry); 5) Waste from Mining, quarries, etc. *Specific waste flows include:* a) Organic waste; b) Waste from Electrical and Electronic Equipment (WEEE); c) End-of-Life (EoL) vehicles; d) Medical Waste.

Solid waste management is a significant issue in both developed and developing countries, as stated in various literature sources. The rapid urbanization of the world poses a challenge for cities, which bear the responsibility of managing waste in a socially and environmentally responsible manner. Effective waste management solutions depend on local waste characteristics, which are influenced by cultural, meteorological, and socioeconomic factors, as well as institutional capabilities. On a global scale, waste management is becoming more regionalized and structured. Developed nations typically have formal control over waste at the municipal or regional level, as their residents produce a significantly higher amount of waste compared to citizens of other countries. In less-industrialized countries, where citizens generate less waste, which is predominantly biogenic, waste management involves a combination of formal and informal actors [112]. A decade ago, there were 2.9 billion urban residents who produced approximately 0.64 kg of municipal solid waste (MSW) per person per day, resulting in 0.68 billion tons of waste annually. However, recent research indicates that these volumes have already increased to nearly 3 billion inhabitants, generating 1.2 kg of waste per person per day, equivalent to 1.3 billion tons per year. It is projected that by 2025, the number of urban dwellers will reach 4.3 billion, resulting in an estimated 1.42 kg/capita/day of municipal solid waste [113].

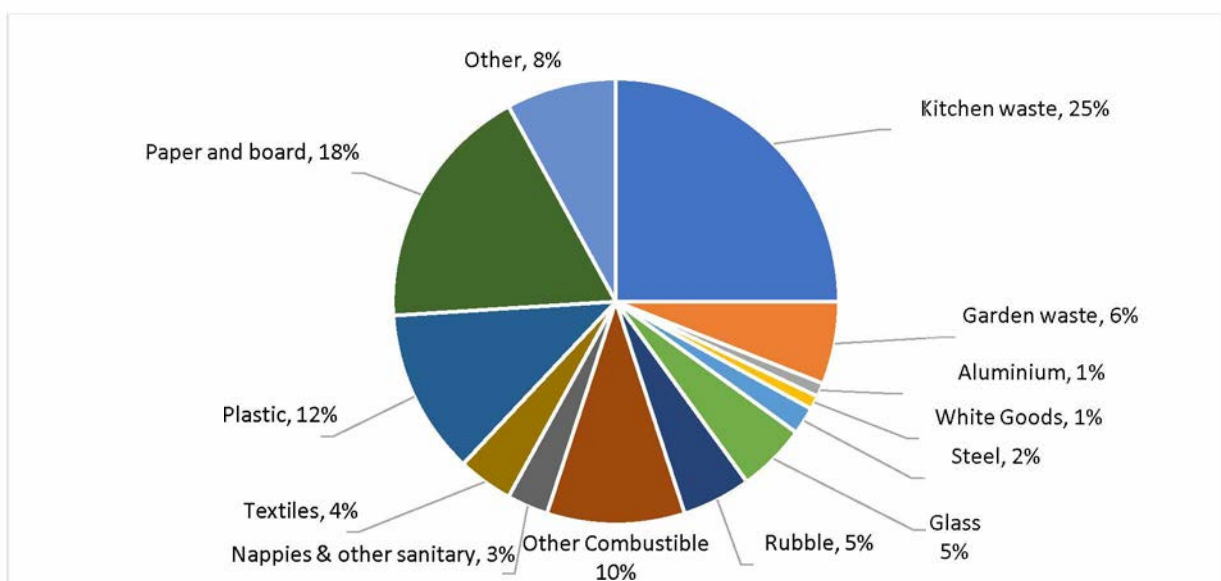


Fig. 2.6. Municipal solid waste composition EU 27, 2020 [99]

The mismanagement of waste presents serious risks to the environment and human health, impeding progress in human and urban development as well as economic growth, thereby acting as a hindrance to overall prosperity. Failure to effectively address waste management issues will significantly impede progress towards achieving the Sustainable Development Goals set by the United Nations, especially SDG12, which emphasizes sustainable consumption and production patterns. It is imperative that waste-related challenges are addressed promptly. The encouraging news is that with collective effort and commitment, these challenges can indeed be overcome.

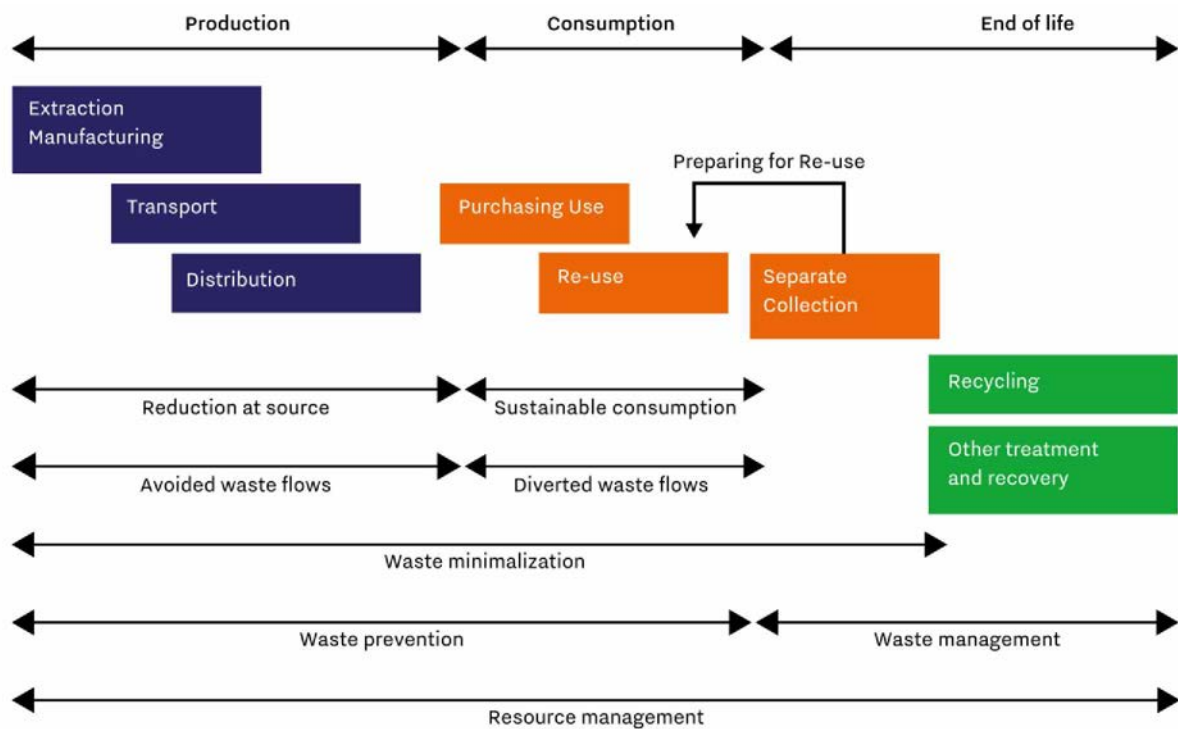


Fig. 2.7. Transition from linear waste to circular resource management [105]

Waste collection has traditionally taken place at the doorstep, with municipalities primarily focusing on collecting unsorted municipal waste. However, private companies and the informal sector have been more involved in collecting valuable materials like metals. To promote effective recycling, it is crucial to have waste collection systems that are easily accessible and user-friendly. Currently, many countries mandate separation of waste at the source to prevent selective collection of

valuable components solely when the market price is favorable. By separating waste at its origin, it becomes easier and often more cost-effective to extract value from the waste stream. In Europe, a common practice is for households to have a three-bin system. One bin is designated for dry recyclable waste, another for organic waste, and the third for residual waste. The dry recyclables are further sorted into specific material categories at material recovery facilities.

Currently, it has become common for households in Europe to divide their waste into various categories, such as paper and cardboard, glass bottles of different colors (green, white, and others), spent batteries, small electronics, light bulbs, organic waste, packaging materials, small chemical waste, and residual waste. In addition to the door-to-door collection, there are also environmental stations or Household Waste Recycling Centres (HWRCs) where individuals can bring their bulk waste and separate it into even more fractions. These HWRCs typically have the capacity to handle 20 different types of waste. As a result, citizens are increasingly faced with numerous waste disposal options, making it difficult to keep track of which type of waste should be placed where. To further encourage waste separation, "Pay as You Throw" (PAYT) systems have been implemented. Under these systems, individuals are charged more if they deposit a larger amount of residual waste. Both volume-based and weight-based PAYT systems are currently in use.

A well-established infrastructure for collection and recycling exists for materials like glass and paper, enabling reuse over multiple life cycles. However, the presence of wet organic waste in municipal solid waste (MSW) impedes the recycling process for the mixed fraction. If this organic waste is separated at its source, it can be transformed into high-quality compost or biogas through digestion. The biogas produced can then be utilized for heat, electricity, or further refined into fuel or other molecules. Plastic packaging can also be sorted into different categories, such as PET, PP, PE, beverage cardboard, or foils. Additionally, construction and demolition waste constitutes a significant portion of a country's waste, primarily due to its heavy nature. Through mechanical recycling, valuable elements like metals, plastics, and wood can be recovered, while aggregates can be processed to meet the required standards for

applications in road foundations or concrete. Hazardous waste can be effectively destroyed or neutralized, and its energy content recovered, for instance, through incineration in cement kilns. Alternatively, it can be safely and permanently stored in dedicated landfills.

The significant volume of waste generated is a prominent consequence of the linear economy. Numerous products are still designed for single use. An increasing number of individuals are recognizing the detrimental impacts of a linear economy. The depletion of resources and global tensions have highlighted people's reliance on goods from distant markets. This growing awareness has propelled the rapid advancement of the circular economy. Efficient waste management, incorporating the 3-R approach of "REDUCE, REUSE, RECYCLE", can serve as a precursor and driving force for the circular economy. By addressing waste management, nations can enhance public health, sanitation, and environmental conditions, and reintegrate resources back into the economy.

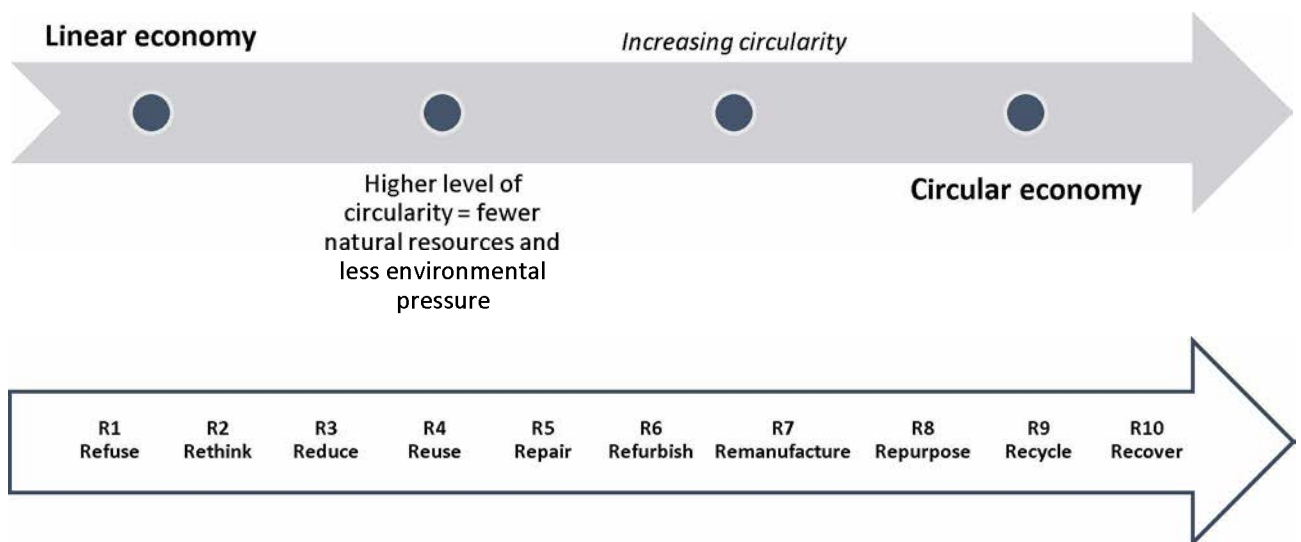


Fig. 2.8. Levels of Circularity [108]

Circular economy builds upon previous understandings of resource limitations and emphasizes the necessity for a shift in mindset away from linear production and consumption patterns of "take-make-discard". It encompasses the entire lifecycle, from

design and production to utilization and waste management, rather than solely focusing on recycling and waste recovery. Emphasis on eco-design involves the creation of innovative business models and more sustainable products that are durable, energy-efficient, and easily repairable or refurbishable. Additionally, it involves reducing unnecessary consumption. In the pursuit of a circular economy, the 3-R strategy has evolved into what is now known as the 10-R approach. This method focuses on enhancing the production and utilization of products through the principles of Refuse, Rethink, and Reduce. Additionally, it emphasizes extending the lifespan of products and components through the Reuse, Repair, Refurbish, Remanufacture, and Repurpose principle. Ultimately, at the end of the value chain, the focus shifts towards the valorization of materials through Recycling or, if not feasible, the recovery of embedded energy.

Waste management is a vital component of any circular economy framework, serving as the cornerstone upon which circularity can be established. It has been emphasized that a functional waste management system is essential for the realization of a circular economy. However, the absence of a perfect waste management system should not deter from the efforts towards achieving circularity. Waste management addresses past issues, while circular economy practices focus on keeping materials in circulation today and implementing effective design strategies to prevent future waste. By adhering to circularity principles, it is possible to minimize waste generation and facilitate advancements in sustainability. Furthermore, the transition to a circular economy is imperative for achieving Climate Goals, with the potential to significantly reduce emissions from heavy industry by up to 56% by 2050 [109] through materials recirculation, product materials efficiency, and circular business models.

Waste management is pivotal in circular solutions. Effective waste management holds the potential to contribute up to 20% towards future solutions. [110], as opposed to its current status of only 5% in addressing the climate problem [111]. Recent observations from space have underscored that methane emissions from organic waste in landfills constitute a noteworthy contributor to greenhouse gas emissions. Through recycling and conversion of organic and other waste into materials and energy, these

emissions can be offset and avoided altogether. Implementing proper waste management practices not only mitigates health, hygiene, and environmental issues but also facilitates the reintroduction of valuable resources back into the economy. This, in turn, contributes to the reduction of the overall costs associated with inadequate waste management.

Consumer products that are discarded improperly, like toys, pharmaceuticals, personal care items, food additives, and plastic waste, have the potential to pollute the environment with harmful substances that can enter water sources and the human food chain. These pollutants, which are referred to as endocrine-disrupting chemicals, consist of substances that imitate, obstruct, or disrupt the hormones in the body. Endocrine-disrupting chemicals, such as cadmium, asbestos, and arsenic, elevate the risks to health by causing conditions like cancer, cognitive disorders, obesity, and reproductive issues in both genders. Implementing a circular economy strategy for municipal solid waste management would yield substantial cost savings. By prioritizing waste reduction and promoting recycling, the projected annual expenses could be reduced to less than \$255 billion. This circular approach not only mitigates the risk of rising waste management costs but also leads to significantly enhanced environmental performance.

The World Economic Forum is implementing several initiatives related to the circular economy. These initiatives extend beyond waste management, aiming to effect broader systemic changes across various industries. They involve collaboration to exchange knowledge, case studies, products, and materials related to the circular economy. By implementing policy changes, providing financial support, and shaping the narrative, the government has the potential to establish favorable conditions for the widespread adoption of zero-waste systems. To achieve this adoption, it is crucial to mobilize a global network of allies and prioritize responsible waste policies that focus on critical areas. These areas include securing international and local funding for zero-waste systems, developing comprehensive roadmaps and regulatory frameworks to facilitate their implementation, and integrating zero-waste goals into local and national climate plans, such as methane reduction roadmaps.

2.2. Evaluation of the features of corporate social responsibility under instability

The concept of corporate social responsibility (CSR) emerged in the late 20th century and is currently in the process of being widely accepted. As a result, there is no universally agreed-upon definition, but the fundamental principle remains unchanged – businesses should have a social orientation towards their employees, the government, society, the environment, and consumers. In various developed frameworks, social responsibility is sometimes referred to as "corporate social activity" or "business ethics" [123]. Corporate social responsibility has become an integral part of the management system and holds significant importance. It encompasses several stages of development. The initial stage of BSR formation (1920s-1950s) was led by H. Bowen (1953) in his research on "Social Responsibility of a Businessman." According to Bowen, a businessman's social responsibility lies in implementing policies, making decisions, or adopting behaviors that align with society's goals and values [115]. Similarly, P. Drucker (1986) identifies public responsibility as one of the eight key factors for achieving business objectives in his research on "Management Practice." [119]. During the second stage of BSR (1970s), the term "social responsibility" was combined with business ethics, with a particular emphasis on volunteering. M. Friedman (1970) defines social responsibility of business as utilizing resources and engaging in activities that aim to increase profits within the framework of open and free competition [120]. A. Carroll (1999) states that business social responsibility entails meeting the economic, legal, ethical, and philanthropic expectations set by society during this period [117].

The connection between business and sustainable development was strengthened during the third stage of social responsibility in the 1980s. This period saw the development of M. Friedman's stakeholder theory, discussions on the organizational structure of business social responsibility management, and the introduction of the concept of sustainable development. Moving on to the fourth stage in the 1990s, the business case for social responsibility was formed. Three motivational reasons for its

development were identified: environmental protection, ecological diversity, and stakeholders. The concept of a triangular balance between economic, social, and environmental goals of development also emerged during this stage. The fifth stage witnessed the institutionalization of business social responsibility at the national level and the establishment of international standards. In the 21st century, the adoption of the ISO 26000 standard, national strategies, state programs on social responsibility, and UN directives provided a new impetus for the development of social responsibility in business. As a result, a definition emerged, indicating that social responsibility encompasses a company's accountability for the consequences of its decisions and behaviors on society and the environment. This accountability is upheld through transparent and ethical conduct that promotes societal welfare, considers stakeholders' expectations, and adheres to relevant legislation.

After reviewing existing theories, various types of approaches to the concept of corporate social responsibility of business can be identified (see Fig. 2.9). From the perspective of corporate egoism, corporations are viewed as tools for generating wealth, with all social activities focused on achieving economic outcomes. Organizations fulfill their economic roles by producing goods, offering services required by society, creating job opportunities, and maximizing profits for shareholders. Advocates of this viewpoint stress that genuine corporate responsibility is determined by long-term profit maximization, as it aligns with the interests of shareholders and other stakeholders [130]. In contrast, the perspective of corporate altruism focuses on the firm's ability to impact society and the corresponding responsibility to utilize this capacity. One well-known concept is "corporate citizenship," which underscores the business's role in terms of social investments and commitments to local communities [126].

In terms of societal expectations, it is crucial for the company to prioritize its efforts in identifying and addressing the social needs of society. This shift signifies a transition from focusing on "what is beneficial for society" to "what society demands from businesses." The stakeholder approach acknowledges that, regardless of the nature of the business or organization, there exists a group of individuals (known as

stakeholders) who have an impact on the company, are influenced by it, or delegate certain responsibilities to the company. These “groups” include employees, customers, shareholders, suppliers, communities, nations, and society as a whole [127]. The ethical approach is founded on the notion that business managers and individuals have a moral obligation to society. According to Bukreieva (2022), every business bears an economic, environmental, and social responsibility towards society, ensuring its sustainability. Therefore, the social responsibility of a business entails a comprehensive framework of economic, environmental, and social measures implemented by the company through continuous engagement with stakeholders. Its objective is to mitigate non-financial risks, enhance long-term reputation, and guarantee the profitability and sustainable growth of the enterprise [118].

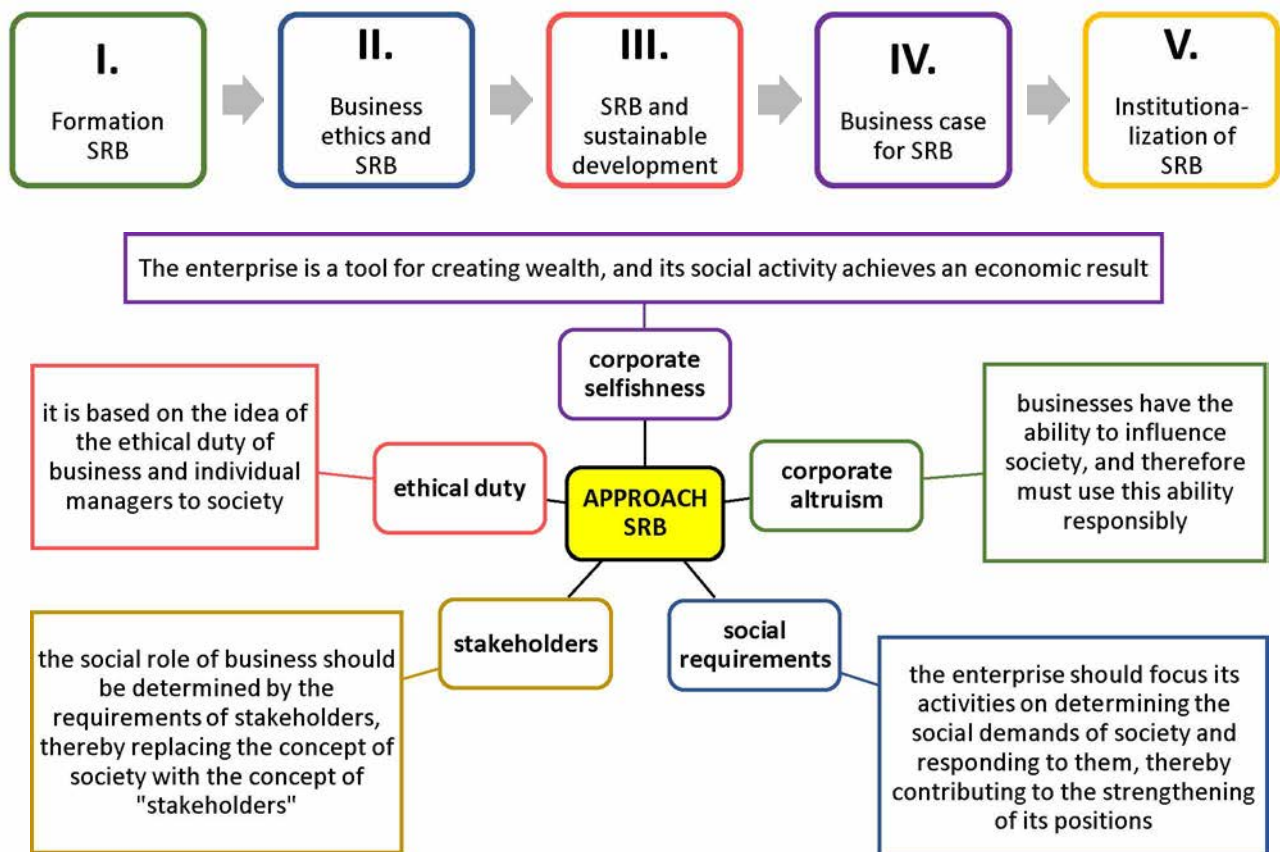


Fig. 2.9. Stages and approaches of social responsibility of business.

Source: [author].

When examining business operations, it is important to highlight that socially responsible companies place significant emphasis on the development of their professionals, allocating approximately 10% of their own resources to this endeavor. These companies also advocate for the inclusion of specialized subjects in higher education institutions, encompassing master's and postgraduate studies, as well as business schools. Furthermore, they provide sponsorship and recognize outstanding projects from final-year university students. Sustainable development encompasses the reduction of inequality, and corporate social responsibility encompasses an anti-discrimination policy that aims to prevent any form of discrimination or inequality based on race, gender, sexual identity, sexual orientation, age, religion or belief, disability, marital status, pregnancy, or maternity. The company's anti-discrimination policy includes collaboration agreements that promote the social and labor integration of individuals with disabilities in regular work environments, participation in training programs focused on labor inclusion for young people with specific disabilities, and charitable sports events that foster the social integration of individuals with disabilities [116].

The fundamental components of fostering entrepreneurship involve innovation and industry specialization, including investing in business capacity and conducting research and development. It also entails financing analytical research, establishing databases, embracing digital transformation, and advancing artificial intelligence. Another crucial aspect is the exchange of knowledge and active participation in specialized forums and industry associations. Furthermore, socially responsible companies prioritize a corporate culture that upholds equal opportunities and gender equality, without any form of discrimination. Consequently, these companies consistently implement measures to promote equality between men and women in vital areas such as employment access, job stability, and fair compensation, regardless of the legal framework in their respective countries. By supporting sustainable business practices, responsible companies contribute to robust economic growth and ensure career advancement opportunities for all employees. This is particularly important as expanding businesses continually seek to attract new talent, including young graduates

[114]. The key responsibilities encompass: establishing high-quality employment opportunities; forming partnerships with schools to offer high school students their initial exposure to the corporate world; collaborating with universities and business organizations to conduct workshops and training sessions on entrepreneurship; engaging in initiatives that encourage innovation and entrepreneurship, enhance critical thinking, problem-solving skills, and impart specific abilities to children and young individuals; providing assistance for microfinancing, easing the process of obtaining credit and financial resources for marginalized communities; endorsing family entrepreneurship and family business initiatives [129].

Achievement of sustainable development goals can provide significant economic benefits for companies that invest in the development of innovative solutions and transformative changes. Attainment of these goals can create 380 million jobs and contribute to obtaining \$12 trillion USD for businesses by 2030. This indicates that enterprises must adopt modern socially responsible measures. From 2010 to 2020, the revenues of Siemens, Toshiba, DuPont, and Philips from environmentally friendly products increased sixfold compared to their overall revenues. Unilever noted that brands that integrate ecology into their goals and products grow 30% faster than others. The transition from fossil fuels makes economic sense in the long term and should start now, hence the recent announcements by many automobile manufacturers worldwide that they are gradually phasing out gasoline and diesel vehicles. Accordingly, leading global companies, including IKEA, H&M, and Google, have committed to using 100% renewable energy sources in the coming years. In addition to strengthening corporate reputation, investing in sustainable practices can lead to long-term profitability.

It is challenging for businesses to operate in the face of global environmental, economic, and social instability. Addressing critical issues such as climate change, biodiversity loss, poverty, and gender inequality will help companies ensure sustainable supply chains and stable markets for future growth (see Figure 2.9). Companies that actively consider climate change and plan for its impact have an 18% higher return on investment compared to those companies that neglect a proactive approach to managing environmental risks. Through the implementation of a new

shared policy, goals, and indicators to ensure effectiveness, businesses can communicate with stakeholders and demonstrate their efficiency compared to competitors. This helps promote long-term partnerships with governments in company markets or supply chains, improving market access and operational flexibility.

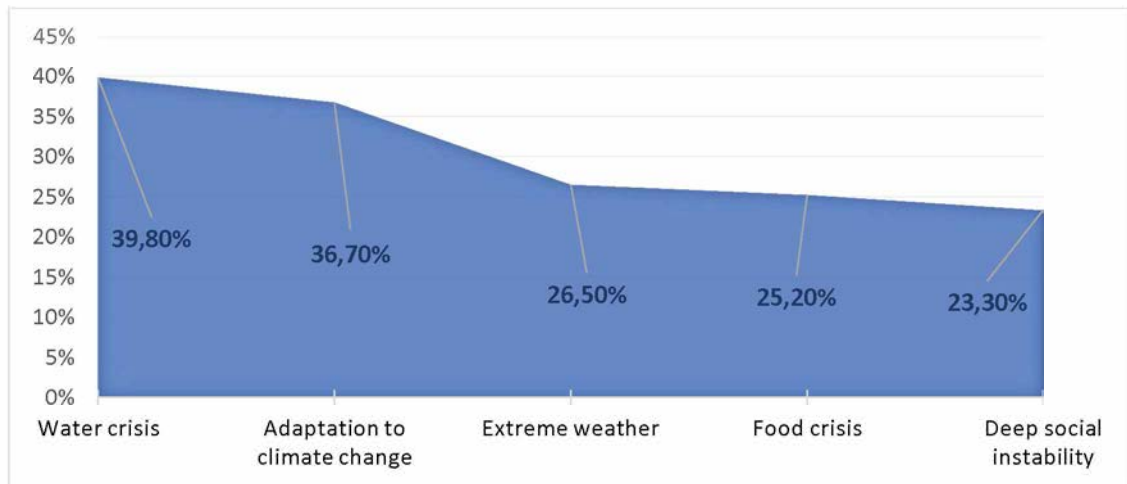


Fig. 2.10. Global corporate risks of sustainable development, 2024-2030.

Source: [<https://worldtop20.org>].

As part of sustainable development, corporate social responsibility entails providing a safe working environment, occupational health insurance, and occupational hazard prevention. Additionally, the business's social responsibility policy promotes sports and corporate wellness, organizing sporting events for employees and subsidizing gyms and other sports centers. Socially responsible companies organize events aimed at strengthening the health and well-being of employees, including blood donation campaigns in various offices around the world, "Solidarity at Work" programs in collaboration with relevant associations (prevention of cancer and other diseases) to disseminate information on health safety and the importance of prevention, collaboration with medical centers (support for incurable and chronically ill individuals, people with disabilities, children's homes), and fundraising for the fight against childhood diseases through respective funds (see Annex A).

Business social responsibility complements sustainable development by improving the quality of education. Socially responsible companies place particular emphasis on training their professionals, dedicating approximately 10% of their resources to this endeavor. For instance, a company like "Management Solutions" invests over 250,000 instructional hours, covering 575 courses, for 250 students participating in internships each year. These companies also advocate for teaching specialized subjects in higher education institutions, both at the master's and doctoral levels, as well as in business schools. They provide sponsorship and recognition for the best graduation projects in universities. For example, the company "Create Foundation" supports various events aimed at enhancing the quality of education, entrepreneurship, and innovation in the field of education and its inclusivity.

Additionally, socially responsible companies have a corporate culture that promotes equal opportunities and gender equality, free from discrimination, as a fundamental principle. These companies constantly implement measures aimed at realizing gender equality in key areas, such as access to work, job stability, and equal pay, regardless of the legal system of their country. Behind every socially responsible company stands a dignified workforce in pursuit of excellence in work (quality work that creates value for clients and society as a whole) and economic growth. Responsible business supports high economic growth rates, providing career advancement for all employees, as a growing business constantly requires the recruitment of new employees (young graduates). These commitments aim at creating quality employment, cooperation agreements with schools that allow high school students to gain their first work experience in a business environment, cooperation with universities and business associations, and achieving other such milestones.

Corporate social responsibility is focused on the development of industry, innovation, and infrastructure. Companies engage in research and development as a key element of their market offerings. Furthermore, the strong industry focus of the company allows for deep knowledge of the business in which clients are involved. Therefore, the key elements of entrepreneurial development are innovation and industry specialization: investing in business capabilities, research and development;

funding analytical research and database creation; digital transformation and artificial intelligence development; knowledge sharing through participation in specialized forums; involvement in industry associations. Stable development involves reducing inequality, while a business's social responsibility includes an anti-discrimination policy aimed at avoiding any discrimination or inequality based on race, gender, sexual identity, sexual orientation, age, religion or beliefs, disability, family status, pregnancy, or maternity. The company's anti-discrimination policy includes: cooperation agreements aimed at promoting social and labor inclusion of people with disabilities in a regular work environment; participation in a training program for labor inclusion of young people with certain disabilities; charitable sports events for the social integration of people with disabilities.

Additionally, business social responsibility is directly correlated with responsible consumption, production, and adaptation to climate change. Although the impact of typical office activities on the environment is very limited, companies are particularly sensitive to this issue. Socially responsible businesses participate in initiatives such as: reducing the impact of business activities on the environment (through the implementation of energy efficiency policies, reducing carbon emissions, recycling and reducing paper consumption, eliminating plastic, etc.) in all countries; investing in new technologies to facilitate communication between employees and clients; strive to adopt measures related to environmental protection and nature restoration; facilitate collaboration with companies whose dividends are directed towards promoting projects providing clean water to disadvantaged communities through solidarity, marathons, and tournaments; and sponsor conferences addressing climate change and the use of natural resources.

In ensuring peace, businesses firmly seek to adhere not only to the legislation and regulatory acts in force in all countries where companies operate but also to their own internal rules. This includes a control system aimed at promoting legal, ethical, and professional behavior of employees, managers, and directors during the implementation of initiatives such as: training for all professionals on corporate code of conduct, ethics, compliance, and policies; prevention of criminal activities related

to corruption, money laundering, confidentiality, and protection of personal data; management of internal criminal liability for business consulting activities and related technologies.

The global shift in the construction of social-labor relations at various managerial and organizational levels represents a new approach to the activities of employers and employees, with their "internal motivation and economic interests in the field of social-labor activity". Several factors influence the probability and scale of CSR policy, namely: the overall level of socio-economic development of the country and the quality of the institutional environment; details of the business and social environment of the company (degree of integration into international business, company size, development of application practices, income levels and consumer awareness, industry connections, levels of competition, etc.); differences in linking various CSR areas to corporate economic efficiency standards; the impact of CSR on short- and long-term financial and economic results. There is a difference in the intensity and values of business owners and top managers. Companies that have identified and implemented their social responsibility strategies face many obstacles inherent in Ukraine.

Limited promotion of corporate social responsibility. The state has limited mechanisms to effectively support CSR, including financially. There are hidden criteria for selecting contractors in tender procedures (government and commercial procurement) that take into account CSR, and criteria for promoting CSR in the banking system, but regulated financial markets do not require or encourage disclosure of information, except for corporate governance. The only effective tool for promoting CSR is the ability for companies to collaborate more efficiently with representatives from other sectors, including NGOs and government institutions, although this factor has limited impact.

Distorted role of the media. Due to the spread of paid connections with the public, the expectations of the media regarding work with companies (the aspect of corporate social responsibility of media companies) are distorted. Reports on CSR are often inaccurate, lack competent media personnel, and require analysis. This affects

the role of business in addressing complex environments and social problems. In certain countries, the media did not report on corporate scandals that would have encouraged companies to implement CSR policies and stimulate their growth in other countries.

The organizational capacity of the influence group is low. One of the main ways to implement CSR is to create partnerships and joint ventures with other influential groups (NGOs, associations, local and regional authorities, educational and research institutions) and involve these groups in the development of CSR and implementation strategies. At the same time, companies today outperform other influential groups in organizational capabilities (availability of qualified personnel, internal processes and procedures, evaluation systems, and decision-making), which weakens their ability to effectively carry out socially responsible actions and can hinder progress.

Limited culture of cooperation. In most countries, there are very few examples of cooperation within companies, as well as with external influence groups. Cooperation between competing firms largely depends on the desires of the owners, with the main criterion being economic and social feasibility (from the managers' point of view). Cooperation with other influence groups is often based on representing interests rather than common strategic social goals. Unreliable cooperation, as a form of realizing socio-economic advantages, creates obstacles for the effective implementation of CSR strategies.

International politics require changes. Most transnational companies have developed CSR policies at the international level. If methods, plans, tools, and directives are not adapted to the needs of the national economy and society, the enterprise risks incurring unjustified costs in terms of financial expenses and social benefits. The need for adaptation and appropriate resources remains a barrier to the effective implementation of multinational corporate social responsibility programs.

Absence of a sufficient number of familiar, interested, and competent managers. The CRM policy should be implemented at the strategic management level as part of the daily activities of the marketing, production, sales, and other departments of the company. The main obstacle to further CRM development is the lack of key

management personnel who are qualified to perform their job duties, understand the CRM strategy, and are ready to participate in its implementation in the workplace.

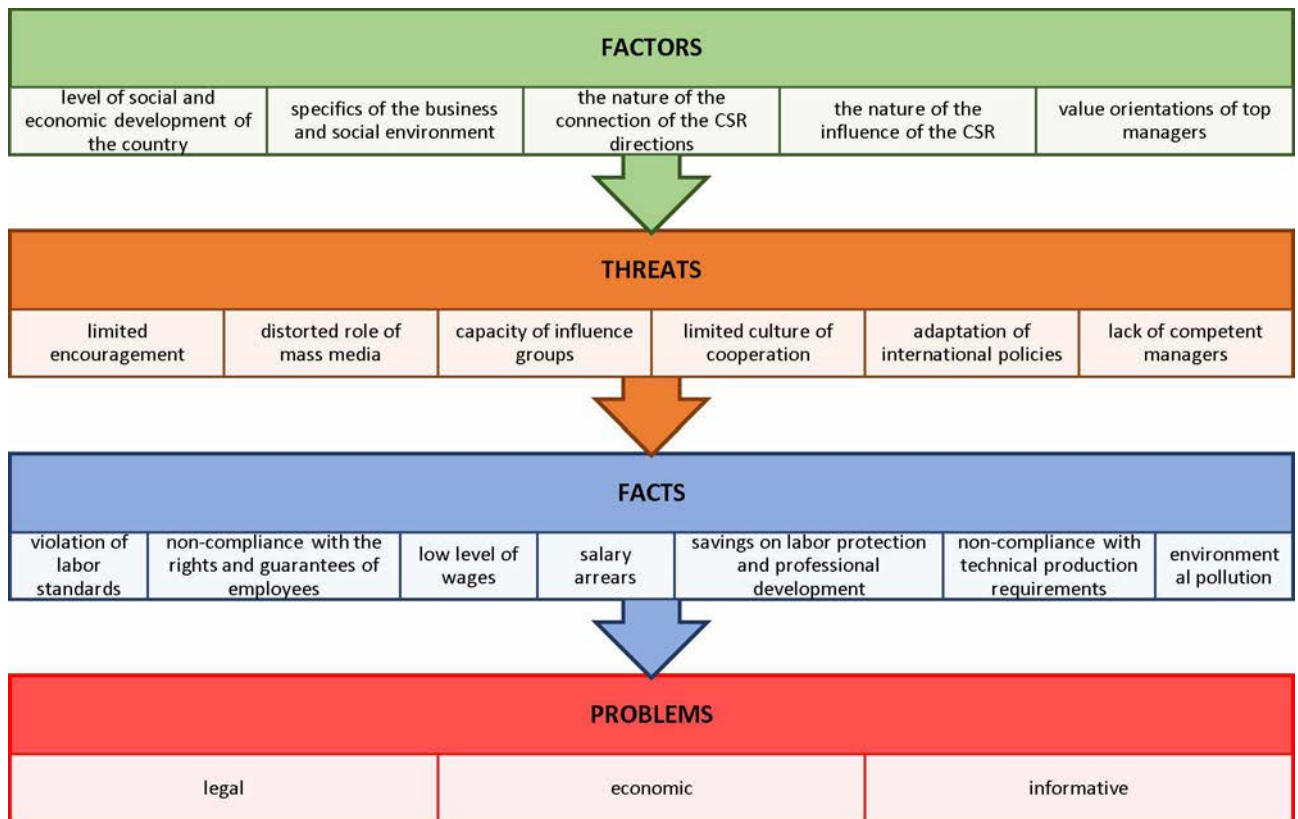


Fig. 2.11. Problems and threats of corporate social responsibility.

Source: [author].

Corporate social responsibility is not a widespread and practical phenomenon in all countries. This is confirmed by the following facts:

- employers violate international human rights and labor norms;
- non-compliance with social and labor rights, labor rights and worker protection;
- low wages;
- wage arrears;
- savings on investments in labor protection, employee health, and professional development.

In addition, there have been issues such as poor product quality, non-compliance with production technical requirements, environmental pollution, and unfair

competition. These issues manifest as direct or indirect violations of the rights and moral norms of others, thereby negatively impacting society. There are numerous reasons for the low level of corporate social responsibility (CSR), such as lack of financial resources, absence of effective legislation in the field of CSR, difficulty in determining the economic impact of CSR activities, lack of appropriate incentives for CSR, and responsibility.

There are various degrees of influence of these factors on enterprises of different sizes. The most restraining factor for small businesses is the inadequacy of domestic legislation, while for medium and large businesses, it is the lack of funding. Thus, the issue of corporate social responsibility is divided into two levels: economic and legal. The legal framework of development is important, as its impact on corporate social responsibility is significant. This can be legally problematic due to the lack of legislation in the field of CSR: there is no direct jurisdiction and almost no tax incentives. The economic dimension of corporate social responsibility is reflected in the survival complexity of local companies in modern economic conditions. Additional investments are necessary for the implementation of CSR.

The main threats to the implementation of social responsibility in the country are as follows:

- declarative and uncontrolled use of activities and determination of the productivity of these activities;
- inconsistency of criteria and evaluation criteria for corporate social responsibility;
- lack of appropriate legislation and funding;
- absence of state and non-governmental organizations supporting social responsibility activities;
- lagging charitable and social activities of the state and public organizations;
- low level of corporate culture and financial-economic weakness in the majority of Ukrainian enterprises;
- legal nihilism, distortion of legal consciousness, and a desire to bypass the law.

- most national companies are closed to the public.

In Ukraine and some other developing countries, a national model of corporate social responsibility has not yet been established. Due to the peculiarities of this stage of economic socialization and the tradition of addressing social issues related to the functioning of social infrastructure, CSR activities cover many areas aimed at meeting the urgent needs of society. The peculiarity and complexity of CSR development in developing countries arise from the following characteristics:

1. The privatization and liquidation of large enterprises have inherited a developed social infrastructure (kindergartens and nursing homes). They are rarely used for social purposes and are sold or privatized.

2. The development of corporate social responsibility depends on the economic benefits of economic activities. The business crisis did not contribute to the expansion of social measures; on the contrary, it forced job cuts, resulting in reduced wages and social savings.

3. Ukrainian CSR is developing spontaneously. There are no clearly defined government or executive decisions, and in most cases, there is no defined sphere of business socialization that can provide the greatest return.

The development of CSR in Ukraine is spontaneous, which also explains its inefficiency for entrepreneurs. One of the factors contributing to the low level of CSR development in Ukraine is the lack of real positive results for owners and business leaders. Therefore, the main issue of CSR is information. However, there is no mechanism for disseminating information about the nature of CSR, the benefits of its implementation, and practical examples of domestic and foreign companies working in this field. The problem is also influenced by an unfavorable economic environment and a suboptimal business environment; widespread manifestations of deteriorating moral values among top business leaders; lack of proper ethical prerequisites for active socially responsible activities; insufficient scientific interpretation of implementation principles; insufficient role of the state as a social institution and social partner; lack of institutional requirements for corresponding social activities.

2.3. Analysis of the level of emissions under global transnationalization

To foster the growth of reusable products and to shift from a disposable economy to a society that embraces reuse, it is crucial to establish a supportive framework that makes the reuse market more economically viable than the single-use plastics market. Extensive research indicates that implementing reuse systems presents the greatest potential for curbing plastic pollution, with a projected reduction of 30 percent by 2040. By replacing problematic and unnecessary products, we can make significant strides in combating this issue (The Pew Charitable Trusts and Systemiq 2020). Enhancing the market for plastics recycling to make it a more reliable and lucrative business could potentially decrease plastic pollution by an extra 20 percent by 2040. To achieve this, it is crucial to have a sufficient supply of recyclable feedstock and ensure that recycled materials can effectively compete with virgin materials on an equal footing. The market for plastic alternatives is being shaped to facilitate sustainable substitutions, aiming to prevent the displacement of plastic products with alternatives that do not effectively reduce environmental impacts. By 2040, sustainable alternatives have the potential to decrease pollution by 17 percent. However, they face difficulties in competing with products made from virgin fossil fuel-based polymers due to various challenges such as high production costs, limited consumer demand, and inadequate regulations.

Despite implementing the market transformation approach, a considerable amount of waste will remain non-recyclable and non-reusable in the next 10 to 20 years. Consequently, effective disposal solutions must be implemented to prevent pollution. This entails responsibly collecting and disposing of plastics that cannot be repurposed or recycled, including those already present in the environment as pollution, as well as those that are stockpiled or will enter the economy in the form of short-lived or durable products that were not designed with circularity or long-term use in mind. Additionally, it involves exploring innovative methods of financing the collection and disposal of legacy plastics, as well as preventing the introduction of microplastics into the economy and the environment.

Since the 1970s, the world's population has been growing at an average rate of 1.5% annually, reaching approximately 8 billion people today. Throughout this period, Asia and the Pacific have consistently been the most densely populated region. However, the rapid population growth in Africa, as shown in Figure 2.12, stands out with significant implications for the future distribution of natural resource utilization. The percentage of people living in high-income countries has decreased from 23% of the global population in 1970 to 16% in 2020. Over the past 50 years, population growth rates in higher-income countries have generally been lower. Conversely, in the low-income group, population growth has been the fastest, averaging 2.6% annually. On a global scale, population growth rates have steadily declined from an average of 1.9% per year in the 1970s to approximately 0.8% per year between 2020 and 2024 (UN 2022).

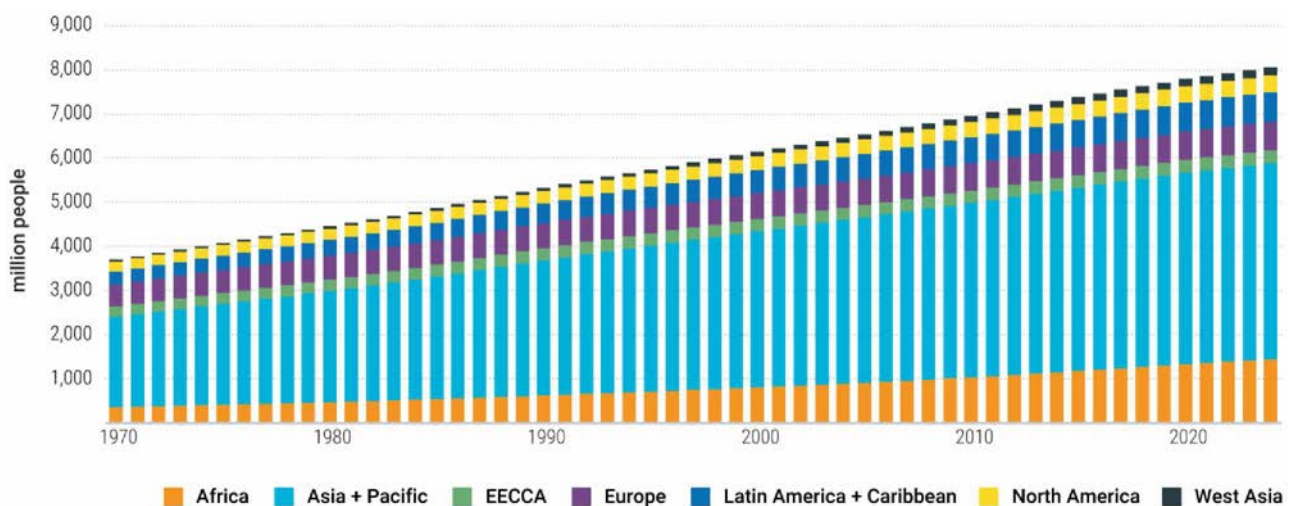


Fig. 2.12. Distribution of population among world regions, million people.

Source: [UN DESA World Population Prospects 2022].

The worldwide Gross Domestic Product (GDP) grew significantly quicker than the global population, averaging a yearly rate of 3% from 1970 to 2020 (Figure 2.13). The economic downturn caused by the COVID-19 pandemic led to a decrease of approximately USD 5 trillion in the world's GDP in 2020 and USD 3 trillion in 2021. From 1970 to 2020, Asia and the Pacific region experienced substantial GDP growth, averaging 4.8% annually. This growth resulted in the region contributing the most

significant portion to the global GDP, increasing from 16% in 1970 to 36% in 2020. Meanwhile, West Asia and Africa saw an annual GDP growth rate of approximately 3.5%. North America, Latin America, and the Caribbean had an average annual growth rate of 2.7%. Europe and the EECCA regions grew at a rate exceeding 2.1% annually. However, despite this growth, their contributions to global GDP decreased, with Europe's share dropping from 38% to 24% and EECCA's from 4% to 2% by 2020 (see Figure 2.13). The GDP of Africa and West Asia had grown five and six times, respectively, by 2020 compared to 1970. Nevertheless, their global GDP shares remained relatively stable at around 2.5%. In the period between 2019 and 2020, Latin America and the Caribbean experienced the most significant percentage drop in GDP at 7%, followed by West Asia at 6% (see Annex B).

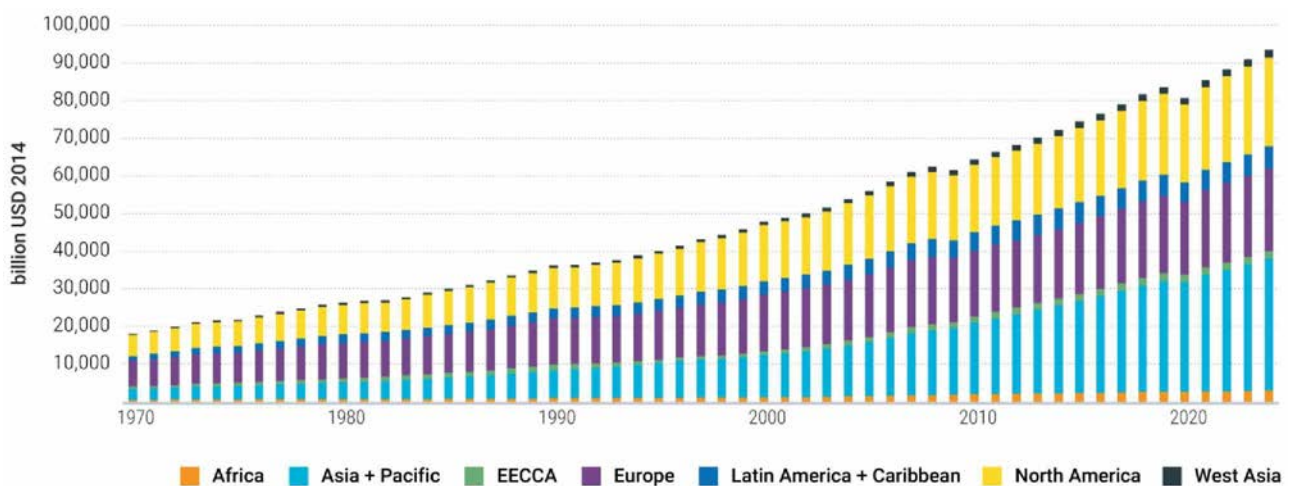


Fig. 2.13. Distribution of global GDP among world regions, billion USD.

Source: [UN DESA National Accounts 2022].

In 1970, high-income economies accounted for 81% of global GDP, a figure that decreased to 61% by 2020 despite their relatively modest average annual growth rate of 2.7%. The decline in the share of global GDP held by high-income countries has been largely balanced out by the rise of upper middle-income countries, which saw their contribution increase from 14% in 1970 to 29% in 2020. At the same time, lower middle-income economies witnessed their share double from 5% in 1970 to 10% in

2020. Conversely, low-income countries maintained a consistent share of around 0.6% of global GDP throughout this entire period.

Per capita GDP provides a more refined gauge of material living standards compared to total GDP. Projections suggest that from 1970 to 2024, global per capita GDP will have surged by 2.4 times, reaching approximately USD 11,600. However, substantial inequalities endure among regions, individual nations, and different income brackets. In 1970, Africa, Asia, and the Pacific exhibited comparable per capita GDP figures of around USD 1,350. Nevertheless, their growth trajectories diverged notably. Africa witnessed a modest annual per capita income growth rate of 0.8%, whereas Asia and the Pacific recorded a significant surge, boasting an average yearly growth rate of 3.3% in GDP per capita. Since the 1970s, per capita GDP has exhibited an overall upward trend across all world regions. Certainly, there have been cases of per capita income decline following significant historical events. For example, in West Asia, GDP per capita has failed to exceed the levels observed in the late 1970s and early 1980s. This is largely attributed to sustained declines in real oil prices and the region's highest population growth rate, averaging 3.1% annually. Likewise, the EECCA region experienced a decline in per capita GDP following the dissolution of the former Soviet Union. Furthermore, both the global financial crisis and the COVID-19 pandemic have had adverse effects on per capita income growth across all regions.

In countries not classified as high-income, per capita income has consistently remained below the global average. In 1970, per capita income in high-income countries was 28 times higher than in low-income countries and 25 times higher than in lower middle-income countries. However, projections indicate that by 2024, the ratio of per capita GDP in high-income countries to that in low-income countries will double, while the corresponding ratio for lower-middle-income countries will decrease to 17. Although the disparity in GDP per capita between upper-middle-income and high-income countries has been diminishing, there still existed a significant income gap of approximately USD 31,000 between these regions in 2020. Furthermore, the GDP per capita in low-income countries in 2020 was only 21% higher than its value in 1970, indicating slow economic growth over the past five decades. On the other hand,

upper-middle-income regions experienced the most significant rise in GDP per capita, climbing from USD 1,700 in 1970 to USD 9,200 in 2020 (UN 2022; United Nations Department of Economic and Social Affairs).

Urbanization has significant consequences for material utilization, as urban regions have a tendency to utilize more resources per person in comparison to rural areas (Schiller and Roscher 2023). For instance, individuals residing in urban areas generally exhibit higher consumption levels and utilize more energy, water, and land than their rural counterparts. Moreover, they also tend to produce more waste and pollution. Furthermore, urbanization can result in a heightened need for housing, infrastructure, and transportation, thereby exerting strain on natural resources and contributing to environmental deterioration. Conversely, well-designed cities have the potential to yield resource-efficiency benefits.

The global urban population has seen a significant rise over the years, with the proportion of people living in cities increasing from 37% in 1970 to 56% in 2020 with an average annual growth rate of 0.8% (Figure 2.14). This growth has been particularly pronounced in developed regions like North America and Europe, where approximately 80% of the population resides in urban areas. However, urbanization has also been on the rise in developing countries, notably in Africa and Asia. Countries in Asia, such as China and India, have witnessed substantial urban growth and infrastructure development, leading to some improvements in pollution levels and efficiency (Wang et al. 2016). Africa, on the other hand, experienced the highest annual urbanization growth rate of 1.4%, resulting in an increase from 22% urban population in 1970 to 47% in 2020. This rapid urbanization trend has posed new challenges in terms of resource management and environmental preservation, while opportunities for sustainable urban development have yet to be fully explored (Güneralp et al. 2018). North America seems to have reached a saturation point in urbanization, with the lowest annual growth rate among all regions at 0.2%. The urban population in the ECCA regions has remained stable at around 52% since 1980. Low- and lower-middle-income countries have seen the highest annual urbanization rates between 1970 and 2020, at 1.5% and 1.1% respectively, while high-income countries experienced a

growth rate of 0.3% per year (Figure 2.14). Across all income groups, urbanization rates have slowed down after 1990 (see Annex C).

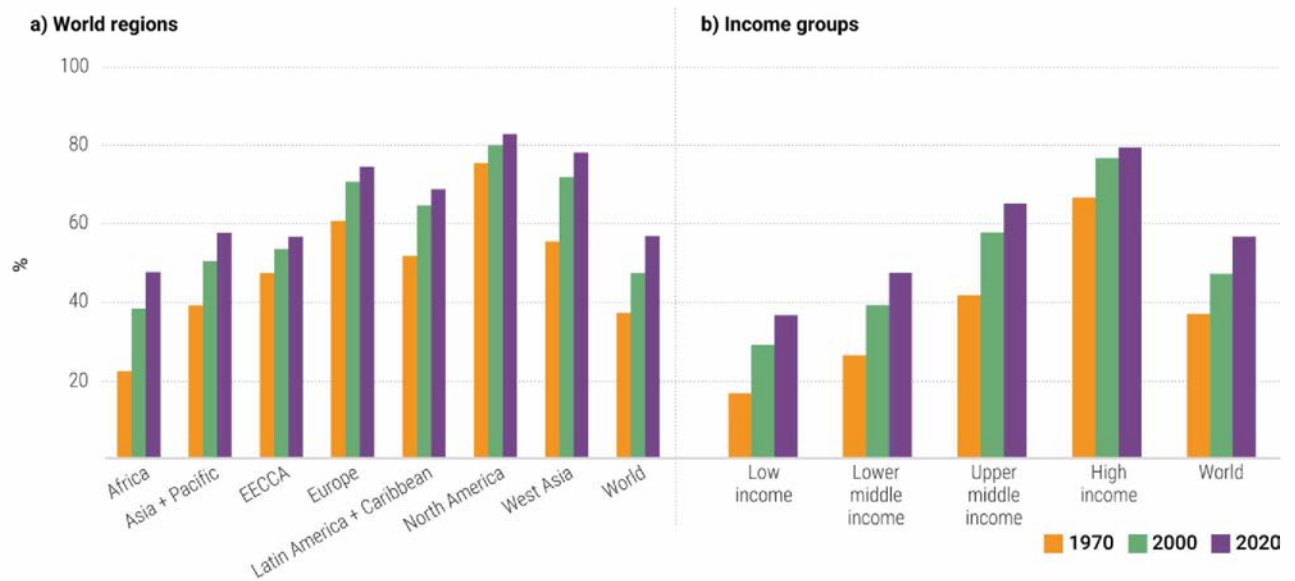


Fig. 2.14. Urbanization rate for world regions and income groups.

Source: [UN DESA World Population Prospects 2022].

In high-income countries, the disparity in material living standards and consumption between urban and rural areas may not be significant. However, in all other country income groups, there are noticeable differences between urban and rural areas. In low- and middle-income countries, rural areas often rely on agroforestry activities and traditional resource use patterns. These patterns are gradually shifting towards modern resource-use patterns, leading to a substantial increase in overall resource consumption. Achieving sustainable material management and dematerializing the global economy is crucial, especially considering the ongoing urban and industrial transformations in many countries of the South (Krausmann et al. 2008).

In 2019, the global economy consumed a total of 105.7 billion tons of materials, as depicted in Figure 2.15. The majority of this consumption, accounting for 91% or 96.2 billion tons, was obtained through harvesting and extraction processes. Approximately 9% of the total, equivalent to 9.5 billion tons, came from recycled and recovered resources. Energy requirements, particularly for electricity generation and

biomass used in food production and animal feed, constituted 40% of the overall material consumption. The remaining 60% was allocated to structural and technical materials. Remarkably, half of this portion was integrated into durable assets such as buildings, transportation and communication infrastructures, productive assets, and consumer products. Within the material flow accounting framework for 2019, waste and emissions played a significant role. A combination of 30 billion tons of solid and liquid waste and 46.7 billion tons of greenhouse gas emissions were recorded. Additionally, there was a dissipative use of 800 million tons. Furthermore, there was a net increase of 31 billion tons in material stocks. It is worth mentioning that material stocks have experienced substantial growth since the 1970s (Krausmann et al., 2017).

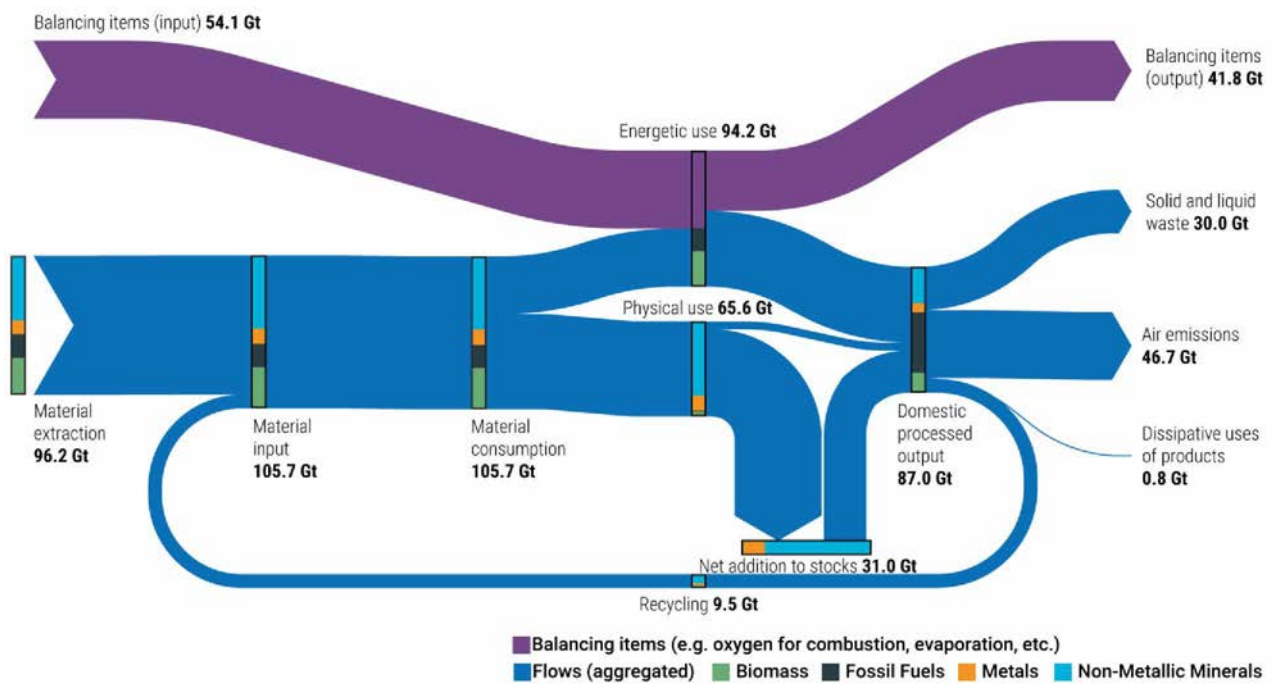


Fig. 2.15. Global material flows, waste, and emissions, 2019, billion tons.

Source: [Global Material Flows Database (UNEP 2023)].

It should be emphasized that, as of 2019, the proportion of secondary materials utilized in manufacturing and construction activities stood at approximately 9% (Krausmann et al. 2018; Schandl and Miatto 2018). Nevertheless, despite fully harnessing the technical potential for resource recovery, the current economic structure only permits a circularity rate ranging from 30% to 40% (Haas et al. 2015). This

highlights the gap between current levels and the maximum potential within the existing framework. To exceed the current potential of circularity, a fundamental restructuring of the global production and consumption system is imperative. Such a shift would require substantial transformations in sectors like consumer goods, the built environment, mobility, food, and energy (Fanning et al. 2020). The redesign of production and consumption systems is increasingly acknowledged as a crucial element of the circular economy, as it encompasses more than just resource recovery and recycling.

A growing number of researchers are assessing the social, economic, and environmental ramifications of plastic pollution. Studies in the scientific literature have delineated a correlation between chemicals in plastic and detrimental impacts on human health across the entire life cycle of plastic, impacting workers and communities residing near plastic production and waste disposal sites (Landrigan et al. 2023). In addition to the potential harm to ecosystems, microplastics have been discovered in the most remote parts of the ocean, in untouched mountain glaciers, in breast milk, and even in human bodies (Braun et al. 2021). Research indicates that if current practices continue, plastic could contribute to 19 percent of the global greenhouse gas emissions permitted under a 1.5°C scenario by 2040, rendering the target unattainable (The Pew Charitable Trusts and Systemiq 2020). Importantly, the costs and consequences are felt by all but are particularly harsh on individuals in some of the world's most impoverished nations.

Global greenhouse gas emissions have shown a significant increase since 1970, primarily due to the rising use of energy sources and carbon-intensive materials like iron, steel, and cement. Over the past fifty years, greenhouse gas emissions have more than doubled from approximately 20 billion tons in 1970 to about 43 billion tons in 2020 (Figure 2.16). When measured in tons without considering their global warming potential, CO₂ emissions have been the most dominant among greenhouse gases. In recent years, the Asia Pacific region has been responsible for over half of the global greenhouse gas emissions, with upper-middle-income countries surpassing high-income countries as the largest emitters. This shift reflects changes in the global energy

landscape, a higher rate of electrification in the Global South, urbanization, and improving living standards in middle-income nations. Nevertheless, in terms of per capita emissions, high-income countries still have the highest levels, with per capita emissions in these countries remaining approximately seven times greater than those in low-income economies since 1970. Between the 1970s and the present day, global waste flow has increased significantly, reaching 19.9 billion tons in 2020. This equates to one-fifth of the 95.1 billion tons of materials ending up as solid waste. Globally, around 30% (6.1 billion tons) of end-of-life waste was recycled in 2020, resulting in a circularity rate of approximately 7% (Haas et al. 2015) (see Annex D).

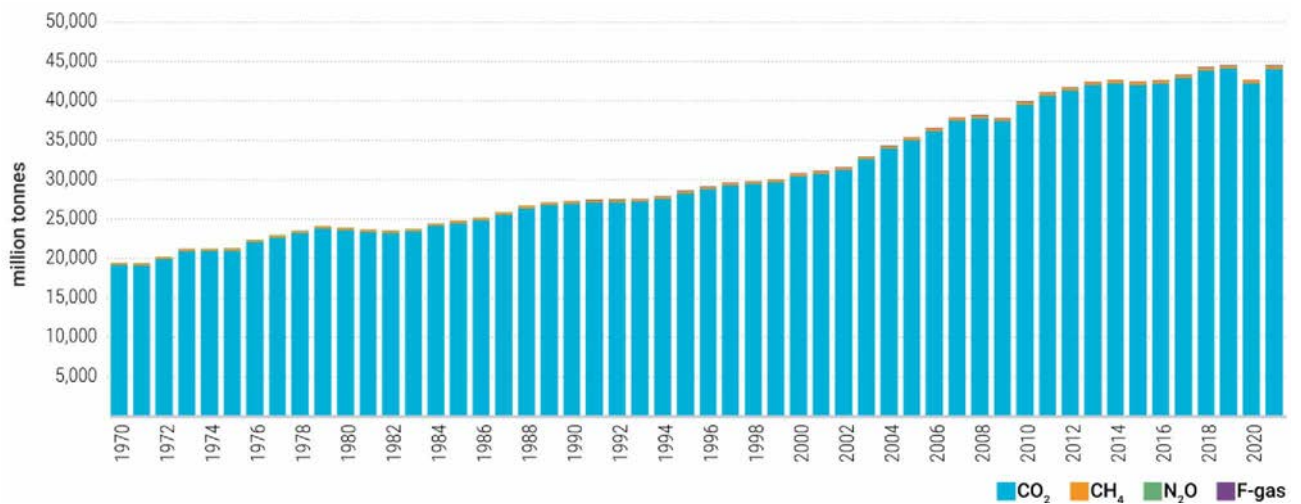


Fig. 2.16. Global GHG emissions by gas, million tons.

Source: [Emissions Database for Global Atmospheric Research 2023].

Approximately 40 billion tons of materials are still in circulation within the economy, contributing to the stock of buildings, infrastructure, and consumer goods. This stock has experienced substantial growth since the 1970s (Krausmann et al. 2017). It is important to highlight that, within the current economic framework, the circularity potential of the global economy ranges between 30% and 40% if all technical possibilities for resource recovery are fully utilized. This underscores the significance of the circularity rate. To attain a higher level of circularity than the current state requires a fundamental restructuring of the global production and consumption system, accompanied by substantial transformations across various sectors including industry,

consumer goods, built environment, mobility, food, and energy. The redesign of production and consumption systems is increasingly acknowledged as a pivotal aspect of the circular economy, transcending mere resource recovery and recycling efforts.

The European Union (EU) has been committed to achieving its policy objective of waste reduction by focusing on waste prevention, which is the initial step in the waste hierarchy outlined in the EU Waste Framework Directive. By 2030, the EU aims to make significant progress towards its zero pollution ambition by substantially reducing total waste. In the period between 2010 and 2020, the EU-27 witnessed a decline of 4.2% in total waste generation per capita, equivalent to a decrease from 5.0 to 4.8 tons per capita. This reduction was primarily driven by the years 2018-2020, during which the COVID-19 pandemic and subsequent economic slowdown had a significant impact [133].

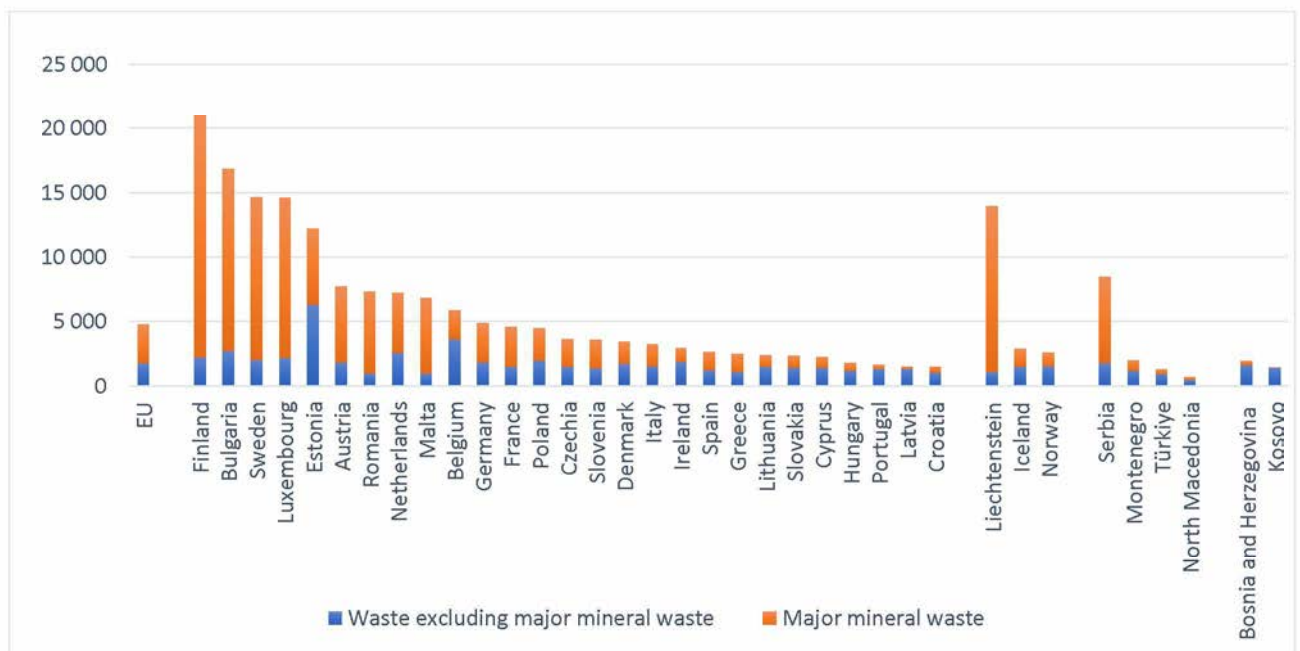


Fig. 2.17. Waste generation, kg per capita, 2020.

Source: [Eurostat, 2023].

Primary mineral wastes, including hard rocks, concrete, soils, and others, are chiefly generated in the mining and construction sectors. These wastes are produced in substantial quantities in comparison to other waste types. However, due to their inert nature, they are generally considered to have a lesser environmental impact. If we

exclude these mineral wastes from the overall waste calculations, the remaining waste streams, which are more environmentally significant, still experienced a 1.4% increase (equivalent to an additional 25 kg per capita). The decline in total waste generation can be ascribed to the reduction in waste output from the mining, quarrying, and construction sectors. This trend is reasonable given that major mineral waste accounts for a significant portion (64% in 2020) of the total waste generated. If we exclude this specific waste type, the trend in waste generation is influenced by a decline in waste produced by the manufacturing and energy sectors, as well as an increase in waste generated by households and water and waste treatment activities. The latter indicates advancements in waste management practices, as the rise in secondary waste from waste management signifies an increase in recycling efforts [132].

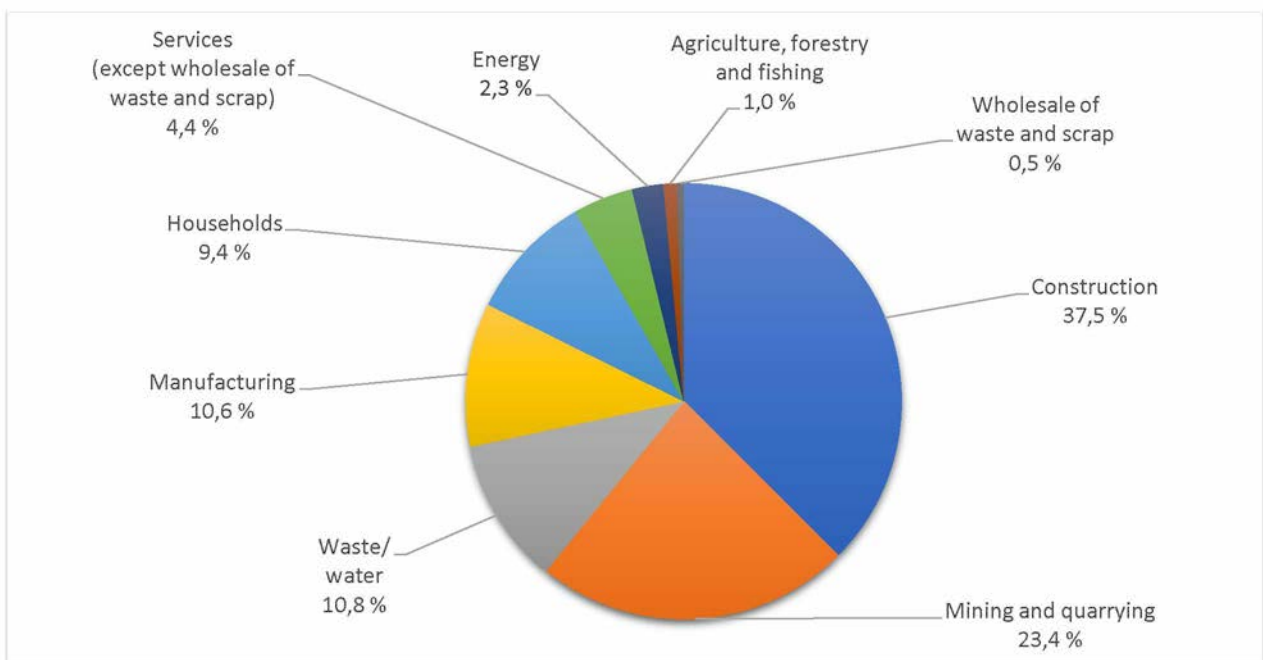


Fig. 2.18. Waste generation by economic activities and households, share of total waste, EU, 2020.

Source: [Eurostat, 2023].

The primary factor influencing the trend in waste volumes is economic growth, with gross domestic product (GDP) serving as the key parameter to monitor the size of the economy. From 2010 to 2020, the EU's per capita GDP increased by 6% in real terms. Although waste generation decreased during the same period, it closely mirrored

the trends in GDP growth, albeit at a slower rate, indicating a relative decoupling. In 2020, the EU economy contracted due to measures implemented to combat the COVID-19 pandemic, resulting in a notable 8% decline in waste generation compared to 2018. Therefore, despite waste decreasing while the economy expanded from 2010 to 2020, the EU has not yet attained absolute decoupling, meaning there hasn't been a continuous reduction in waste generation in a growing economy. It seems improbable that per capita total waste generation will experience a significant decrease by 2030. The only noticeable decline in waste generation occurred very recently (2018-2020) and coincided with negative GDP growth rates. Moreover, waste generation has historically closely tracked GDP growth, and since 2020, GDP growth rates have been positive, with the European Central Bank forecasting this trend to persist in the coming years. Achieving a substantial reduction in per capita waste generation by 2030 would require significant additional efforts [134].

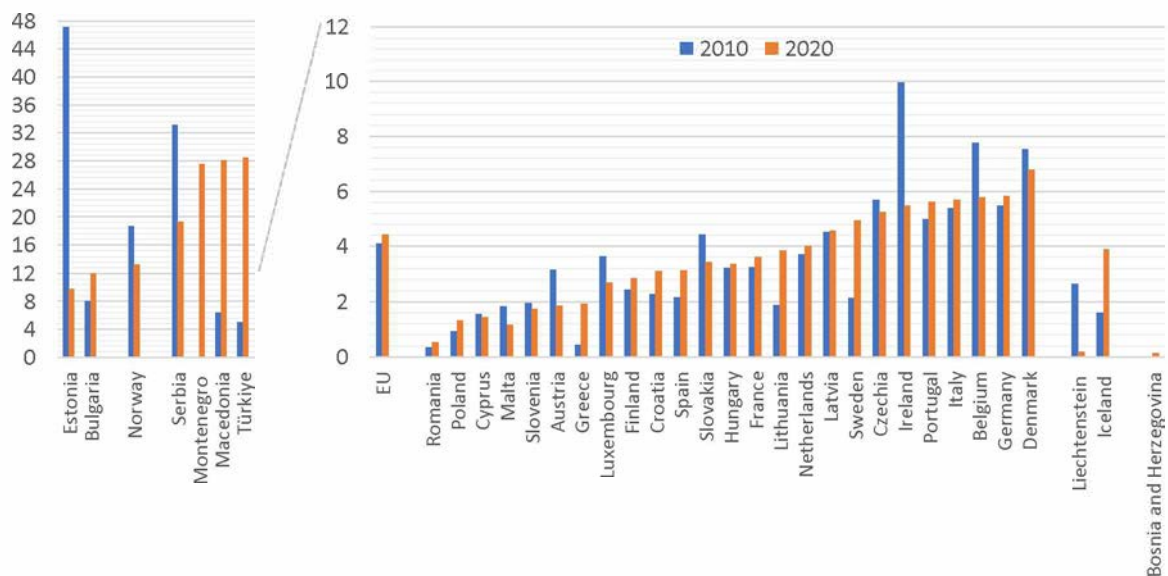


Fig. 2.19. Hazardous waste generated, 2010 and 2020.

Source: [Eurostat, 2023].

In 2020, the average amount of total waste produced per EU citizen was 4.8 tons, which is a decrease from 5.0 tons per capita in 2010. However, this average masks significant variations in waste volumes and generation trends among different

countries. For EU Member States, the amount of waste generated ranged from less than 1.5 tons per capita in Portugal to 21 tons per capita in Finland in 2020. Other European countries also showed varying levels, with North Macedonia producing less than 1 ton per capita and Liechtenstein generating 11.5 tons per capita. These differences can be attributed to the diverse economic structures of the countries, and extreme numbers may be influenced by specific situations in each country. In terms of waste generation trends over time, there is a mixed picture among countries. In 16 Member States (out of 21 countries with available data), the total waste generated per capita increased, while it decreased in the remaining countries. Greece experienced the largest relative decrease in waste generation within the EU, while Latvia saw the largest relative increase (with Iceland having the highest overall increase). It is important to note that these trends can also be influenced by improvements in data quality over time.

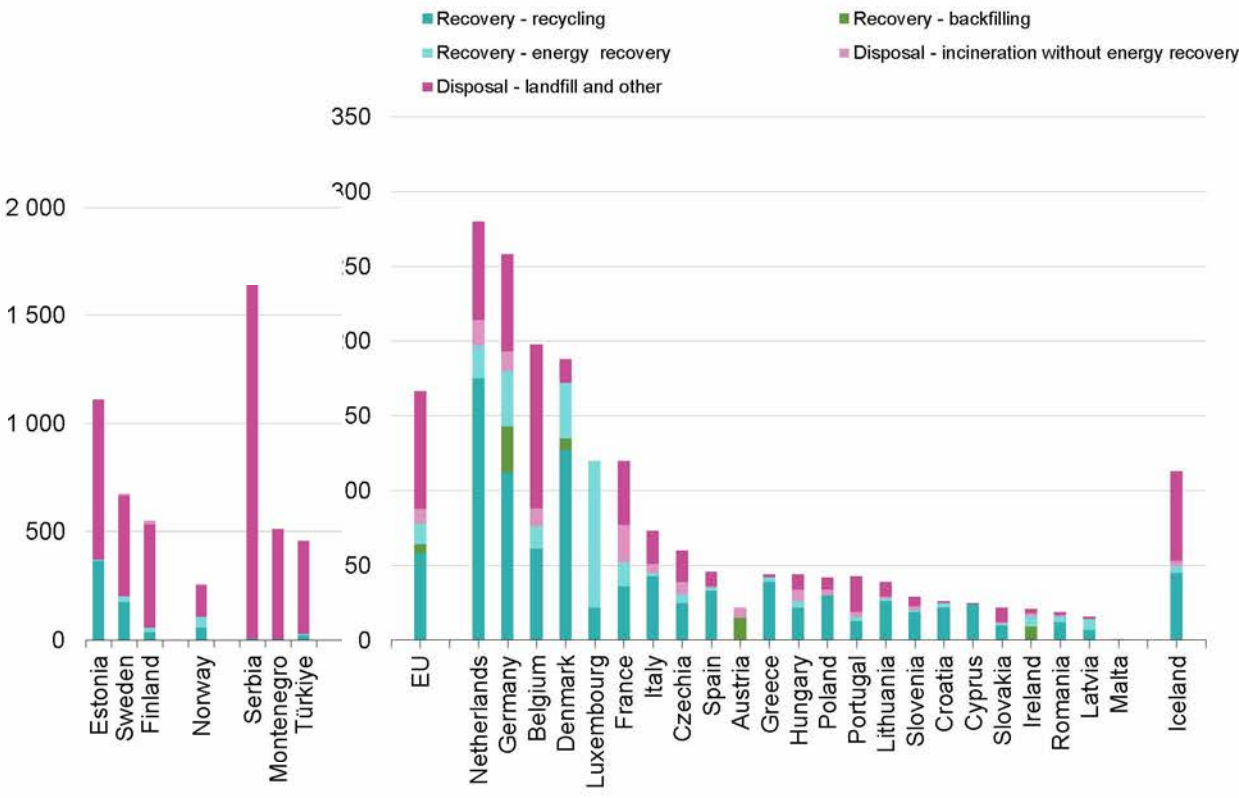


Fig. 2.20. Hazardous waste treatment, 2020.

Source: [Eurostat, 2023].

Technological advancements have been pivotal in enabling sustainable waste management practices. Businesses can harness technology, such as smart bins, for more efficient waste collection, and utilize advanced recycling technologies to enhance waste management processes and minimize their environmental impact. Additionally, there is a growing focus on extended producer responsibility and product lifecycle management.

Producers are now being held accountable by governments and regulatory bodies for the complete lifecycle of their products, which includes waste disposal and recycling. This change is pushing companies to create products with waste reduction as a priority and to acknowledge their environmental impact from production to disposal. The demand for environmentally responsible businesses is increasing as public awareness grows. Consumers are becoming more aware of the environmental implications of their purchasing choices and are actively seeking out businesses that prioritize sustainable waste practices. This growing trend underscores the importance of companies being transparent about their waste management initiatives and actively participating in environmentally responsible practices.

Meeting corporate responsibility in waste management is hindered by regulatory obstacles and the absence of uniform waste management practices. Diverse regulations and standards in different regions and countries create complexities for companies striving to maintain compliance and uniformity in their operations. Striking the delicate balance between economic considerations and environmental sustainability goals presents a significant challenge for businesses. While implementing responsible waste management practices can lead to long-term cost savings, it's crucial to recognize that substantial financial resources may be needed for initial investments and operational adjustments. Therefore, it is imperative for companies to strike the right balance between economic considerations and environmental sustainability goals. The incorporation of artificial intelligence and data analytics into waste management procedures has the potential to completely transform the industry. By utilizing these advanced technologies, waste collection routes can be optimized, recycling efficiency can be enhanced, and companies can gain valuable insights to make informed decisions

based on data. This will ultimately lead to the improvement and advancement of waste management practices.

International collaborations and partnerships are of utmost importance in discovering solutions for global waste management. Given that waste management is a worldwide challenge, it is imperative for companies, governments, and organizations to collaborate and pool their knowledge, best practices, and resources to effectively tackle this issue. To summarize, the significance of corporate responsibility in promoting sustainable waste practices cannot be overstated for both businesses and society at large. Through the implementation of responsible waste management strategies, companies can effectively reduce their environmental footprint, realize financial savings, and bolster their brand image. It is imperative for businesses to incorporate waste reduction measures into their sustainability efforts, foster collaboration with supply chain partners, and harness technological advancements to improve sustainable waste practices. By undertaking these actions, companies can play a pivotal role in shaping a more sustainable future while simultaneously enjoying economic advantages.

Conclusions to chapter 2

Hence, the recycling sector has transformed into a global enterprise, spanning international markets and intricate supply and transport networks. Yet, it's imperative to recognize the pivotal role played by over two million informal waste pickers, particularly in low and middle-income countries, in the waste management industry. This informal sector faces distinct challenges and warrants support from governmental policies, given its crucial role in delivering waste management solutions to communities.

Solid waste management presents a significant challenge in both developed and developing nations, as highlighted in numerous literature sources. The rapid urbanization worldwide imposes a burden on cities, which must responsibly handle waste in a manner that considers social and environmental impacts. Crafting effective

waste management strategies hinges on understanding local waste characteristics, influenced by cultural, climatic, socioeconomic factors, and institutional capacities. Globally, waste management trends are shifting towards regionalization and increased structure. Developed countries typically exercise formal oversight over waste at the municipal or regional level due to their higher waste production rates. Conversely, in less industrialized nations where waste generation is lower and mostly organic, waste management involves a blend of formal and informal actors.

The World Economic Forum is actively advancing several initiatives concerning the circular economy. Beyond mere waste management, these efforts aim at instigating systemic transformations across diverse industries, fostering collaboration to exchange insights, case studies, products, and materials pertinent to circular economic principles. By enacting policy reforms, offering financial backing, and shaping public discourse, governments hold the potential to create conducive environments for the widespread adoption of zero waste systems. Crucially, mobilizing a global network of allies and prioritizing responsible waste policies are pivotal steps towards this goal. Key focal areas include securing both international and local funding for zero waste systems, crafting comprehensive roadmaps and regulatory frameworks to facilitate their implementation, and integrating zero waste objectives into local and national climate strategies, such as methane reduction initiatives.

In terms of societal expectations, it is crucial for the company to prioritize its efforts in identifying and addressing the social needs of society. When analyzing business operations, it's essential to note that socially responsible companies prioritize the development of their employees, dedicating approximately 10% of their resources to this endeavor. The achievement of sustainable development goals can provide significant economic benefits for companies that invest in the development of innovative solutions and transformative changes.

An increasing number of researchers are evaluating the social, economic, and environmental consequences of plastic pollution. Studies in the scientific literature have established a connection between chemicals in plastic and adverse effects on

human health throughout the entire life cycle of plastic, affecting workers and communities living near plastic production and waste disposal sites.

Meeting corporate responsibility in waste management is often impeded by regulatory barriers and the lack of standardized waste management practices. Varying regulations and standards across regions and countries introduce complexities for companies aiming to uphold compliance and consistency in their operations.

Technological advancements have played a crucial role in bolstering sustainable waste management practices. Businesses can utilize technologies such as smart bins for efficient waste collection and employ advanced recycling methods to enhance waste management processes and reduce their environmental footprint.

Furthermore, consumers are becoming more aware of the environmental consequences of their purchasing decisions and are actively seeking out businesses that prioritize sustainable waste practices. This growing trend motivates companies to be transparent about their waste management initiatives and to actively engage in environmentally responsible practices.

The main scientific results were published in the following scientific articles: 89; 168; 169; 170; 171; 172; 173; 174; 175; 176; 177.

CHAPTER 3

PROSPECTS OF DEVELOPMENT THE WASTE MANAGEMENT SYSTEM AND IMPROVEMENT OF THE CORPORATE SOCIAL RESPONSIBILITY

3.1. The key areas of waste management system improvement

The waste processing sector is a global business with international markets and complex supply and transportation networks. However, the waste management sector relies heavily on the persistent work of over two million informal waste pickers, especially in low- and middle-income countries. The informal sector faces unique challenges and requires government support as it contributes to providing environmentally important waste disposal services to communities. There are examples of government policies that utilize and formalize the informal waste management sector, which are acceptable but require specific measures to ensure people have stable livelihoods [145].

Businesses can integrate multiple waste management strategies to establish a comprehensive waste management system. While cost-effective measures are paramount, waste disposal alternatives encompass reduction, reuse, and recycling. Recycling is well-suited for handling inorganic waste like plastic, glass, and metals. Additionally, organic waste such as paper and food products can undergo recycling, but composting stands out as the optimal disposal method, converting organic waste into fertilizer. Waste-to-Energy (WtE) is the process of converting waste that cannot be recycled into heat, electricity, or fuel, using renewable energy sources such as anaerobic digestion and plasma gasification. While anaerobic digestion involves the biological conversion of waste into biogas, plasma gasification uses a plasma-filled chamber operating at high temperatures and low oxygen levels to convert hazardous waste into synthetic gas [146].

The waste management system “5R” encompasses a set of principles aimed at reducing the impact of waste on the environment: 1) *Refuse* unnecessary items, such as single-use plastics or excessive packaging; 2) *Reduce* resource usage and promote

conscious consumption; 3) *Reuse* items or utilize durable goods with longer lifespans; 4) *Repurpose* items by giving them new functions or extending their useful life; 5) *Recycle* used materials into new products, reducing the need for raw materials and overall environmental impact. Overall, these principles are geared towards responsible waste management and encouraging individuals and businesses to be more mindful of their consumption and disposal habits [147].

The waste audit, or the assessment of an organization's waste management system from generation to disposal, deserves special attention. Common approaches to conducting waste audits include record verification, facility walkthroughs, and waste sorting. Record verification involves reviewing the transportation and disposal of waste, as well as contracts with recycling companies. Facility walkthroughs focus on auditors identifying waste-generating activities through observation and employee interviews. Waste sorting involves physically collecting and weighing waste samples from the organization for a specific day or shift. The effectiveness of conducting a waste audit depends on keeping the audit date confidential, the organization's commitment to responding to the results, and post-audit verification [148].

In today's business landscape, having an effective waste management system is increasingly essential. As the global population grows and demand for products and services rises, businesses are generating larger quantities of both hazardous and non-hazardous waste. Consequently, implementing a sustainable waste management strategy is imperative to mitigate adverse environmental impacts, enhance operational efficiency, and reduce costs [151].

As the initial step in developing an effective waste management system, it's crucial to assess current waste management procedures. This involves evaluating the types and volumes of waste generated, as well as the treatment methods utilized. Conducting a waste audit is a valuable approach to pinpointing areas that require improvement. This process entails analyzing the waste stream to identify the sources, types, and quantities of waste produced. Additionally, it involves evaluating the methods and costs associated with waste disposal. After completing a waste audit, businesses can identify areas in need of improvement and develop strategies to address

them. For example, if the audit reveals a significant amount of waste being sent to landfills, implementing a recycling program may be a viable solution [152].

Developing a waste management plan is an essential second step in implementing an efficient waste management system. This plan must outline the goals, targets, and strategies required for successful waste management.

The waste management plan should cover the following areas [153]:

- *Objectives and goals*: The waste management plan must distinctly define the objectives and goals of the waste management system, which could involve waste reduction, higher recycling rates, and enhanced operational efficiency.
- *Waste minimization strategy*: The waste management strategy must encompass methods to minimize the volume of waste produced, such as implementing source reduction methods like reducing packaging waste or shifting towards a paperless workplace.
- *Recycling strategies*: The waste management plan should include strategies for increasing recycling rates, for instance, establishing a recycling program, implementing composting programs, or donating reusable items.
- *Waste treatment strategies*: The waste management plan should include strategies for disposing of waste in an environmentally responsible manner. These may include landfill diversion strategies such as waste-to-energy facilities or composting facilities.
- *Employee training*: The waste management plan should outline training programs for employees to raise awareness of the importance of waste reduction and recycling.

The third step towards implementing an effective waste management system is to deploy the waste management plan. This involves setting the strategies outlined in the waste management plan into action.

The following are some practical steps businesses can take to implement their waste management plan:

— *Set up recycling stations:* Set up recycling stations in key locations throughout the facility, such as the break room, kitchen, and production areas. Clearly label the recycling stations and provide training to employees on what materials can be recycled.

— *Implement source reduction measures:* Implement source reduction measures to decrease the amount of waste generated. This could involve using refillable containers, minimizing packaging waste, or adopting a paperless office approach.

— *Establish partnerships with waste management companies:* Establish partnerships with waste management companies to ensure that waste is managed in an environmentally friendly manner. Conduct research to identify and select companies with a proven track record in sustainable waste management.

— *Provide training to employees:* Provide training to employees on the importance of waste reduction and recycling. This could include training on properly disposing of waste, what materials can be recycled, and how to identify waste reduction opportunities.

— *Monitor and track progress:* Monitoring and tracking progress towards achieving the waste management objectives and targets specified in the waste management plan allows businesses to pinpoint areas needing improvement and make necessary adjustments.

The last step in establishing an efficient waste management system is to continuously assess and enhance it. Businesses should periodically review their waste management plans and measure their effectiveness.

The results of this study show that by following some practical steps, businesses can evaluate and improve their waste management system [154]:

1) *Regular waste audits:* Regular waste audits are instrumental in evaluating the effectiveness of the waste management system. These audits aid in identifying areas requiring improvement and facilitate adjustments accordingly. 2) *Analyze waste management data:* Businesses should analyze waste management data, including the quantity and types of waste produced, and the disposal methods used. This will provide valuable insights into the effectiveness of the waste management system and outline areas that need improvement.

3) *Involve employees*: Employees should be engaged in the waste management process and encouraged to provide feedback on ways to improve the system. This can help identify waste reduction and recycling opportunities that may not have been identified previously.

4) *Establish new waste management goals and objectives*: Based on the insights gained from waste management data and employee feedback, businesses should set new goals and objectives for their waste management system. This will help drive continuous improvement and promote greater sustainability.



Fig. 3.1. The waste management system improvement

Source: [author].

When analyzing the waste management system, it's important to recognize the value of leveraging new technology. Implementing blockchain technology in waste management represents a novel approach to addressing environmental sustainability and accountability challenges in our modern world. Blockchain, a technology that enables decentralized and immutable ledgers, is now being re-imagined as a tool to revolutionize waste management. This innovative approach aims to enhance waste

management transparency, traceability, and efficiency, leading to significant environmental and economic benefits [155].

The blockchain has the potential to serve as a communication channel, facilitating the development of digital services and products, while also offering the necessary tools to create effective solutions. In the market, there are numerous blockchain solutions available that can be applied in diverse scenarios. For instance, IoTeX combines the advantages of fast and secure blockchain technology with the Internet of Things (IoT). VeChain blockchain specializes in providing enterprise-level solutions. Its stability and integration capabilities make it ideal for constructing solutions centered around supply chain management and data integrity. SkeyNetwork blockchain offers technology that establishes a connection between IoT devices and the blockchain. Moreover, SkeyNetwork's Non-Fungible Tokens (NFTs) serve as proof of ownership, as each smart object within the network possesses its own unique token.

The integration of blockchain technology into waste management can be viewed as a component of the progression toward smart cities. Smart cities represent a conceptual model of urban development that leverages human, collective, and technological resources to foster growth and prosperity in urban areas. Despite the widespread adoption of technology in smart cities, waste management can still present challenges. These cities generate diverse types of waste, encompassing domestic, commercial, medical, agricultural, and industrial waste. This waste can be classified into various groups such as liquid and solid household waste, medical waste, hazardous waste, recyclables, green waste, and electronic waste (e-waste). These cities produce a range of waste types, including domestic, commercial, medical, agricultural, and industrial waste. This waste can be categorized into various groups such as liquid and solid household waste, medical waste, hazardous waste, recyclables, green waste, and electronic waste (e-waste). These functionalities allow for real-time monitoring of the whereabouts and status of waste from the point of collection all the way through sorting, transportation, treatment, and final disposal or recycling. In contrast to existing centralized waste data management systems that are susceptible to tampering, these tracking capabilities enhance the reliability of the entire process. Traceability plays a

vital role in streamlining the identification, storage, and comprehensive management of data concerning activities and outcomes in waste management operations. Important data points, typically logged during waste disposal, include specifics like waste category, quantity, collection site, routing details, updated transit schedules, and information about individuals involved in each stage of waste disposal. Therefore, blockchain technology holds significant promise for replacing the sluggish manual systems currently utilized in waste management across numerous smart cities [156].

The blockchain has the potential to enhance waste management through the creation of digital asset tokens, such as security tokens, that are linked to smart cities' waste for the purpose of tracking and tracing. These tokens are crucial in monitoring recycled waste materials and greatly aid government agencies in reducing waste management expenses and optimizing business processes. By ensuring traceability, the blockchain guarantees that waste produced in smart cities is handled according to established waste management protocols, safeguarding the environment from pollution. Additionally, it enables users to effectively monitor the entire lifecycle of smart city waste.

The utilization of blockchain technology allows for the identification of the precise category of healthcare waste that undergoes recycling at facilities, subsequently being repurposed for the manufacturing of medical devices and equipment. The enhanced transparency in tracking assets, made possible by blockchain, amplifies the value of the waste supply chain. This, in turn, reduces the expenses associated with waste management procedures such as collection, sorting, transportation, and processing. Various industries can leverage blockchain to determine the origin and transportation route of food scraps and waste destined for recycling facilities, where they are utilized for fertilizer production. By utilizing this data, these industries can establish new fertilizer production facilities in close proximity to waste sources, thereby reducing transportation costs [157].

The tracking feature of the blockchain enables users to log the whereabouts of trucks carrying smart city waste in real-time, offering details like the best routes and the weight of the waste. This information regarding the waste shipment locations

guarantees that the trucks follow the specified garbage collection points. This becomes crucial when waste originates from various regions and neighborhoods. For enhanced human safety, sensors on garbage bags can be utilized by the blockchain to confirm the segregation of hazardous waste from non-hazardous waste while in transit.

The transparency and immutability of blockchain technology are beneficial for monitoring the waste flow in recycling facilities, documenting the activities of waste handlers, and tracking the storage locations of waste throughout the recycling process. Each waste source can be assigned a unique identifier within the blockchain system. This identifier can take various forms, such as a QR code or a specialized Radio Frequency Identification/Near Field Communication (RFID/NFC) chip, depending on the specific requirements of the system. QR codes, for example, can store a large amount of information and can be easily scanned with a smartphone or reader, making it convenient to access data related to the waste's origin. On the other hand, RFID/NFC technology allows for remote tracking of items using radio waves, with data stored directly on the chip and connected to the blockchain as an NFT token. The choice of identifier depends on factors such as the type of waste, infrastructure, cost, and security needs, and different technologies can be combined to meet the specific demands of a waste management system [158].

An effective product-tracking ecosystem necessitates the integration of cutting-edge technologies with meticulously planned procedures and close cooperation among all participants in the supply chain. Employing this approach to guarantee visibility in the recycling process plays a crucial role in promoting sustainable waste management. In today's world, there is a growing focus on the conscientious utilization of resources, and the transparency of recycling operations stands out as a vital instrument in earning the confidence of both consumers and stakeholders [158].

With the increasing environmental awareness and the growing emphasis on sustainable business practices, it is probable that real-time, closed-loop monitoring will become standard in various industries. As technology advances and the cost of IoT sensors decreases, the opportunities for closed-loop applications will broaden, offering benefits to both businesses and the environment. By leveraging the immutable record

of data and transactions, blockchain technology can authenticate and identify any discrepancies in waste management processes by comparing the weight of waste received and shipped. This makes blockchain platforms preferable in scenarios where the organizations involved have diverse interests and potential conflicts. While centralized solutions are more appropriate for implementing waste management services when organizations share aligned interests, waste management often involves entities with competing interests. Therefore, blockchain technology can offer numerous advantages to waste handlers in such contexts.

The service life and dependability of various waste materials differ and rely on their composition and the environment in which they are used. When these materials reach the end of their life cycle, it is crucial to recycle or dispose of them responsibly at authorized waste recycling facilities. For example, many waste mobile phones contain valuable materials, such as lithium and cobalt, that can be repurposed to create new products once the phones are no longer in use.

Drawing from Khan's food supply-chain system, we can redefine the process for a waste management system as follows [159]:

(1) Provider: In waste management, this phase involves providing information regarding the origin of waste, including details about the crops, the application of pesticides and fertilizers, and the machinery used. All transactions related to this stage are recorded on the blockchain for transparency and accountability.

(2) Producer: In waste management, this phase focuses on collecting information about the waste-producing entity, which may include a farm or a similar establishment. It includes details about farming practices, cultivation processes, and weather conditions. This information is documented to ensure transparency and accountability throughout the waste management process.

(3) Processing: In waste management, this phase concerns the processing facility responsible for managing waste. It encompasses details about the facility, including its equipment and specific processing methods. Transactions with waste producers and suppliers are logged on the blockchain to ensure traceability.

(4) Distribution: This phase involves supervising the transportation and distribution of waste. It encompasses information about shipping, routes taken, storage conditions, and transit times at each transportation stage. All transactions involving waste suppliers and traders are recorded on the blockchain to ensure transparency and accountability.

(5) Retailer: In waste management, this stage involves providing information about the waste item, including its quality, quantity, expiry date, storage conditions, and shelf life. This data is essential for ensuring the proper handling and disposal of the waste.

(6) Consumer: In this final stage, the end consumer can access detailed information about the waste item using a QR code on their mobile device. This information includes the journey of the waste item from its source to the retailer, promoting transparency and boosting consumer confidence in the waste management process [160].

Therefore, efficient waste management can significantly contribute to the development of an environmentally sustainable and secure smart city. Manufacturers of solid waste, including items such as scrap metal, car tires, and smartphones, typically have the responsibility to monitor the disposal of these materials once they reach the end of their useful life. Technology plays a pivotal role in ensuring that waste from all sold materials is gathered at waste treatment centers. By monitoring the lifespan of each solid material device and assessing the overall market supply, proper disposal of all solid waste at waste treatment centers can be guaranteed. Producers can facilitate waste collection through authorized retailers, designated collection sites, or approved dismantlers/recyclers.

Residential waste management involves the collection and processing of waste at specific waste treatment centers. However, centralized waste management solutions are expensive and less reliable. Moreover, these solutions fail to provide a dependable traceability of waste management. Some challenges faced by centralized systems include maintaining complete control over waste collection data, ensuring sensor

credibility, meeting fault tolerance requirements, and addressing low robustness due to non-replicable data.

3.2. Methods for implementation of a corporate social responsibility management strategy

The development of CSR is progressing very slowly. Usually, it is the global corporations or companies trying to establish themselves in foreign markets, where corporate social responsibility is mandatory. Therefore, raising a country's public awareness and informatization will increase the prevalence of socially responsible institutions. Governments can play an important role in enhancing the social responsibility of companies. Thus, state actions should aim to increase the social responsibility of entrepreneurs. At the beginning of each year, all large and medium-sized enterprises should formulate corporate social activity plans to improve the social status of the enterprise, thereby increasing the social responsibility of the enterprise. It is well known that higher social responsibility within the enterprise leads to higher labor productivity, higher employee morale, and improved labor outcomes.

The prospects for the development of social responsibility projects are associated with:

- the formation of a national mechanism to promote the systematic improvement of the social responsibility of economic entities;
- an increase in the number of legal entities that develop and implement their own social responsibility strategies, and voluntarily prepare and publish non-financial reports annually;
- the use of advanced experience in corporate social responsibility in ethical behavior and improvement of working conditions;
- the protection and improvement of the social and labor rights of workers, compliance with modern occupational safety and human development standards;
- the protection of consumer rights;

- the improvement of staff capacity, including among vulnerable populations;
- the improvement of community life and the reduction of regional development disparities;
- the development of corporate social responsibility which has become a recognized trend in society;
- ensuring sustainable development of the country's economy and society;
- increasing the competitiveness of the economy;
- reducing unemployment, alleviating social tension, improving living standards, and creating a middle class;
- rational use of natural resources and reduction of pollution;
- promoting investment and innovation processes;
- economic and social regional integration.

With the onset of a new economic cycle in the global economy, market differentiation factors and corporate capitalization will once again increase the importance of Corporate Social Responsibility (CSR) as a management strategy. The development of CSR will determine the following:

Increased strategic focus:

- CSR will be considered by supervisory boards as part of the strategy of a larger number of companies (private, state-owned, closed, and public).
- CSR programs and projects will be implemented based on long-term plans, taking into account the need to explore new markets and deepen existing ones.
- ICSR strategy will consider national and international priorities for social and economic development, international trends (including industries), and best practices for implementation.
- Financial and credit institutions and capital markets (including international ones) will consider CSR standards for social stimulation in national state and national financial companies.

Improving systematization:

- most major companies will have socially responsible managers who will report directly to the CEO and will not be associated with functional departments;

- the company will properly monitor its responsibilities in accordance with widely accepted norms and standards that consider all aspects of CSR;
- increasing the number of comprehensive socio-economic reports prepared in accordance with international reporting standards, which will provide more information (positive and negative) about the company's activities and their consequences;
- national CSR will be considered and monitored by other influential groups (both national and international), and the public will demand information about CSR.

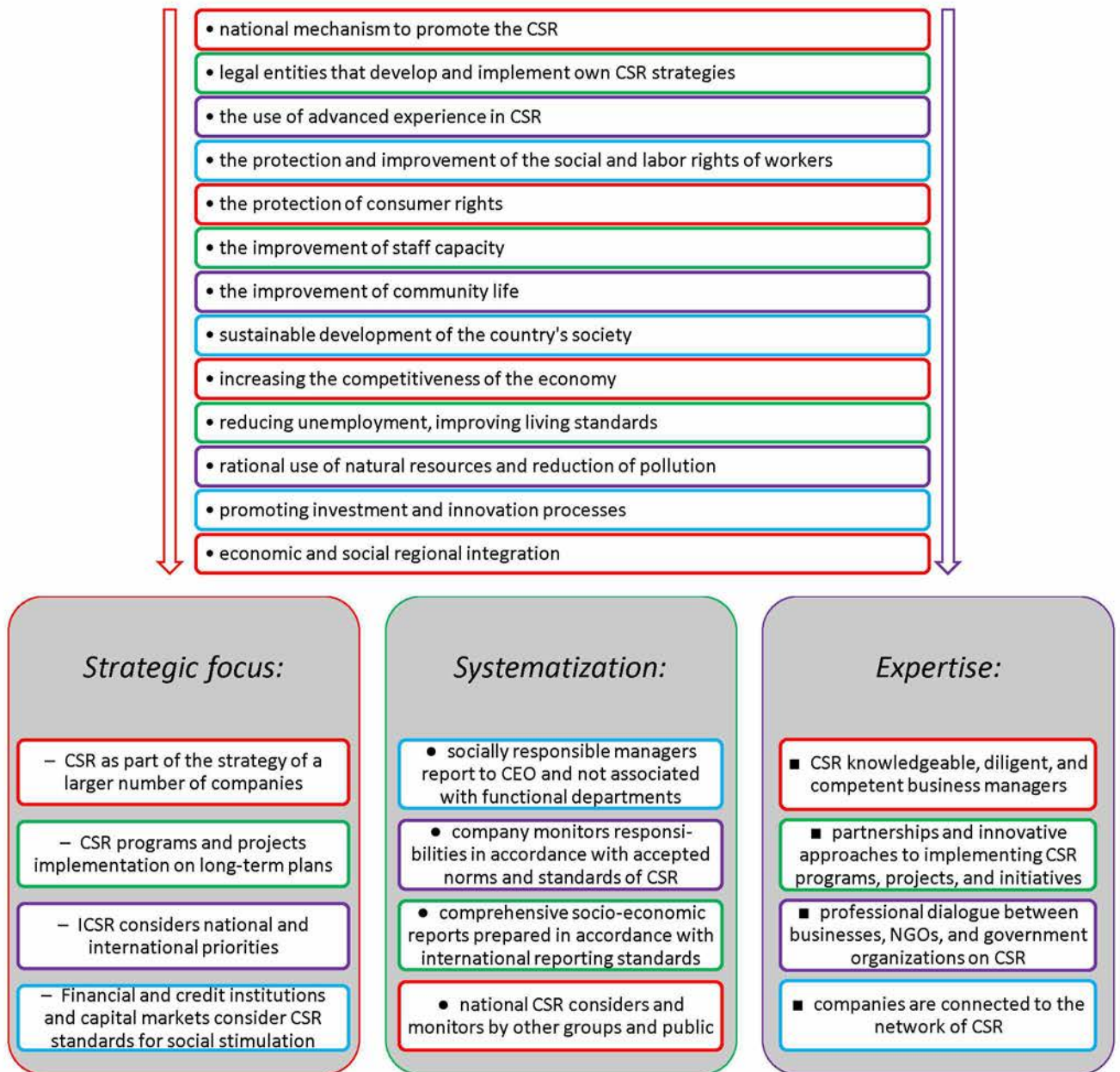


Fig. 3.2. Development process of CSR as a management strategy

Source: [author].

Enhancing expertise:

- increase the number of knowledgeable, diligent, and competent business managers with CSR;
- increase the number of partnerships and innovative approaches to implementing corporate social responsibility programs, projects, and initiatives that contribute to improving social, economic, and environmental well-being;
- raise the level of professional dialogue (especially in the media) between businesses, NGOs, and government organizations on CSR and socio-economic development issues;
- companies are connected to the network (such as the European) of CSR.

The wider and more extensive implementation of corporate social responsibility by companies contributes to the creation of new markets both domestically and internationally, helps address social and environmental issues, improves companies' access to international markets, increases the capitalization of national companies, and ensures sustainable development. In the United States, Western Europe, and Japan, the most common way to provide employees with additional social security is by offering them a so-called social package, with life insurance being one of its main components.

The main governmental branches of labor and social security have determined that a group insurance contract would be beneficial for employees. Although a legislative mandate to provide group insurance for large and medium-sized corporations would be effective, all forms of private insurance are strictly voluntary, and therefore, companies cannot be forced to offer such insurance. The state cannot adopt a coercive method. Instead, it can only send a recommendation letter to each company, suggesting that they increase their level of corporate social responsibility by adopting a group insurance contract.

Although medical insurance can be used to motivate employees, subsidized life insurance plans can address a broader range of issues. Insurance companies today offer three main types of corporate life insurance - life insurance for a specific period (term life), pensions, and products that combine both types of coverage. The use of combined products has significantly increased the effectiveness of insurance operations. Term life

insurance provides coverage for the risk of death from any cause and is the cheapest option among all life insurance options. In the event of the insured's death, the beneficiary (the person who is entitled to receive the insurance compensation) will receive a payment that is several times higher than the amount paid to the insurance company. The beneficiaries of the contract can be either: immediate family members and/or the company itself (as it may suffer losses due to the loss of employees). If an employee (the breadwinner of their family) passes away, their relatives usually receive one to two years' worth of annual income.

The popularity of corporate life insurance plans is rapidly growing, and individuals are not yet the main participants in the life insurance market. Just a few years ago, only large Western companies operating in the Ukrainian market offered such social protection to their employees. Now, it is an integral part of the activities of domestic companies, including medium-sized companies. Long-term life insurance and pension insurers typically offer long-term savings plans to corporate clients, usually with a one-time payment at the end of the contract term, and are often age-rated, offering payments in the form of annuities or hybrids. Companies have a variety of options in their arsenal for combining insurance products and providing various mechanisms to protect policyholders and their families. Some insurance companies offer corporate clients comprehensive plans with the ability to develop individual proposals for each company based on their needs and requirements.

The main advantage of corporate employee insurance is that it partially solves the problem of staff turnover. Corporate life insurance is an important factor in retaining the best employees in the workplace. After all, the life insurance policy becomes the property of the employee only after many years of service. The insurance term, in which the policy does not transfer ownership to the insured employee, is usually at least 5 years. If the individual employee changes employment before this period, the compensation amount will remain with the premium-paying company and will be redistributed among other contract participants. Based on this, many companies consider such products an effective vehicle to retain their employees and ensure their structural stability.

Corporate insurance also allows companies to track cases of illness among their employees, thus preventing potential abuses, as the insurer must be contacted in case of any illness if the company provides the employee with an insurance policy. Essentially, voluntary medical insurance can become a way to combat absenteeism. Many companies have developed what they call a "social package," which includes a range of social measures to improve the lives, work, development, and motivation of employees. Certainly, if a large business or factory decides to enter into a corporate insurance contract, it is better to insure only the managers who directly oversee and manage the business. However, at the discretion of the company's management, all employees can be covered. This will provide more opportunities to support a positive social climate within the company. Every business owner should know that a business requires business insurance. In doing so, they lay a strong foundation of social security not only for their employees but also for their own families, which will be a crucial motivating factor for this employee.

Before effectively implementing any social initiatives, organizations should have a clear CSR strategy that can help them achieve their main goals in the market. Deloitte's third annual global survey of over 2,000 C-suite executives at companies with goals focused on societal impact revealed that the existence of a comprehensive CSR strategy was closely linked to enhanced success. This success was measured by factors such as innovation, growth, and the acquisition of talented employees.

A properly executed corporate social responsibility (CSR) strategy can enhance the reputation of any company and foster stronger ties with society. Irrespective of the organization's scope and influence, a well-implemented CSR strategy can have a positive influence on both the environment and the company's perception [161].

To better implement CSR strategy, organizations should [162]:

— *Analyze the current CSR practices.* Any organization might already have established strategies to adhere to environmental regulations and support charitable endeavors or other corporate social responsibility initiatives. If so, it is advisable to incorporate these existing initiatives into CSR strategies. This approach can lend a

more natural and cost-effective methodology to future CSR endeavors, as opposed to adopting an entirely new tactic.

— *Research competitor's CRS strategies.* When determining the most effective approach to implementing a CSR strategy, it is beneficial to begin by analyzing comparable initiatives undertaken by rival companies. Conduct thorough research to uncover the actions taken by other firms in the same industry and assess their level of achievement. By doing so, an organization can emulate their successful practices while also steering clear of any mistakes they may have made.

— *Connect it to overall business strategy.* It is essential for any CSR-related initiative to align with an organization's fundamental business practices and core objectives. This alignment can enhance credibility with potential customers and the public. Generally, adhering to this approach is more cost-effective than pursuing actions that are not connected to the company's existing practices [162].

— *Provide support from top-level management.* Prior to executing a CSR strategy, it is crucial to secure the backing of all senior leaders in the company, such as the CEO, other executives, and the board of directors. Demonstrating agreement and solidarity not only enhances the company's reputation but also increases the likelihood of full employee engagement with the CSR strategy.

— *Donate funds to relevant causes.* When choosing what causes to sponsor, it is usually best that the organization select those that align with its business activities. For example, if a company manufactures clothing, it might partner with a foundation or establish its own to donate a portion of its products to those in need. This can help establish a more genuine bond between the company and the causes it supports.

— *Find reliable partners.* Companies should seek out potential partners in the local area who specialize in CSR initiatives, such as educational or environmental institutions. Collaborating with organizations that have expertise and experience in similar projects can greatly enhance the efficiency of the company's CSR efforts.

— *Involve the suppliers.* A company should ensure that all of the suppliers adhere to the same overarching strategies in order to minimize their environmental impact and contribute to societal well-being. This alignment of corporate social responsibility

(CSR) objectives can not only result in fair pricing for the business but also prevent any unintended repercussions that may arise from collaborating with a supplier lacking social consciousness. Moreover, fostering shared values over time can build stronger relationships between the company and its suppliers.

— *Prioritize communication.* It is essential to guarantee efficient communication in order to fully leverage the advantages of a carefully planned CSR strategy within the organization. Ensuring that all initiatives and strategies are effectively communicated through appropriate channels is crucial to reaching the intended audiences. This approach can prevent misunderstandings, enhance productivity, and secure stronger support from employees [162].

— *Attract potential employees.* Companies have the opportunity to attract high-caliber individuals by engaging in corporate social responsibility (CSR) initiatives that focus on supporting employee education. By investing in scholarships across a range of fields including science, technology, math, engineering, and sports, companies can empower and educate talented young individuals who may develop a sense of loyalty towards the organization that provided them with educational opportunities. Companies that pursue this approach should explore potential partnerships with local educational institutions.

— *Consider the environment.* Environmental conservation is a fundamental aspect of the majority of CSR initiatives. Irrespective of the sector in which the company operates, it is imperative to prioritize environmental concerns within the CSR strategy. Each individual and organization contributes to the carbon footprint of our planet and actively striving to diminish it is an essential component of contemporary CSR practices.

— *Keep it current.* Given the dynamic nature of current events and circumstances, the conditions surrounding CSR can undergo rapid changes. A company's CSR approach tends to be more effective when it aligns with society's most urgent and pressing issues. By staying informed about current events and adapting the CSR strategy accordingly, its long-term effectiveness can be ensured.

— *Stay accountable*. It is of utmost importance to establish attainable goals when implementing a CSR strategy. Making commitments that cannot be fulfilled will inevitably reduce the influence of the CSR strategy on the wider community. To prevent any harm to the reputation of the company, it is advisable to only commit the business to objectives that can be confidently achieved [162].

A CSR strategy can prove advantageous for both the company and society at large. Here are only a handful of the advantages [163]:

- It creates a positive image for an organization, making it more attractive for potential customers to do business with this company because they perceive it as being ethical and honest.
- Implementing CSR practices can empower a company to command higher prices. If the business's customer base values ethical business practices, they generally understand that implementing these practices may entail additional costs.
- It meets the expectations of the company's stakeholders who view ethical commerce as a moral responsibility for every business.
- The favorable image that the company presents has the potential to attract and maintain high-caliber employees.
- Corporate Social Responsibility encourages sustainable business practices by investing in solutions that yield short-term profits while maintaining focus on long-term objectives.
- It has the potential to decrease operational expenses by minimizing waste and emissions while maximizing resource efficiency.
- Companies with strong reputations and robust business strategies often have the ability to attract external investments. Potential investors tend to show greater interest in such companies [163].

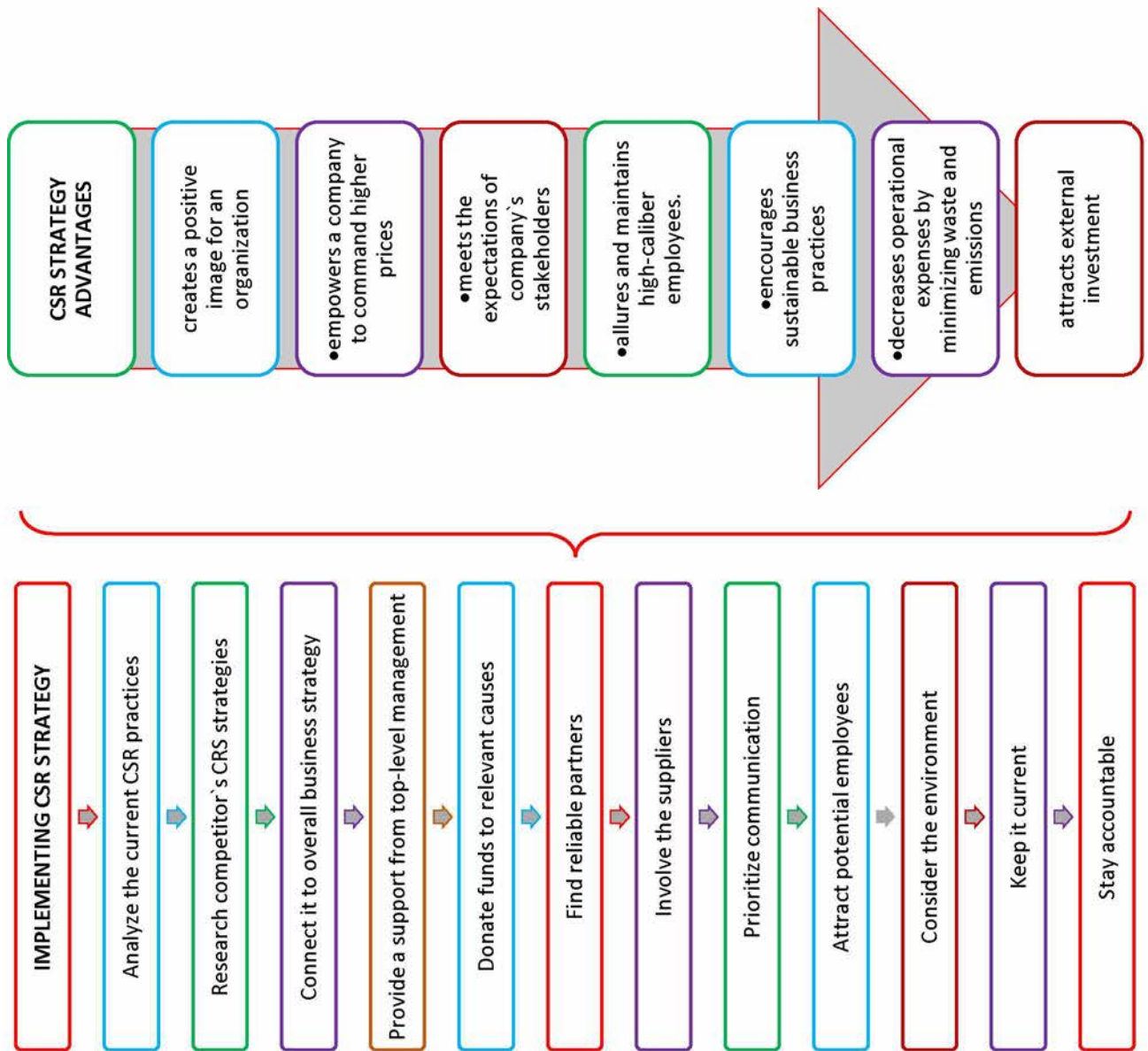


Fig. 3.3. CSR implementation strategy

Source: [author].

In addition, there are some recommendations on how to improve CSR strategy among all stakeholders of any company. CSR leaders have the potential to achieve positive results by engaging in CSR initiatives. They can mitigate adverse impacts on the environment and meet the demands of stakeholders. It is imperative to underscore the significance of enhancing CSR understanding among both internal and external stakeholders. There are three suggestions that could prove advantageous for CSR leaders in meeting the needs of internal and external stakeholders. They can assist CSR executives in making informed decisions regarding their CSR initiatives [164].

The primary recommendation is to engage communities in CSR endeavors to boost profitability. By improving communication with stakeholders, CSR leaders can gain insights into CSR activities and gather input on how to meet stakeholders' requirements. Transparency in reporting CSR activities allows for better stakeholder visibility into the CSR leaders' efforts. External stakeholders may acknowledge the positive intentions of CSR leaders towards certain communities. Engaging communities in CSR activities can effectively convey messages to shareholders, who can impact organizational profitability. The second recommendation involves enhancing business operations to boost profitability. CSR leaders can make well-informed decisions regarding the needs of stakeholders. By improving business practices, CSR leaders can find ways to assess the outcomes of CSR initiatives. This may lead to more favorable responses from stakeholders towards CSR activities, organizational reputation, and profitability. The third recommendation focuses on reinforcing corporate CSR for enhanced business profitability. CSR leaders can contribute to the community by providing job opportunities for youth and the elderly. Employees may also participate in the decision-making process related to CSR initiatives within the organization.

Business leaders can effectively address and meet stakeholders' needs by implementing three proven CSR strategies to enhance financial performance. CSR leaders may tailor specific strategies based on the requirements of different stakeholder groups. While certain strategies may need to be customized for certain stakeholder segments, CSR leaders can identify strategies that yield positive outcomes [165].

In addition, the implementation of the CRS strategy in the activity of any organization can be more effective with the use of Artificial Intelligence (AI). The strategic and integrated deployment of AI technology aims to significantly enhance the CSR process. The intelligent system comprehends the key elements that influence a company's business value and deliver beneficial outcomes for various stakeholders. It suggests a strategic approach and ensures transparency within the company's management. Through a deliberate assessment of business drivers and CSR objectives, it devises a tailored plan to streamline and enhance the CSR program. AI can help

companies monitor and report on CSR performance, as well as identify and address any gaps or risks. For instance, AI can be employed to scrutinize data from diverse channels, including social media, customer input, audits, and surveys, in order to gauge the company's influence on society and the environment. Additionally, AI can be utilized to produce reports that adhere to internationally recognized benchmarks, such as the Global Reporting Initiative (GRI) or the United Nations Global Compact (UNGC). By harnessing the power of AI, the company can enhance its transparency and accountability, fostering trust and bolstering its reputation among stakeholders.

AI has the capability to enhance resource efficiency and minimize waste, resulting in advantages for companies' financial performance and the environment. For instance, AI can be utilized to streamline energy usage, water consumption, supply chain operations, and manufacturing procedures through the integration of intelligent sensors, predictive analysis, and automation. Additionally, AI can aid in decreasing waste production by employing image recognition, sorting algorithms, and recycling technologies. By harnessing the power of AI, the company can enhance its transparency and accountability, thereby fostering trust and bolstering its reputation among its stakeholders. By leveraging AI, organizations can diminish their ecological impact, cut down on expenses, and boost their competitive edge. Artificial intelligence (AI) can assist in supporting social and environmental causes that are in line with the company's corporate social responsibility (CSR) vision and values. For instance, AI can be utilized to pinpoint and collaborate with relevant non-governmental organizations (NGOs), charities, or social enterprises through the application of natural language processing, sentiment analysis, and matching algorithms. Moreover, AI can be employed to develop and implement social and environmental solutions by leveraging machine learning, computer vision, and chatbots. This includes the creation of educational applications, health diagnostics, or disaster relief tools. Through the utilization of AI, the company has the ability to amplify its social and environmental influence, thereby fostering positive change on a global scale [166].

AI has the potential to revolutionize the way organizations engage and empower their stakeholders, including employees, customers, suppliers, and communities. One

way to leverage AI is by utilizing voice assistants, chatbots, and video conferencing to enhance communication and collaboration. Additionally, AI can be used to empower stakeholders through training, feedback, and incentives, employing techniques like gamification, personalization, and rewards. By harnessing the power of AI, organizations can enhance stakeholder satisfaction, loyalty, and participation, while also fostering a culture of corporate social responsibility (CSR). AI is not only a valuable tool for driving business innovation but can also play a crucial role in advancing CSR efforts. By integrating AI into organizations' CSR initiatives, companies can effectively and efficiently achieve their CSR goals, making a positive impact on society and the environment.

Moreover, the strategic and integrated implementation of AI technology aims to significantly enhance the CSR process. The intelligent system comprehends the key elements influencing a company's business value and delivers beneficial outcomes for various stakeholders. It suggests a strategic approach and ensures transparency within management. Through a deliberate assessment of business drivers and CSR objectives, it devises a tailored plan to streamline and enhance the CSR program. AI has demonstrated its worth as a valuable asset in boosting customer engagement and satisfaction, which are vital elements of corporate social responsibility (CSR). Through the utilization of AI-driven chatbots and virtual assistants, businesses can deliver tailored and timely customer support, thereby ensuring a favorable customer experience. For example, a telecommunications firm integrated an AI chatbot into their website, enabling customers to swiftly resolve their inquiries. This not only diminished reliance on human support but also enhanced accessibility for people with disabilities.

Numerous entities are harnessing the power of AI to advance sustainable energy practices and mitigate carbon footprints. Employing smart grid technologies and AI algorithms, organizations can fine-tune energy distribution, track consumption trends, and pinpoint avenues for enhancement. An energy utility firm, for instance, effectively deployed AI to scrutinize energy consumption patterns across various regions and provide personalized suggestions to customers for curbing their energy usage. This endeavor not only facilitated savings on customers' energy bills but also played an

integral part in fostering a more eco-friendly and sustainable ecosystem [167]. AI has played a crucial role in optimizing waste management procedures, empowering organizations to minimize waste production and enhance recycling endeavors. Through the integration of computer vision and machine learning algorithms, waste sorting systems can autonomously recognize and segregate various types of waste, thereby facilitating effective recycling practices. Waste management enterprises could introduce AI-driven sorting machines in their recycling plants, leading to increased recycling rates and a notable decrease in landfill waste.

It is worth saying that AI holds substantial potential in advancing accessibility and fostering inclusion, thereby strengthening a company's CSR endeavors. Leveraging AI-driven language translation tools and speech recognition technologies, organizations can dismantle language barriers and guarantee equitable access to information. Furthermore, AI can aid individuals with disabilities by furnishing assistive technologies like voice-controlled devices or smart home automation systems. A tech enterprise effectively integrated AI-powered language translation functionalities into their mobile application, enabling users from various backgrounds to seamlessly communicate and utilize the company's services [167]. In addition, AI holds the promise of transforming healthcare accessibility, especially in underserved regions. Through the utilization of AI algorithms for medical diagnosis, remote patient monitoring, and telemedicine, healthcare providers can expand their outreach and deliver high-quality healthcare services to individuals deprived of conventional medical facilities.

3.3. The model of waste management in the system of corporate social responsibility

In the business world, the risk and uncertainty factor is an important element to consider in making decisions and taking action, especially at the institutional, local, regional, or national level. However, there are several cases where a global crisis can be predicted, with its consequences affecting multiple sectors. This requires strategic

flexibility to change actions and business models, adapting them to emerging needs. One such instance is the COVID-19 health pandemic, which was able to paralyze the global economy in a matter of weeks, resulting in immediate negative consequences for the business sector. This affected organizations and all those who work or are associated with them, thereby jeopardizing the survival of families. In response, companies were forced to be more flexible in order to develop new action scenarios and offer products and services in accordance with the new requirements.

The analysis of external factors compels companies to be better prepared to counter various types of crises, which involves developing measures to maintain continuity of their business practices, with protocols and resources in place to ensure maximum operational efficiency. Considering this, swift response holds paramount importance for timely decision-making. However, the emergence of certain phenomena, such as COVID-19, is difficult to predict. This crisis is considered one of the most significant, leaving behind profound and lasting economic, political, social, and cultural consequences. During such a crisis, factors of values perception, communication, and physical interaction undergo significant changes. The current challenges have led to a series of complications, forcing companies to leverage their comprehensive skills to address them, while maintaining their vision and core business objectives. This includes the social responsibility of businesses, which is intended to meet the needs of various stakeholders (environment, employees, customers, and the community).

In this regard, socially responsible companies have recognized the need to implement higher-order strategies that enable them to maintain their initial orientation during unforeseen situations. In view of this, a set of practices has been proposed to assess the degree of companies' adaptation to the current environment while maintaining the philosophy of social responsibility. These practices involve analyzing companies' actions towards their clients, employees, community, environment, and innovations. Consequently, it is expected that companies have the ability to adapt and strategically flex, as necessary, to continue their social responsibility from a new perspective.

Responsible behavior and sustainability have been relevant topics in recent years. The academic and business sectors have considered them from various perspectives, such as corporate social responsibility, socially responsible consumption, and socially responsible investments. Despite this focus, these concepts have not shown significant promise. One of the best ways to influence corporate decisions in this regard is by changing consumer demand. Socially responsible consumers take into account the societal consequences of their consumption and use their purchasing power to drive social changes within companies. In this sense, it is a conscious choice of consumption based on moral and personal beliefs, or the conceptualization of oneself as an individual who, through the purchase of a certain product or service, minimizes or eliminates harm to society, thereby maximizing positive long-term impact. On the other hand, ethical consumer behavior relates to the choice of a particular company and product based on political, religious, environmental, or social motivations, as well as considering other factors.

In this case, in order to increase CSR, the following steps are necessary:

- establishing a system for obtaining reliable and timely information on the social, and economic impact of companies;
- ensuring the accuracy of financial and non-financial (social) reporting indicators and evaluating the effectiveness of socio-economic expenses;
- formulating social reports as a separate form of reporting or as a separate part of an integrated report;
- financial support for the social package should be included in the organization's social security plan (an integral part of the organization's event plan). The determination of the components of the social package (incentives and compensations) is individual and considered under specific circumstances.

For the purpose of effective analysis and control of social security indicators, as well as rational and targeted use of social security funds, it is recommended to submit management accounting to the responsibility center.

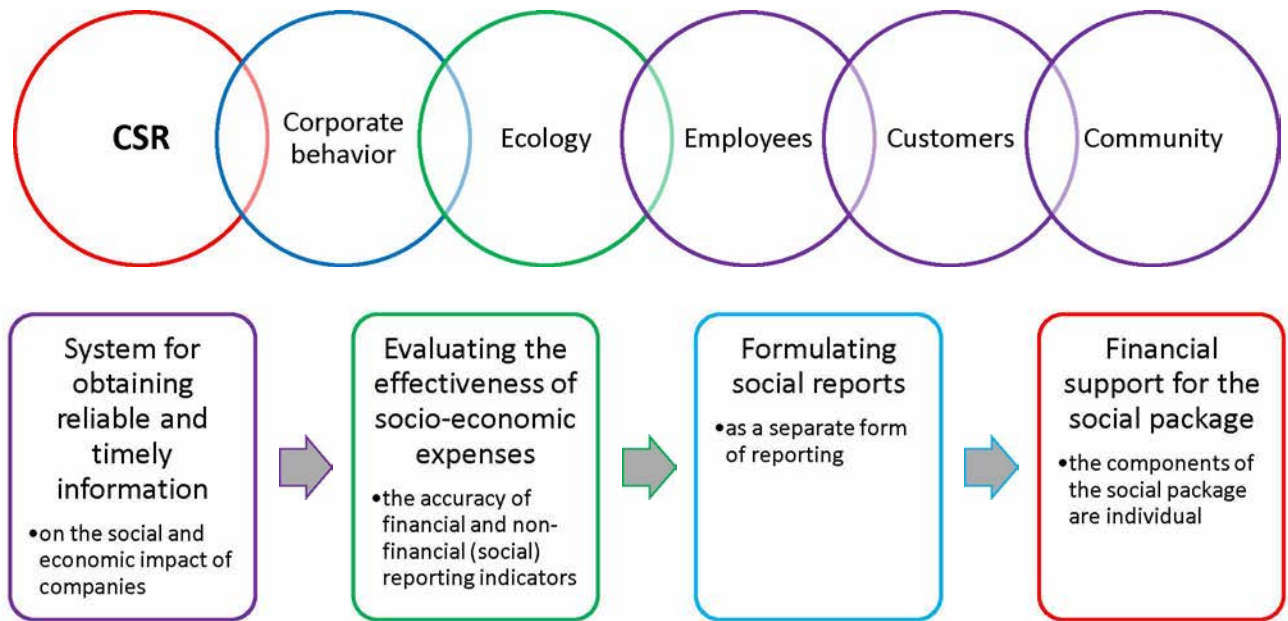


Fig. 3.4. Interdirections of corporate social responsibility under crisis

Source: [author].

The COVID-19 pandemic has had a negative impact on the global economy, the way of life of millions of people, and the business sector. The importance of business social responsibility has increased due to ethical, socio-economic, and managerial components that form the basis of modern social consciousness. The diverse experiences, both positive and negative, caused by the lockdowns have influenced society's behavior. Restrictions on food availability, job insecurity, increased risk perception, and decreased desire to contribute to environmental efforts provide companies with the opportunity to incorporate and expand their responsible practices, redirecting social behavior towards greater cooperation in overcoming the consequences that have been created.

Global challenges, such as COVID-19, have prompted companies to increasingly incorporate social and environmental aspects into their business activities. This has been mainly driven by government regulations and is a potential source of competitive advantage for companies. In addition to government pressure, compulsion has been another catalyst for the adoption of business social responsibility practices. Actions focused on environmental outcomes have become the centerpiece of sustainable development, as adopting such practices stimulates corporate growth, as

well as investments. Debates between interest groups and shareholders have intensified in recent years, as regulatory and coercive pressures exerted on the company have led to the inclusion of robust indicators, such as ESG (environmental, social, and governance-focused indicators), which include aspects related to climate change, pollution, and working conditions. The components that make up social responsibility were disrupted under the influence of the pandemic, which had a significant impact on the global economy due to the policies implemented to contain the spread of the virus. These included the closure of non-essential activities; thus, the expected economic impact will persist. The environmental efficiency during the pandemic encourages a decrease in proactive actions towards the environment, as the pandemic remains a central issue worldwide. Indeed, fuel efficiency standards and environmental restrictions have decreased. Therefore, at the end of the pandemic, coupled with the decrease in fuel prices, there will be an increase in demand for transportation, leading to an increase in emissions into the atmosphere.

On the other hand, employees, as stakeholders, are involved in social responsibility and are another important focus that companies have had to pay attention to in order to reduce the negative impact caused by extraordinary health conditions, such as the vulnerability of physical integrity and increased unemployment rates. The goal is to support the quality of life of employees through business adaptation. In this sense, regarding the interest in preserving the health and safety of human capital, it is worth noting that companies have sought to strengthen employees' knowledge through better training and education, allowing them to better coordinate their work activities and thus generate a healthier work environment. Ensuring the necessary equipment for the protection of people's health was part of the necessary protocols, including face masks, gloves, information related to their proper use, as well as sanitary restrictions. Increasing the level of hygiene and cleanliness in the workplace also became part of the daily routine. In parallel with the above, working conditions were adjusted to remote and home office modes, schedules and shifts were reorganized, electronic devices were used to support regular communication, and training was conducted to help employees adapt to new operations. Despite the aforementioned, as a result of

these work adaptations, a problem arose related to the excessive workload that needed to be completed, as well as the emotional stress that developed.

The companies' focus on satisfying customer needs has become an important role over time, placing customers at the center of their operations in order to gain competitive advantages, improve their image and reputation, and ensure greater customer loyalty. As a result, businesses have had to adapt their strategies to emerging needs, directing their business activities towards meeting these opportunities by offering new products and services, or higher quality products and services, new forms of customer service, improving customer relationships to understand their needs, providing more adequate solutions to complaints, promoting updated information, and maintaining ethical and honest practices. Considering the need to search for better opportunities, reduce uncertainty caused by the pandemic, and mitigate its impact and consequences, product diversification has shifted towards supplying masks, gowns, personal protective equipment, and disinfectants. With care towards its employees, the company has implemented measures that promote the safety of clients, creating areas with necessary safety protocols for financial transactions. Therefore, hygiene care in these premises has become crucial. Such business decisions have become crucial in consumer choice, as ensuring and implementing protocols and strategies to meet sanitary needs (disinfectant gel, protected workers, healthy distance, temperature measurement, limiting the number of clients, thorough cleaning of high-touch surfaces) and led to increased safety and trust in the establishment and a sense of care for the consumer.

Charity, social events, providing free services or products, helping to solve social problems, and striving to improve social well-being and quality of life for a segment of the community, positively influence the perception and behavior of clients. In times of crisis, businesses are seen as key players in efforts to mitigate the impact of infectious diseases on the population. Business interest in supporting active participation mainly stems from the desire for a swift economic recovery; therefore they seek to interact favorably with stakeholders to achieve positive outcomes. In this regard, in order to reduce uncertainty during a crisis, companies strive to maintain

active cooperation or promote citizen engagement by providing free services and special discounts to support their staff (food, money, internet, restructuring payments). Additionally, companies with greater capacity actively seek to participate in production and provide essential products and services free of charge, such as sanitizers, respirators, and specialized equipment.

Implementation of environmentally conscious measures within the framework of corporate social responsibility directly impacts the economic interests of MNCs through functional areas such as finance, marketing, and risk management. In the long term, this leads to an increase in the company's resilience level and the "environmental" achievement of its goals, which aligns with the concept of sustainable development. Additionally, the adoption of environmentally conscious practices by MNCs enhances the competitiveness of their products, which is particularly important for companies and their associations operating in the global market, as the environmental friendliness of goods and services is one of the key competitive advantage factors for them.

Approaches to enhancing the effectiveness of environmentally responsible corporate social responsibility practices for transnational companies and their associations include the following:

Integration of environmental values into the mission and vision of companies.

"The values and principles of corporate social responsibility embedded in the mission of the main company association should be transformed into a system of strategic goals and implemented at all relevant levels of strategic planning – corporate, business – functional" [19].

Formation of a team of managers to implement environmental projects.

"Organizational and managerial structures should contribute to achieving the set goals in the field of environmentally responsible activities. Project groups involving specialists from various departments such as marketing, human resources development, sales, and public relations should be involved in the development and implementation of environmental programs. This contributes to the formation and implementation of comprehensive programs covering various areas of company activities" [20].

Conducting an environmental audit. The criteria for environmental assessment include a value system, industry standards, best practices, and stakeholder expectations.

Priority should be given to projects where the environmental impact is aligned with business interests. Implementing environmentally conscious measures is not just an act of charity but should be clearly aimed at achieving corporate goals. When calculating the economic impact of implementing environmental projects and programs, it is necessary to consider the indirect influence on external stakeholders, including the local community. It is important to find a common ground between the interests of companies, consumers, and the local community, which will allow for the implementation of environmental investment projects on a mutually beneficial basis.

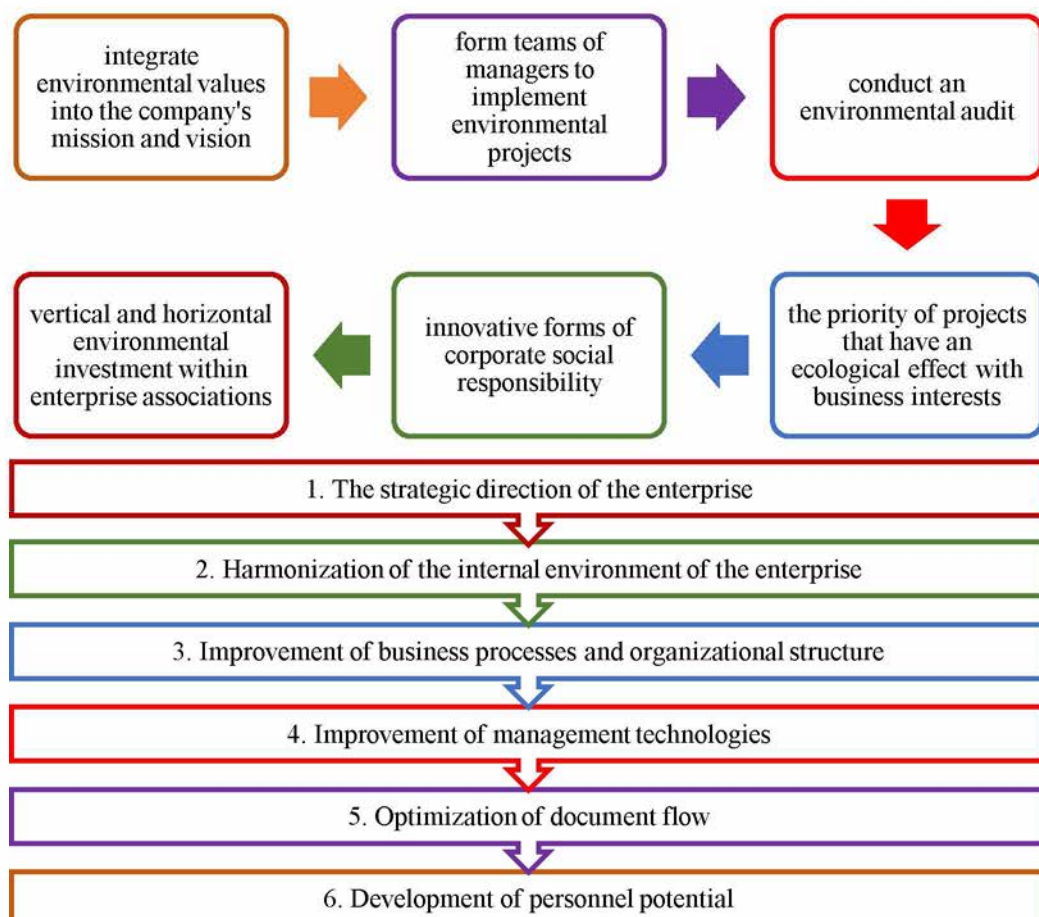


Fig. 3.5. Ways of implementing environmental management and directions of corporate social responsibility

Source: [author].

Implementation of innovative forms of corporate social responsibility, including participation in grant-giving associations, local development corporations, programmatic investment, and comprehensive programs for the socio-economic development of territories. Typically, they involve forming partnerships with other companies, non-profit organizations, and local authorities to implement joint environmental programs.

Carrying out vertical and horizontal environmental investment within business associations. Implementing joint "green" investment projects allows for the control of environmental aspects in supply chain management, improves product quality, and reduces operational risks.

As a result, transnational companies have an opportunity to switch to more environmentally friendly industrial products and improve them in the following ways:

- excluding environmentally harmful components from production;
- using environmentally friendly raw materials;
- implementing low-waste or zero-waste technologies and processes;
- reducing the weight or volume of products, reducing the amount of packaging material;
- manufacturing products in concentrated form;
- mass production;
- combining the functions of several production cycles;
- reducing the number of models or modifications;
- extending the life cycle of products;
- improving repairability;
- increasing the quality of products, including the possibility of their reuse;
- product restoration.

An important step in implementing an environmental pollution prevention program for MNCs operating in the country should be the establishment of a philosophy of environmental harm prevention. Some companies have created bonus and reward systems for employees who have made a significant contribution to the

program aimed at preventing negative impact on the environment. For the MNCs themselves, such stimulation can include:

- exemption from tax payments;
- exemption from import duties (only for equipment);
- advantages in ecological construction;
- land lease on preferential terms.

The company must preserve this direction by dedicating itself to the ideas of environmentalism. Program participants should focus on identifying areas where waste generation can be reduced based on information gathered from various sources. Therefore, it is necessary to establish certain requirements for investment projects:

- ✓ eco-friendly construction, modernization, and job creation;
- ✓ optimal project implementation period – 5 years;
- ✓ projects should have a positive impact on GDP without causing harm to the environment.

When addressing or expanding a damaged area, it is advisable to focus on greening a specific process. Participants should choose the most effective methods of waste reduction or emission reduction from this source. This requires a detailed analysis of all costs and benefits that may arise as a result of specific actions, such as: reducing the cost of operating equipment, fines for violating environmental laws, and further obligations to compensate for environmental damage. For example, Ukraine is an agricultural country, with a large number of agro-industrial multinational corporations operating within its borders. Therefore, focus should be directed to the agricultural business, which:

- must produce "green" products;
- minimize the use of pesticides;
- use modern technologies to monitor the need for fertilizer use.

Environmentally friendly sunflower processing practices are gradually being implemented in agricultural countries using clean presses. The processing results in oil, meal (animal feed), and granulated husks, which are used as biofuel. The excess husks are then exported abroad. There are also examples of zero-waste chicken production:

the byproducts are used for biogas, and feathers and related products are processed into proteins.

In order to improve the environmental indicators of industrial production, it is necessary to: strengthen monitoring of the technological impacts on the environment, by improving control tools and statistical reporting of enterprises and establishing administrative responsibility for their reliability by company's managers; improve the methodology for determining environmental fee norms and strengthen their role in restoring natural environmental parameters, as current fees are too low and do not successfully perform a regulatory function; strengthen the system of economic incentives for transnational companies to reduce harmful emissions and improve the overall environmental state of production by providing preferential loans and progressive taxation; verify the maximum emission levels for enterprises in relation to maximum emission standards and the actual damage to the natural environment.

Regardless of the approach chosen by the company, it is necessary to determine how to measure the impact of the production eco-friendliness project. First, it is necessary to compile accurate data regarding expenses associated with existing production methods. Then, this cost is compared to the cost (including the cost of necessary equipment) required for the implementation of the eco-friendliness project. In addition to traditional methods of evaluation and decision-making, the eco-friendliness project should also take into account implicit benefits and losses. Non-material results should be converted into tangible income and losses, which are equally as important as material ones.

Among other initiatives that require immediate attention is the issue of polymer accumulation, specifically:

- reducing plastic production;
- producing strong film with less plastic content.

Successful implementation of environmentally responsible practices by multinational companies leads to improving business sustainability by enhancing relationships with stakeholders, reducing environmental risks, and increasing product competitiveness. In the long term, this ensures the sustainable development of

enterprises. To monitor the effectiveness of environmentally conscious initiatives within corporate social responsibility, companies utilize a wide range of assessment tools, including those in line with international standards and reporting systems. In order to enhance the efficiency of environmentally conscious practices in the realm of corporate social responsibility, a series of measures need to be taken, such as integrating environmental values into the strategic management system, forming a team of managers to implement environmental projects, conducting environmental audits, with the business interests of projects being given priority.

The development of the waste management model within the system of corporate social responsibility includes: waste management system improvement; implementation of corporate social responsibility management strategy via the development process of CSR as a management strategy; CSR implementation strategy; creation of guidelines for corporate social responsibility under crisis; deployment of environmental management strategies and guidelines of corporate social responsibility. The application of the waste management model within the framework of corporate social responsibility is characterized by: the strategic direction of the company's activities. Adherence to the principles of environmental management is associated with the incorporation of environmentally relevant issues into the business strategy as an integral part.

It is important to harmonize the internal environment of the company. Practical experience indicates the imperfection in management within enterprises that operate on the basis of traditional operational management mechanisms. The environmental management system involves the coordination of tactical and strategic planning. Organizations need to focus on improving business processes and organizational structure. By doing so, conflicts between core and environmental activities can be avoided, and reasonable and achievable environmental goals can be set. It is also necessary to improve management technologies and optimize document flow. Furthermore, it is crucial to ensure the development of human resources, as in the absence of support, positive results will be insignificant.

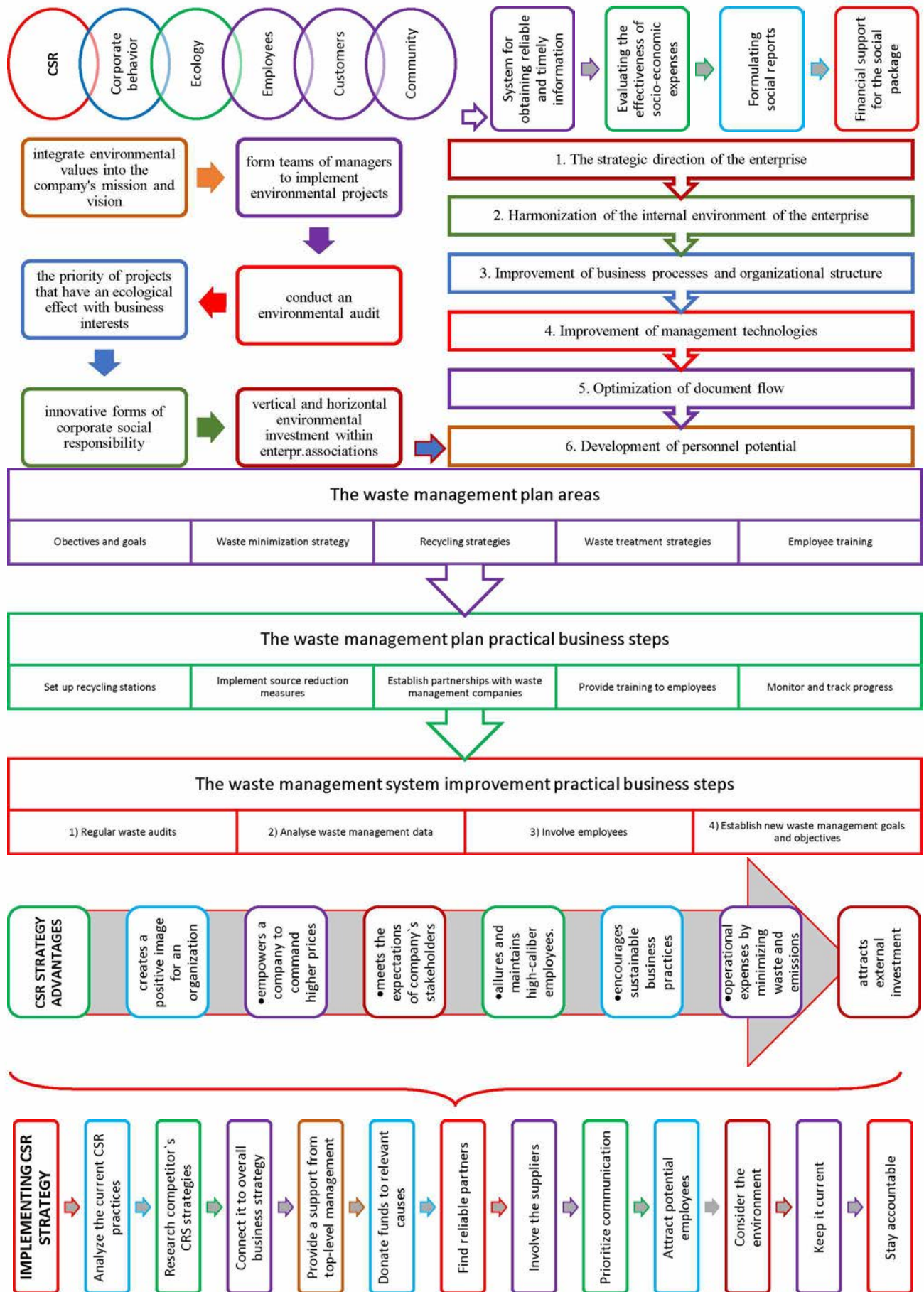


Fig. 3.6. The model of waste management in the system of corporate social responsibility

Source: [author].

Before implementing strategies to improve the effectiveness of environmentally responsible practices in corporate social responsibility, specific steps need to be taken: integrating environmental values into the mission and vision of companies, establishing teams of managers to carry out environmental projects, conducting environmental audits, aligning the implementation priority of projects with environmental benefits with business interests, introducing innovative forms of corporate social responsibility (participation in grant-giving associations, local development corporations, programmatic investment, comprehensive programs for socio-economic development of territories), and making vertical and horizontal environmental investments within business associations.

The development of corporate social responsibility requires: increasing strategic focus (system as part of a larger strategy of more companies; long-term projects; advanced experience; financial-credit incentives), improving systematic approach (socially responsible managers; activities in accordance with norms and standards; reports according to international standards; informativeness), and deepening expertise (competent managers; projects to improve social, economic, and environmental well-being; raising the level of professional dialogue; participation in the network). Employees, as part of stakeholders, are also involved in social responsibility and are another important area that companies have to focus on in order to reduce the negative impact caused by extraordinary health conditions.

Conclusions to chapter 3

Thus, businesses can integrate various waste management strategies to create the most efficient waste management system. While cost-effectiveness is a primary consideration, effective waste management strategies encompass reduction, reuse, and recycling. Recycling, for instance, is particularly effective for disposing of inorganic waste materials like plastic, glass, and metals.

In the contemporary business landscape, a robust waste management system is increasingly essential. With the world's population growing and the demand for

products and services rising, businesses are generating larger quantities of both hazardous and non-hazardous waste. Consequently, adopting a sustainable waste management strategy is vital to mitigate adverse environmental effects, enhance operational efficiency, and lower costs.

To establish an efficient waste management system, the initial step is to assess the current waste management procedures. This involves evaluating the types and quantities of waste generated, as well as the treatment methods employed. Additionally, it is essential to develop a waste management plan, outlining the aims, targets, and tactics necessary for successful waste management. When examining waste management systems, it becomes evident that integrating new technology is imperative. The adoption of blockchain technology in waste management represents an innovative approach to addressing environmental sustainability and accountability challenges in today's world. Blockchain has the potential to revolutionize waste management by introducing digital asset tokens, such as security tokens, which are linked to waste in smart cities for tracking and tracing purposes. These tokens play a vital role in monitoring recycled waste materials and greatly assist government agencies in reducing waste management expenses while optimizing business processes.

Furthermore, before effectively implementing any social initiatives any organization should have a clear CSR strategy, that can help it to achieve main goals in the market. A properly executed corporate social responsibility (CSR) strategy can enhance the reputation of any company and foster stronger ties with society.

The implementation of CSR strategy in the activity of any organization can be more effective with the use of Artificial Intelligence. AI can help companies monitor and report on the CSR performance, as well as identify and address any gaps or risks. AI has played a crucial role in optimizing waste management procedures, empowering organizations to minimize waste production and enhance recycling endeavors.

For the purpose of effective analysis and control of social security indicators, as well as the rational and targeted use of social security funds, it is recommended to submit management accounting to the responsibility center.

Successful implementation of environmentally responsible practices by multinational companies leads to improving business sustainability by enhancing relationships with stakeholders, reducing environmental risks, and increasing product competitiveness.

To improve the effectiveness of environmentally conscious practices within the scope of corporate social responsibility, several steps can be undertaken. These include integrating environmental principles into the strategic management system, establishing a dedicated team of managers to execute environmental initiatives, conducting regular environmental audits, and ensuring that business interests remain a priority in these projects. Furthermore, the development of the model of waste management in the system of corporate social responsibility helps companies to achieve their goals in the efficient and responsible way.

The main scientific results were published in the following scientific articles: 89; 168; 169; 170; 171; 172; 173; 174; 175; 176; 177.

CONCLUSIONS

In summarizing, the findings of this study demonstrate the widespread acknowledgment of waste management services as essential provisions for all communities. Waste manifests in diverse forms, and its categorization encompasses various dimensions. Common criteria for classifying waste include its physical state, properties, potential for reuse, biodegradability, origin, and environmental impact magnitude.

The theoretical framework of waste management provides a structured approach to comprehend waste management practices, delineating essential concepts and suggesting methodologies for efficient waste handling. At the core of this theory lies the understanding that sustainable waste management largely depends on how we conceptualize and classify "waste." The concept of "waste" is deeply intertwined with human behaviors and lifestyles. Communities, households, and economies depend on a steady provision of air, water, food, raw materials, and fossil fuels.

Preventing waste generation stands out as the foremost alternative to waste disposal, making waste prevention the focal point of all waste management strategies. Various technologies can intervene at different stages of a product's lifecycle – production, use, or post-use – to eradicate waste and thereby diminish or prevent environmental pollution. Prominent strategies encompass environmentally conscious production practices, which involve employing less hazardous or harmful materials, implementing advanced systems for monitoring hazardous material storage, and adopting innovative techniques for chemical neutralization and freshwater conservation.

The operational practices of businesses carry the potential to negatively impact both the natural environment and human health and well-being. This impact ripples beyond employees, affecting local communities and society as a whole. By implementing a comprehensive environmental safety management system, businesses can leverage the synergies among its components, optimizing the use of crucial materials and organizational resources. Embracing such a system profoundly influences economic, social, and environmental dimensions. This holistic approach

involves adherence to production standards, labor regulations, emissions and waste management protocols, resource conservation efforts, and more. To ensure long-term viability, businesses must prioritize environmental stewardship, resource efficiency, and the well-being of their workforce and society.

Implementing corporate social responsibility strategies can enhance organizations' reputation, social relevance, and long-term sustainability. This study highlights the pivotal role of environmental management in bolstering the physical, social, and economic aspects of enterprises or projects. By advocating for planned investments early in the production chain, it mitigates the necessity for expensive clean-up endeavors in the future.

Environmental management is a multidisciplinary field that incorporates socioeconomic, policy, and scientific dimensions. Its primary objective is to devise practical solutions for the challenges stemming from resource extraction, waste generation, and human interaction with the environment. In a strictly anthropocentric context, environmental management revolves around tackling the core issue of advancing technology to progress while minimizing its impact on the natural world.

As a result, the recycling sector has evolved into a global enterprise, encompassing international markets and complex supply and transportation networks. However, it is crucial to acknowledge the significant contribution of over two million informal waste pickers, especially in low and middle-income nations, to the waste management industry. This informal sector encounters unique challenges and deserves governmental policy support due to its vital role in providing waste management solutions to communities.

Solid waste management poses a significant challenge in both developed and developing nations, as evidenced by numerous literature sources. The ongoing global urbanization exerts pressure on cities to handle waste responsibly, considering its social and environmental impacts. Crafting effective waste management strategies relies on a deep understanding of local waste characteristics, influenced by cultural, climatic, socioeconomic factors, and institutional capabilities. There's a global trend towards regionalization and greater organization in waste management practices. Developed

countries typically maintain formal oversight over waste at the municipal or regional level due to higher waste production rates. In contrast, in less industrialized nations with lower waste generation, often organic, waste management involves a mix of formal and informal stakeholders.

The World Economic Forum is actively advancing various initiatives related to the circular economy. These efforts go beyond simple waste management and aim to instigate systemic transformations across diverse industries. They foster collaboration to exchange insights, case studies, products, and materials relevant to circular economic principles. Governments play a crucial role in creating conducive environments for the widespread adoption of zero waste systems by enacting policy reforms, providing financial backing, and shaping public discourse. Mobilizing a global network of allies and prioritizing responsible waste policies are pivotal steps towards this goal. Key areas of focus include securing both international and local funding for zero waste systems, crafting comprehensive roadmaps and regulatory frameworks for their implementation, and integrating zero waste objectives into local and national climate strategies, such as methane reduction initiatives.

It is paramount for companies to prioritize identifying and addressing the social needs of society in line with societal expectations. Socially responsible companies emphasize the development of their employees, allocating approximately 10% of their resources to this endeavor when analyzing business operations. Investing in innovative solutions and transformative changes to achieve sustainable development goals not only benefits society but also yields significant economic advantages for companies.

A growing body of researchers is examining the social, economic, and environmental impacts of plastic pollution. Scientific studies have linked chemicals found in plastic to detrimental effects on human health across the entire life cycle of plastic, impacting workers and communities residing near plastic production and waste disposal sites.

Meeting corporate responsibility in waste management is frequently hindered by regulatory barriers and the absence of standardized waste management practices. Differing regulations and standards across regions and countries introduce

complexities for companies striving to maintain compliance and consistency in their operations.

Technological advancements have been instrumental in enhancing sustainable waste management practices. Businesses can harness technologies such as smart bins for efficient waste collection and advanced recycling methods to streamline waste management processes and reduce their environmental impact.

Moreover, consumers are becoming more aware of the environmental consequences of their purchasing choices and are actively seeking out businesses that prioritize sustainable waste practices. This growing trend compels companies to be transparent about their waste management initiatives and adopt environmentally responsible practices.

Therefore, businesses can integrate diverse waste management strategies to establish the most efficient waste management system. While cost-effectiveness is a primary concern, effective waste management strategies include reduction, reuse, and recycling. Recycling, for instance, is especially efficient for handling inorganic waste materials such as plastic, glass, and metals.

In today's business landscape, a well-operating waste management system is increasingly essential. As the global population grows and demand for products and services rises, businesses are generating larger quantities of both hazardous and non-hazardous waste. Therefore, adopting a sustainable waste management strategy is vital to mitigate adverse environmental effects, enhance operational efficiency, and reduce costs. To establish an efficient waste management system, the initial step is crucial: assessing the current waste management procedures. This involves evaluating the types and quantities of waste generated, as well as the treatment methods employed. Equally important is developing a waste management plan essential for implementing an efficient waste management system. This plan must outline the objectives, goals, and strategies necessary for successful waste management.

When evaluating waste management systems, it's essential to recognize the importance of integrating new technologies into the process. The implementation of blockchain technology in waste management presents an innovative approach to

addressing environmental sustainability and accountability challenges in our modern world. Blockchain has the potential to enhance waste management by introducing digital asset tokens, such as security tokens, that are linked to waste in smart cities, facilitating tracking and tracing. These tokens are pivotal in monitoring recycled waste materials and significantly aiding government agencies in reducing waste management costs and optimizing business processes.

Furthermore, before effectively implementing any social initiatives, an organization should have a clear CSR strategy in place. Such a strategy can help the organization achieve its primary objectives in the market. A well-executed corporate social responsibility (CSR) strategy has the potential to enhance the reputation of any company and foster stronger bonds with society.

The implementation of a CSR strategy in the operations of any organization can be significantly enhanced through the use of Artificial Intelligence (AI). AI can assist companies in monitoring and reporting on CSR performance, as well as identifying and addressing any gaps or risks. Additionally, AI has played a vital role in optimizing waste management procedures, enabling organizations to minimize waste production and improve recycling efforts. To ensure effective analysis and control of social security indicators, as well as the rational and targeted use of social security funds, it is advisable to establish management accounting within the responsibility center.

The successful implementation of environmentally responsible practices by multinational companies results in enhancing business sustainability. This is achieved through strengthening relationships with stakeholders, mitigating environmental risks, and boosting product competitiveness. To enhance the effectiveness of environmentally conscious practices within the realm of corporate social responsibility, several steps can be taken. These include integrating environmental principles into the strategic management system, forming a dedicated team of managers to implement environmental initiatives, conducting regular environmental audits, and ensuring that business interests remain a priority in these endeavors. Furthermore, developing a waste management model within the framework of corporate social responsibility helps companies achieve their goals in an efficient and responsible manner.

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ANNEXES

ANNEX A

FIGURE A Short and long-term global outlook

"Which of the following best characterizes your outlook for the world over the following time periods?"

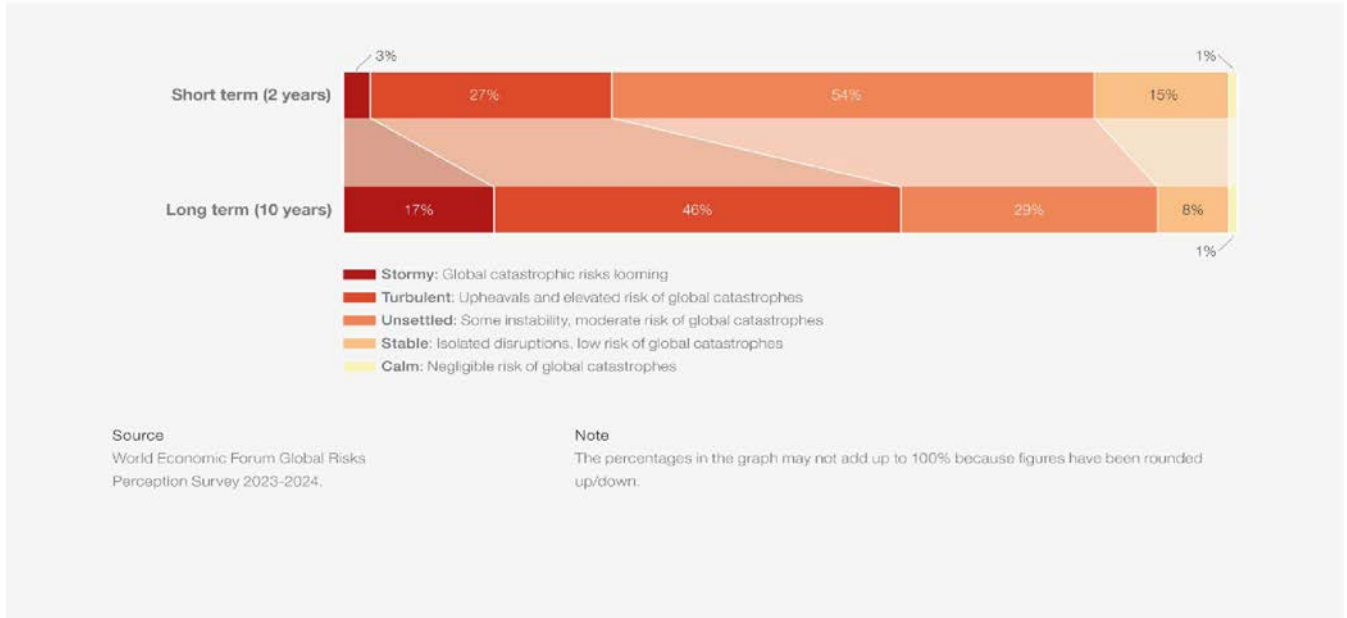


FIGURE B Current risk landscape

"Please select up to five risks that you believe are most likely to present a material crisis on a global scale in 2024."

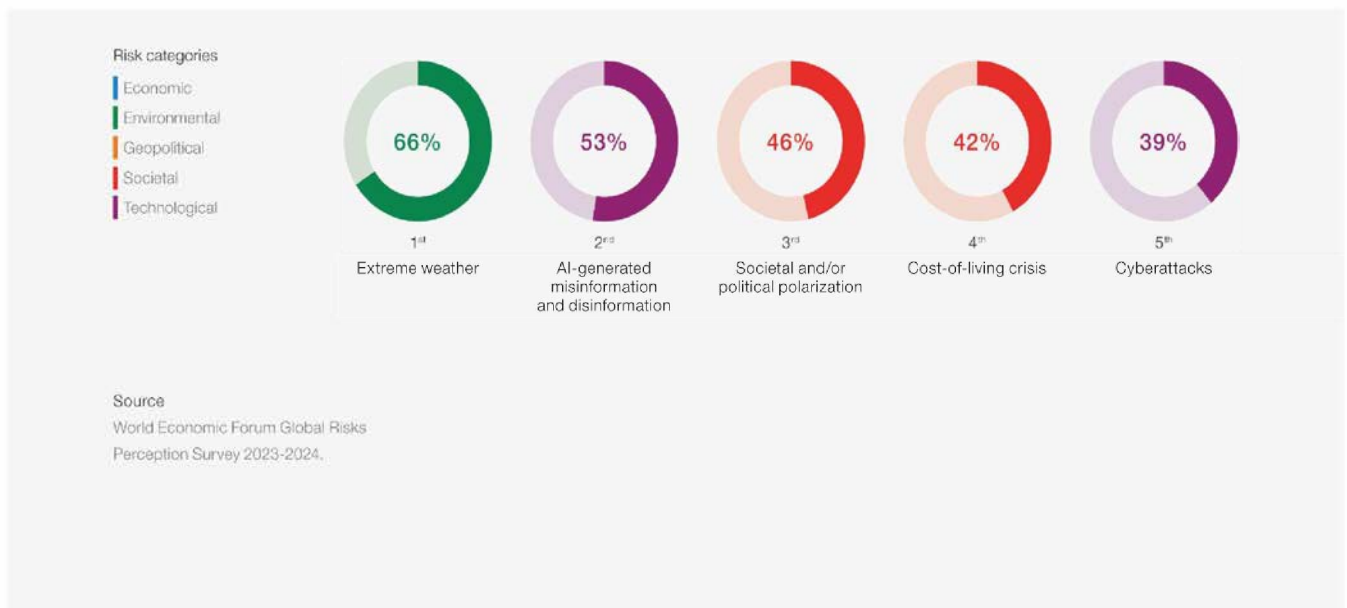


FIGURE C Global risks ranked by severity over the short and long term

Please estimate the likely impact (severity) of the following risks over a 2-year and 10-year period.



FIGURE D Global risks landscape: an interconnections map

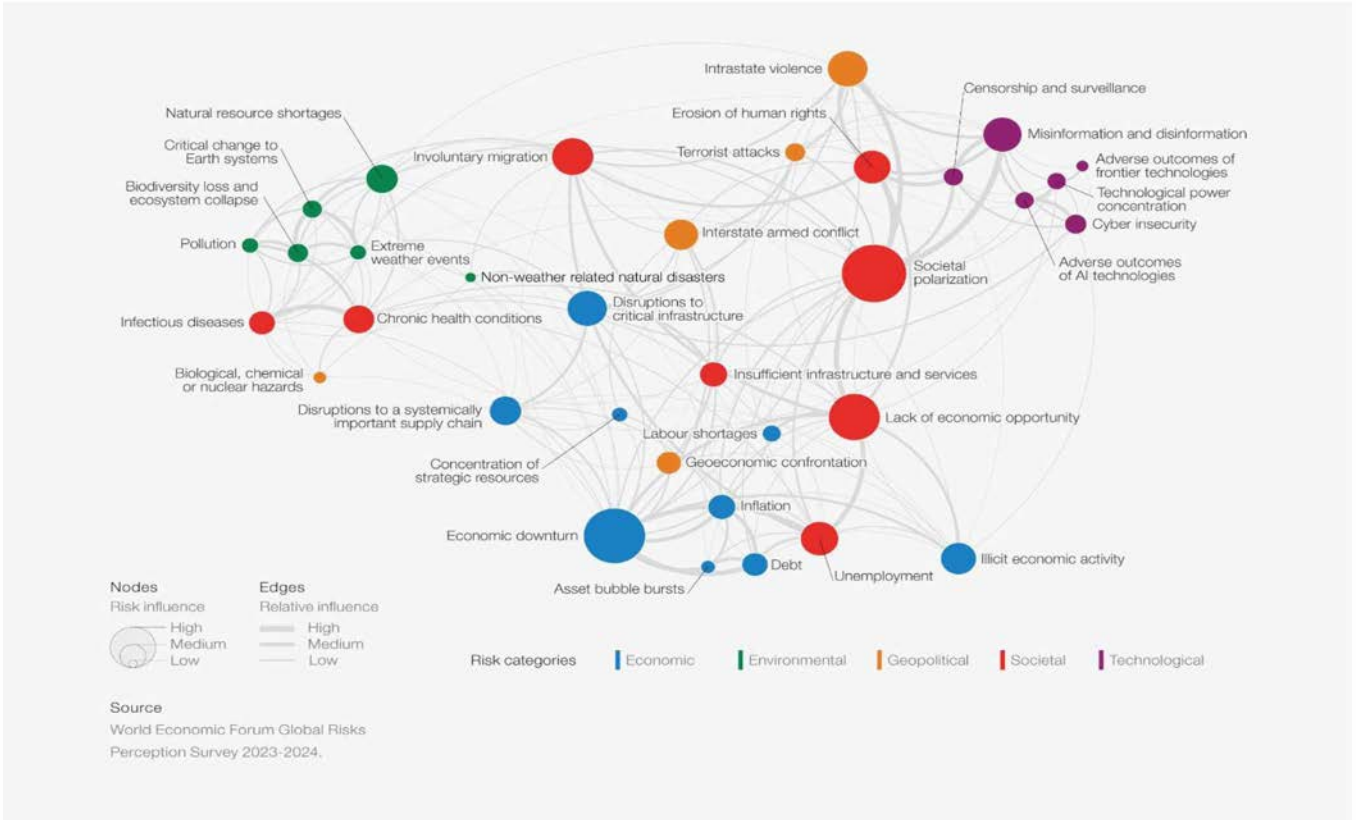


FIGURE E Global risks ranked by severity

Please estimate the likely impact (severity) of the following risks over a 2-year and 10-year period.

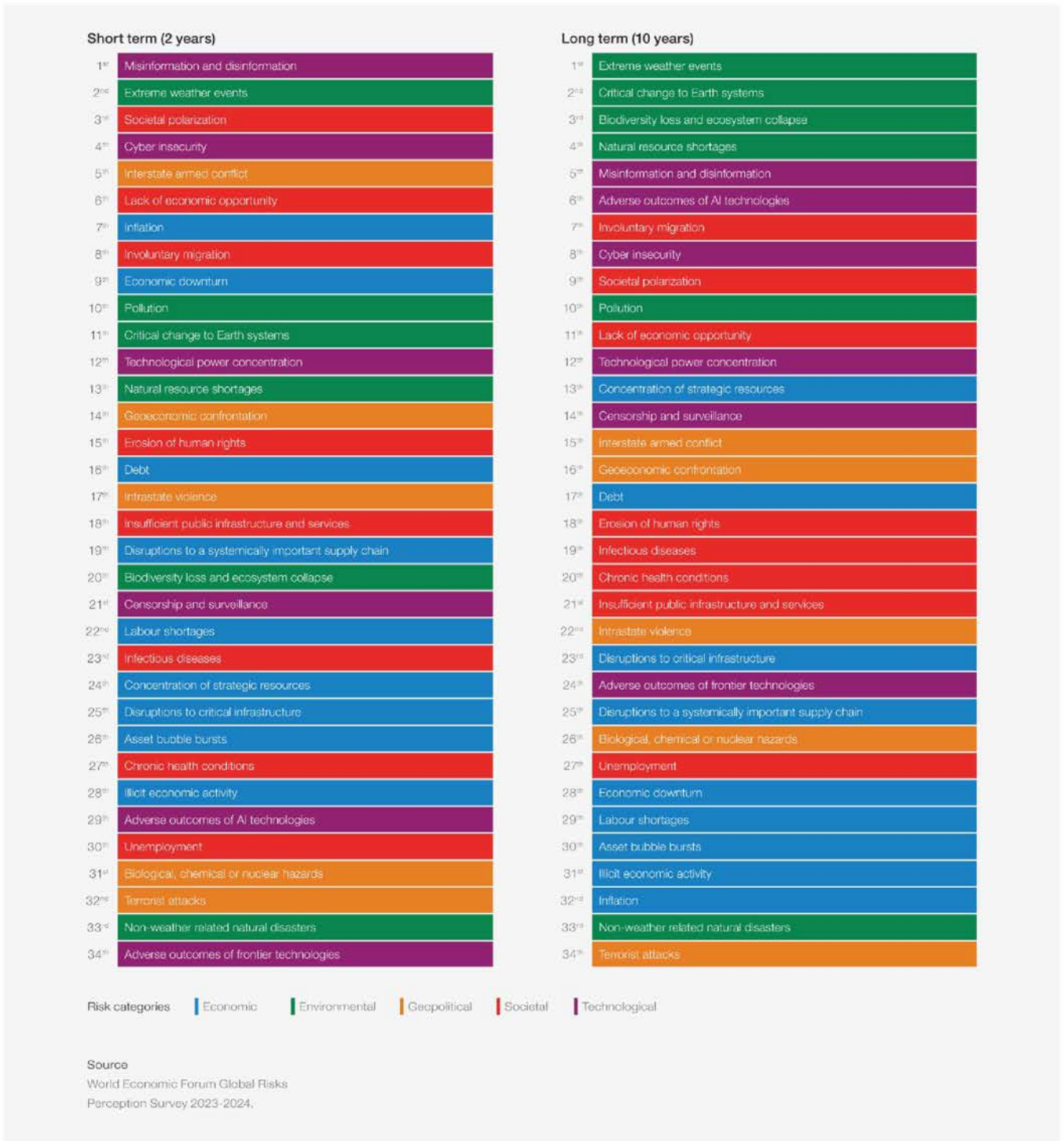


Table B1.

World's 100 Richest Countries, 2024

Rank	Country/Territory	GDP-PPP per capita (\$)
1	<u>Luxembourg</u>	143,743
2	<u>Macao SAR</u>	134,141
3	<u>Ireland</u>	133,895
4	<u>Singapore</u>	133,737
5	<u>Qatar</u>	112,283
6	<u>United Arab Emirates</u>	96,846
7	<u>Switzerland</u>	91,932
8	San Marino	86,989
9	<u>United States</u>	85,373
10	<u>Norway</u>	82,832
11	<u>Guyana</u>	80,137
12	<u>Denmark</u>	77,641
13	<u>Brunei Darussalam</u>	77,534
14	<u>Taiwan</u>	76,858
15	<u>Hong Kong SAR</u>	75,128
16	<u>Netherlands</u>	74,158
17	<u>Iceland</u>	73,784
18	<u>Saudi Arabia</u>	70,333
19	<u>Austria</u>	69,460
20	<u>Sweden</u>	69,177
21	Andorra	69,146
22	<u>Belgium</u>	68,079
23	<u>MTMalta</u>	67,682
24	<u>Germany</u>	67,245

Rank	Country/Territory	GDP-PPP per capita (\$)
25	<u>Australia</u>	66,627
26	<u>Bahrain</u>	62,671
27	<u>Finland</u>	60,851
28	<u>Canada</u>	60,495
29	<u>France</u>	60,339
30	<u>South Korea</u>	59,330
31	<u>United Kingdom</u>	58,880
32	<u>Cyprus</u>	58,733
33	<u>Italy</u>	56,905
34	<u>Israel</u>	55,533
35	Aruba	54,716
36	<u>Japan</u>	54,184
37	<u>New Zealand</u>	53,797
38	<u>Slovenia</u>	53,287
39	<u>Kuwait</u>	52,274
40	<u>Spain</u>	52,012
41	<u>Lithuania</u>	50,600
42	<u>Czech Republic</u>	50,475
43	<u>Poland</u>	49,060
44	<u>Portugal</u>	47,070
45	<u>The Bahamas</u>	46,524
46	<u>Croatia</u>	45,702
47	<u>Hungary</u>	45,692
48	<u>Estonia</u>	45,122
49	<u>Panama</u>	44,797
50	<u>Slovak Republic</u>	44,081
51	<u>Türkiye</u>	43,921

Rank	Country/Territory	GDP-PPP per capita (\$)
52	Puerto Rico	43,219
53	<u>Romania</u>	43,179
54	<u>Seychelles</u>	43,151
55	<u>Latvia</u>	41,730
56	<u>Greece</u>	41,188
57	<u>Oman</u>	39,859
58	<u>Malaysia</u>	39,030
59	<u>St. Kitts and Nevis</u>	38,870
60	<u>Russia</u>	38,292
61	<u>Maldives</u>	37,433
62	<u>Bulgaria</u>	35,963
63	<u>Kazakhstan</u>	34,534
64	<u>Trinidad and Tobago</u>	32,685
65	<u>Mauritius</u>	32,094
66	<u>Chile</u>	31,005
67	<u>Uruguay</u>	30,170
68	<u>Montenegro</u>	29,696
69	<u>Costa Rica</u>	28,558
70	<u>Serbia</u>	27,985
71	<u>Antigua and Barbuda</u>	27,309
72	<u>Dominican Republic</u>	27,120
73	<u>Libya</u>	26,456
74	<u>Argentina</u>	26,390
75	<u>Mexico</u>	25,963
76	<u>Belarus</u>	25,685
77	<u>Georgia</u>	25,248
78	<u>China</u>	25,015

Rank	Country/Territory	GDP-PPP per capita (\$)
79	<u>Thailand</u>	23,401
80	<u>North Macedonia</u>	22,249
81	<u>Grenada</u>	21,799
82	<u>Armenia</u>	21,746
83	<u>Islamic Republic of Iran</u>	21,220
84	<u>Brazil</u>	20,809
85	<u>Albania</u>	20,632
86	<u>Bosnia and Herzegovina</u>	20,623
87	<u>Barbados</u>	20,592
88	<u>Botswana</u>	20,097
89	<u>Colombia</u>	19,770
90	<u>Turkmenistan</u>	19,729
91	St. Lucia	19,718
92	<u>Gabon</u>	19,452
93	<u>Azerbaijan</u>	19,328
94	<u>St. Vincent and the Grenadines</u>	19,196
95	<u>Suriname</u>	18,928
96	<u>Equatorial Guinea</u>	18,378
97	<u>Moldova</u>	17,902
98	<u>Egypt</u>	17,614
99	<u>Fiji</u>	17,403
100	Palau	17,381

Source: <https://gfmag.com/data/worlds-richest-and-poorest-countries/>

(figure 2.14)

Figure 1: Growth in the world's urban population by region from 1960 to 2020 and projected to 2040

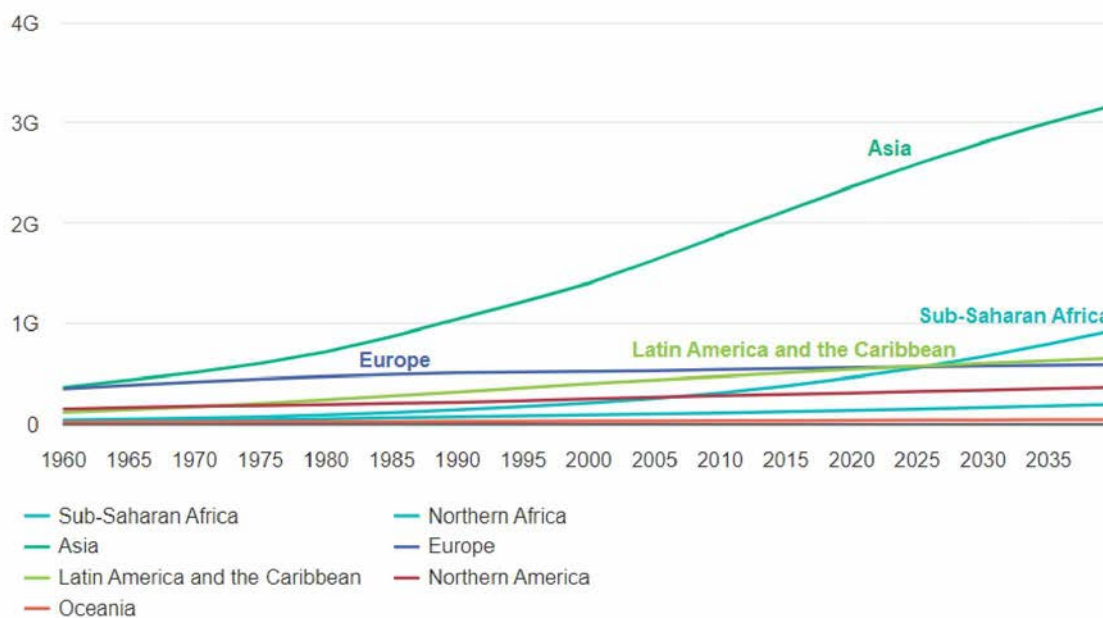


Figure 2: Distribution of the world's urban population in 2020

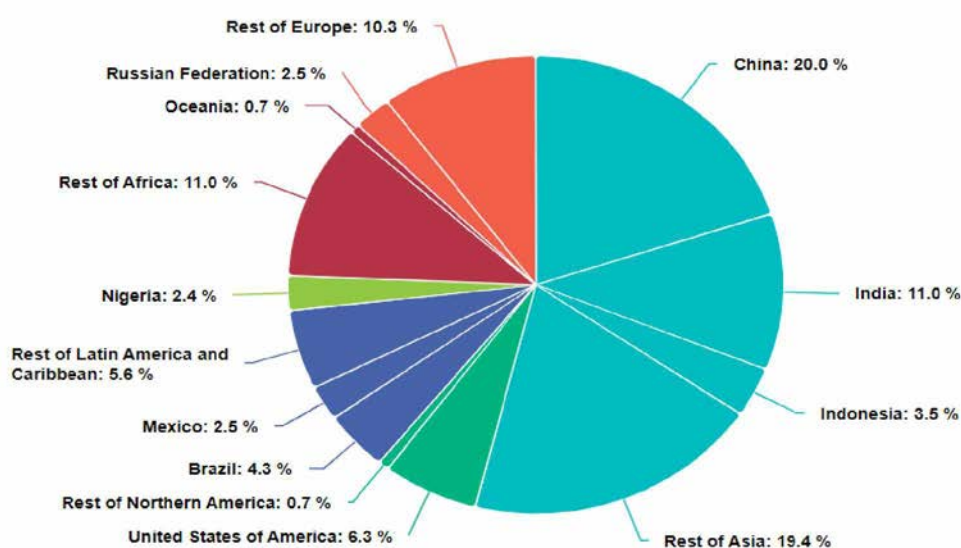
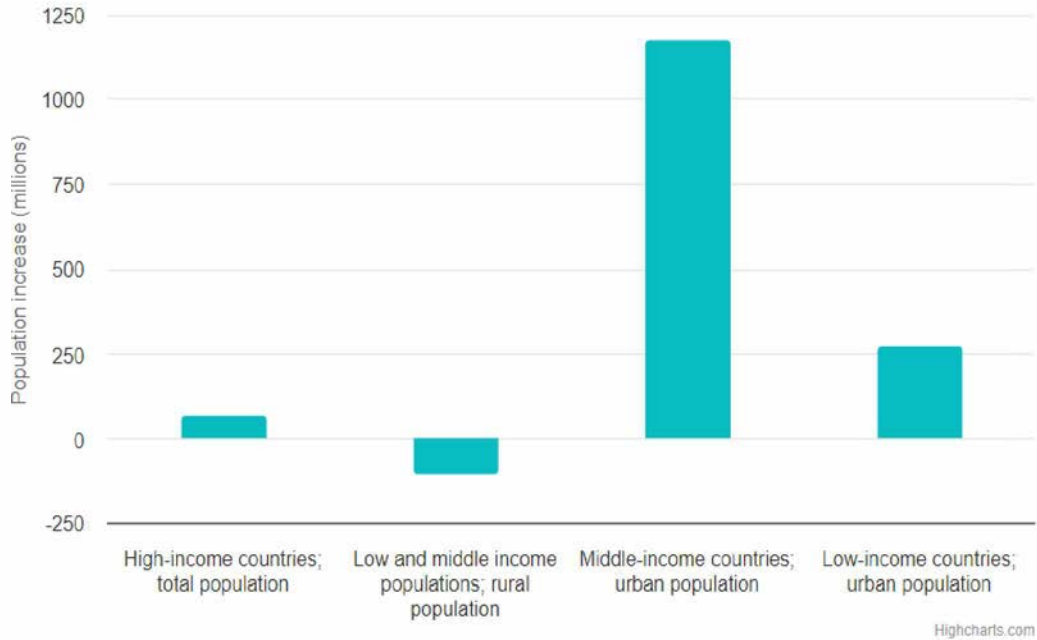


Figure 2: Distribution of the world's urban population in 2020

Figure 3: The distribution of global population growth across rural and urban areas, 2020-2040



The growth in the world's urban population 1960-2020 by countries' per capita income group and projected to 2040

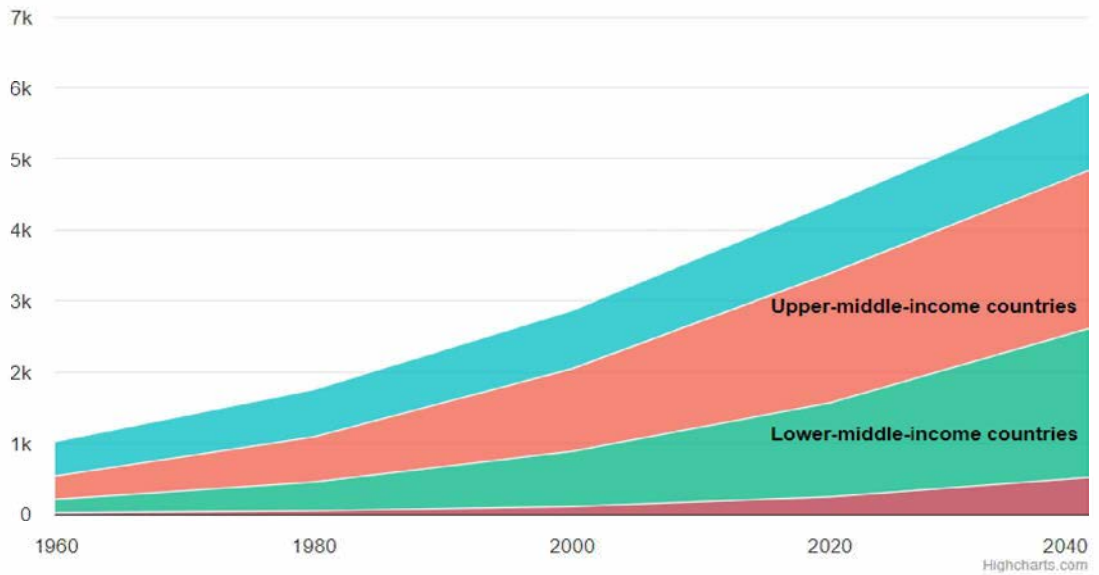


Figure 4: The growth in the world's urban population 1950-2035 by countries' per capita income group (thousands)

GNG total emissions

Country	1990	2000	2005	2015	2020	2021	2022	2022 %
unit	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	% World Tot
EU27	4915.14	4513.34	4597.10	3922.02	3427.44	3617.74	3587.80	6.67
GLOBAL TOTAL	33268.12	36991.71	42318.43	50134.38	50632.31	53056.61	53786.04	100.00
Afghanistan	13.78	16.05	18.19	31.21	28.15	28.95	29.12	0.05
Albania	11.57	7.25	8.07	8.85	7.86	7.90	7.98	0.01
Algeria	145.89	179.75	188.34	259.85	265.21	284.17	284.45	0.53
Angola	34.96	71.46	73.53	90.11	71.68	69.61	66.48	0.12
Anguilla	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.00
Antigua and Barbuda	0.25	0.23	0.27	0.36	0.36	0.35	0.36	0.00
Argentina	262.67	303.68	344.83	375.12	359.03	378.42	382.99	0.71
Armenia	24.37	6.03	7.43	8.62	9.80	10.00	9.38	0.02
Aruba	0.21	0.34	0.46	0.48	0.49	0.48	0.50	0.00
Australia	457.22	542.60	576.59	593.56	572.83	561.65	571.38	1.06
Austria	81.51	84.76	96.88	82.72	78.31	81.22	76.74	0.14
Azerbaijan	69.81	41.44	46.46	58.03	63.53	68.04	68.88	0.13
Bahamas	1.29	1.23	1.15	1.46	1.87	1.82	1.88	0.00
Bahrain	30.22	39.60	43.73	62.94	67.63	69.43	69.98	0.13
Bangladesh	139.91	156.85	179.56	248.09	269.03	276.80	281.08	0.52
Barbados	0.86	0.86	0.89	0.94	0.92	0.90	0.93	0.00
Belarus	137.53	78.02	81.38	100.53	100.06	102.49	99.87	0.19
Belgium	142.80	153.80	145.84	128.00	116.79	121.88	114.03	0.21
Belize	0.50	0.53	0.60	0.86	0.91	0.95	0.98	0.00
Benin	4.20	6.55	8.76	14.50	19.06	20.10	20.69	0.04
Bermuda	0.27	0.17	0.21	0.25	0.35	0.34	0.35	0.00
Bhutan	1.16	1.62	1.85	2.67	3.41	3.06	3.07	0.01

Country	1990	2000	2005	2015	2020	2021	2022	2022 %
unit	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	% World Tot
Bolivia	31.28	31.21	36.47	54.59	53.95	58.29	58.46	0.11
Bosnia and Herzegovina	32.79	19.92	23.25	27.96	30.23	29.29	29.32	0.05
Botswana	9.33	10.76	10.14	12.79	10.59	11.34	12.61	0.02
Brazil	695.64	934.71	1067.46	1307.97	1277.69	1343.14	1310.50	2.44
British Virgin Islands	0.02	0.03	0.04	0.08	0.08	0.07	0.08	0.00
Brunei	8.18	11.27	11.47	12.69	15.48	15.34	14.83	0.03
Bulgaria	104.99	63.14	66.76	64.91	56.08	63.36	68.41	0.13
Burkina Faso	11.28	14.87	20.70	29.42	34.40	35.58	36.50	0.07
Burundi	3.06	3.33	3.73	6.14	7.14	7.33	7.48	0.01
Cabo Verde	0.23	0.54	0.86	1.07	1.18	1.25	1.30	0.00
Cambodia	20.26	24.14	28.92	37.39	48.60	49.69	50.02	0.09
Cameroon	31.27	32.70	32.47	41.04	43.53	43.67	43.17	0.08
Canada	582.17	710.25	745.21	764.53	711.47	733.08	756.81	1.41
Cayman Islands	0.12	0.14	0.16	0.27	0.34	0.33	0.34	0.00
Central African Republic	7.82	9.57	10.29	12.07	12.86	13.13	13.45	0.03
Chad	11.14	26.66	36.55	63.00	82.09	86.02	89.84	0.17
Chile	60.74	88.19	95.55	121.12	128.96	140.66	137.01	0.25
China	4073.56	5425.51	8431.92	13479.88	14879.56	15632.89	15684.63	29.16
Colombia	139.10	159.19	164.78	193.01	206.09	209.85	215.54	0.40
Comoros	0.34	0.45	0.54	0.68	0.87	0.91	0.92	0.00
Congo	11.47	22.60	20.72	21.24	26.66	25.11	25.96	0.05
Cook Islands	0.05	0.08	0.10	0.12	0.11	0.12	0.12	0.00
Costa Rica	10.00	11.48	12.44	14.99	15.06	16.21	16.86	0.03
Côte d'Ivoire	11.28	18.66	20.28	29.24	33.63	35.30	36.18	0.07

Country	1990	2000	2005	2015	2020	2021	2022	2022 %
unit	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	% World Tot
Croatia	34.07	25.86	30.01	25.76	24.33	24.16	24.18	0.04
Cuba	63.55	50.75	46.03	50.77	44.41	43.90	44.38	0.08
Curaçao	2.86	5.90	6.15	5.95	2.16	2.08	2.15	0.00
Cyprus	5.55	8.31	9.18	8.59	9.54	10.38	10.63	0.02
Czechia	197.20	154.20	151.15	131.37	116.97	123.19	124.50	0.23
Democratic Republic of the Congo	28.58	31.09	30.97	52.66	58.96	60.59	61.64	0.11
Denmark	69.46	70.57	67.26	50.05	44.05	47.09	45.80	0.09
Djibouti	1.89	1.91	1.97	2.14	2.11	2.20	2.23	0.00
Dominica	0.09	0.12	0.13	0.15	0.15	0.14	0.15	0.00
Dominican Republic	18.07	29.29	30.91	39.53	40.75	41.23	41.86	0.08
Ecuador	38.51	46.21	56.60	72.77	65.80	73.26	76.94	0.14
Egypt	153.02	206.84	278.86	342.43	336.01	360.40	377.78	0.70
El Salvador	7.78	11.11	13.03	12.65	11.79	12.66	13.07	0.02
Equatorial Guinea	0.18	12.42	17.07	18.67	12.71	12.86	11.55	0.02
Eritrea	4.83	5.68	5.76	6.40	6.78	6.89	6.95	0.01
Estonia	43.09	20.72	22.73	24.05	14.63	14.73	13.81	0.03
Eswatini	3.34	3.41	3.37	3.06	3.18	3.22	3.39	0.01
Ethiopia	66.23	76.68	95.21	145.65	179.20	186.28	192.47	0.36
Falkland Islands	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.00
Faroës	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00
Fiji	2.20	3.03	3.30	2.65	2.78	2.90	2.98	0.01
Finland	85.56	86.14	87.45	71.11	58.14	57.40	54.81	0.10
France and Monaco	535.19	544.03	546.47	464.53	405.72	442.59	430.36	0.80
French Guiana	0.37	0.34	0.36	0.52	0.57	0.58	0.59	0.00

Country	1990	2000	2005	2015	2020	2021	2022	2022 %
unit	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	% World Tot
French Polynesia	0.96	0.94	1.15	1.19	1.06	1.10	1.12	0.00
Gabon	20.39	27.96	26.34	21.68	20.01	19.03	18.63	0.03
Georgia	42.12	11.54	11.26	16.47	17.31	17.94	18.05	0.03
Germany	1235.23	1032.29	983.71	908.13	751.34	792.45	784.00	1.46
Ghana	11.32	16.84	19.31	36.49	49.47	51.62	53.01	0.10
Gibraltar	0.16	0.36	0.43	0.61	0.67	0.67	0.69	0.00
Greece	99.51	121.69	128.98	91.37	71.93	73.55	76.03	0.14
Greenland	0.07	0.07	0.69	0.60	0.53	0.51	0.54	0.00
Grenada	0.10	0.11	0.13	0.18	0.19	0.19	0.19	0.00
Guadeloupe	0.96	0.90	0.99	1.24	1.20	1.23	1.26	0.00
Guatemala	14.15	23.21	27.40	38.08	41.61	44.52	45.02	0.08
Guinea	7.90	11.50	13.78	23.20	27.24	28.29	29.28	0.05
Guinea-Bissau	1.66	2.01	2.18	2.98	3.14	3.19	3.24	0.01
Guyana	3.85	4.80	4.45	5.78	7.27	7.67	7.79	0.01
Haiti	7.93	10.48	11.25	14.52	14.77	14.71	14.87	0.03
Honduras	9.65	12.26	16.53	22.61	21.60	22.97	23.74	0.04
Hong Kong	39.97	47.32	48.36	50.44	41.67	41.08	39.14	0.07
Hungary	96.78	77.21	80.24	64.48	68.10	70.33	66.21	0.12
Iceland	4.43	3.94	4.27	4.89	4.27	4.28	4.77	0.01
India	1436.58	1919.34	2203.10	3389.88	3519.12	3754.63	3943.26	7.33
Indonesia	427.66	602.21	694.31	961.41	1104.71	1128.06	1240.83	2.31
International Aviation	261.80	355.89	423.31	532.88	299.33	345.38	425.96	0.79
International Shipping	394.75	533.72	607.27	702.30	671.96	710.46	750.70	1.40
Iran	332.76	525.59	683.56	857.02	901.56	936.57	951.98	1.77
Iraq	169.63	165.70	163.85	273.11	329.53	340.17	367.94	0.68

Country	1990	2000	2005	2015	2020	2021	2022	2022 %
unit	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	% World Tot
Ireland	57.59	74.65	75.34	64.02	59.46	61.10	62.42	0.12
Israel and Palestine, State of	42.69	70.43	73.94	86.88	83.58	84.45	87.75	0.16
Italy, San Marino and the Holy See	513.74	545.78	580.43	430.30	367.41	392.96	394.75	0.73
Jamaica	9.29	12.25	12.60	8.69	7.50	7.70	7.71	0.01
Japan	1321.81	1391.88	1402.61	1335.57	1161.78	1175.42	1182.77	2.20
Jordan	12.54	20.46	25.59	33.92	31.50	33.54	34.54	0.06
Kazakhstan	349.54	178.77	243.17	276.04	308.44	319.12	331.53	0.62
Kenya	42.67	47.46	59.86	92.11	109.71	114.27	117.89	0.22
Kiribati	0.04	0.06	0.09	0.10	0.10	0.11	0.11	0.00
Kuwait	49.87	86.18	117.47	140.98	148.89	156.06	167.86	0.31
Kyrgyzstan	33.70	11.29	12.05	19.95	20.33	21.47	21.94	0.04
Laos	8.24	10.34	11.74	23.21	35.49	36.62	36.86	0.07
Latvia	27.27	10.23	11.74	11.95	11.64	11.63	11.11	0.02
Lebanon	8.06	18.65	20.98	33.36	29.17	30.63	31.93	0.06
Lesotho	2.21	2.74	2.83	2.85	2.96	2.96	3.02	0.01
Liberia	1.79	2.14	2.70	4.33	4.98	5.21	5.31	0.01
Libya	86.63	91.34	105.18	76.09	69.48	101.47	104.51	0.19
Lithuania	46.63	18.45	21.68	23.27	22.71	22.24	20.85	0.04
Luxembourg	12.67	9.81	13.07	10.24	8.98	9.53	8.48	0.02
Macao	1.01	1.74	2.30	2.99	2.30	2.38	2.41	0.00
Madagascar	25.25	27.67	28.17	33.64	35.03	35.14	34.98	0.07
Malawi	6.40	8.67	9.74	14.93	18.94	19.74	20.92	0.04
Malaysia	94.79	185.31	246.08	321.31	324.52	334.67	353.92	0.66
Maldives	0.15	0.80	0.85	1.82	2.28	2.37	2.42	0.00
Mali	13.39	17.60	22.42	35.31	45.59	47.45	49.38	0.09

Country	1990	2000	2005	2015	2020	2021	2022	2022 %
unit	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	% World Tot
Malta	2.49	2.36	2.92	2.12	2.09	2.14	2.18	0.00
Martinique	0.92	0.84	0.88	1.08	0.91	1.05	1.08	0.00
Mauritania	6.65	9.09	10.40	13.54	15.77	16.33	16.67	0.03
Mauritius	1.98	3.40	3.84	5.70	5.73	6.09	6.41	0.01
Mexico	466.42	634.17	707.98	790.36	739.32	765.46	819.87	1.52
Moldova	37.45	9.83	11.18	11.54	12.34	12.96	12.32	0.02
Mongolia	25.92	25.38	25.06	48.38	64.73	62.16	62.79	0.12
Morocco	45.25	60.15	74.24	97.88	108.01	117.30	114.77	0.21
Mozambique	10.38	12.98	17.95	30.18	34.71	37.72	40.07	0.07
Myanmar/Burma	72.77	91.33	111.06	134.83	163.51	166.96	169.39	0.31
Namibia	6.64	8.50	10.70	12.00	12.41	12.63	13.10	0.02
Nepal	31.60	36.06	37.51	45.73	55.48	56.56	56.74	0.11
Netherlands	228.34	229.77	226.13	208.38	176.88	178.70	167.85	0.31
New Caledonia	1.91	2.66	3.14	5.14	5.47	5.65	5.69	0.01
New Zealand	70.54	81.82	88.08	86.68	85.21	85.14	82.72	0.15
Nicaragua	10.61	13.66	14.98	19.76	19.84	20.59	21.03	0.04
Niger	11.68	17.51	21.58	31.79	39.88	41.57	43.24	0.08
Nigeria	287.31	419.54	399.98	404.08	408.25	409.45	407.69	0.76
North Korea	169.84	103.94	113.56	55.75	80.42	82.59	81.29	0.15
North Macedonia	14.47	11.49	12.44	10.65	10.39	11.15	11.18	0.02
Norway	62.91	72.38	74.51	74.30	70.08	71.68	69.97	0.13
Oman	33.46	52.02	66.65	117.17	122.64	131.69	137.24	0.26
Pakistan	215.03	296.59	351.13	455.75	527.44	561.01	546.10	1.02
Palau	2.33	2.23	1.84	1.25	1.34	1.39	1.42	0.00
Panama	7.37	10.20	12.93	17.03	16.46	17.86	18.48	0.03
Papua New Guinea	3.85	6.54	9.57	11.14	8.89	9.13	9.10	0.02

Country	1990	2000	2005	2015	2020	2021	2022	2022 %
unit	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	% World Tot
Paraguay	21.38	25.63	26.63	41.69	43.49	45.57	45.57	0.08
Peru	47.00	61.57	66.34	95.61	89.32	97.73	105.14	0.20
Philippines	109.81	149.36	162.96	210.10	242.64	254.43	265.30	0.49
Poland	514.61	413.21	412.03	389.99	374.33	406.94	400.82	0.75
Portugal	59.46	81.93	84.12	67.78	58.43	57.58	59.71	0.11
Puerto Rico	21.71	27.36	28.59	14.22	14.96	15.52	15.26	0.03
Qatar	29.08	69.91	83.45	187.61	191.20	197.51	194.65	0.36
Réunion	1.16	2.43	2.76	2.93	3.00	3.06	3.15	0.01
Romania	245.77	133.27	140.12	117.60	114.44	119.96	117.06	0.22
Russia	3053.15	2134.35	2221.77	2294.78	2432.51	2606.63	2579.80	4.80
Rwanda	6.22	4.73	5.54	7.88	8.73	8.93	9.03	0.02
Saint Helena, Ascension and Tristan da Cunha	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.00
Saint Kitts and Nevis	0.07	0.10	0.11	0.15	0.15	0.15	0.15	0.00
Saint Lucia	0.16	0.23	0.24	0.32	0.42	0.42	0.43	0.00
Saint Pierre and Miquelon	0.09	0.02	0.03	0.04	0.04	0.04	0.04	0.00
Saint Vincent and the Grenadines	0.09	0.10	0.13	0.16	0.15	0.15	0.15	0.00
Samoa	0.30	0.40	0.44	0.59	0.54	0.55	0.55	0.00
São Tomé and Príncipe	0.09	0.12	0.16	0.23	0.26	0.27	0.26	0.00
Saudi Arabia	238.39	355.02	466.49	771.90	755.37	779.97	810.51	1.51
Senegal	10.46	14.32	16.96	24.54	28.47	29.70	30.61	0.06
Serbia and Montenegro	85.53	66.40	76.99	69.94	71.92	70.01	69.94	0.13
Seychelles	0.33	0.85	1.05	1.08	1.13	1.18	1.20	0.00

Country	1990	2000	2005	2015	2020	2021	2022	2022 %
unit	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	% World Tot
Sierra Leone	4.07	3.39	5.00	6.65	6.87	7.03	7.12	0.01
Singapore	34.20	57.88	51.21	67.03	69.41	71.34	70.47	0.13
Slovakia	74.71	51.43	52.15	44.24	42.43	46.67	45.56	0.08
Slovenia	21.43	20.50	23.67	19.01	18.12	18.68	18.28	0.03
Solomon Islands	0.27	0.41	0.49	0.58	0.56	0.58	0.59	0.00
Somalia	25.35	27.48	30.34	30.58	32.57	33.05	33.36	0.06
South Africa	411.94	457.24	555.48	590.09	551.46	548.48	534.53	0.99
South Korea	330.37	545.18	582.52	719.38	699.65	730.84	725.74	1.35
Spain and Andorra	300.27	398.46	455.62	351.38	291.81	305.89	328.59	0.61
Sri Lanka	23.10	28.33	32.33	41.24	42.39	41.72	38.80	0.07
Sudan and South Sudan	62.64	97.23	116.45	133.20	142.06	145.13	146.96	0.27
Suriname	1.92	2.56	2.65	3.92	3.80	4.49	4.50	0.01
Sweden	79.21	80.80	81.44	66.67	62.78	61.41	60.64	0.11
Switzerland and Liechtenstein	54.84	53.88	56.34	49.60	45.20	45.98	45.56	0.08
Syria	64.10	87.17	89.64	44.71	44.14	45.05	46.31	0.09
Taiwan	140.58	248.98	332.14	310.30	305.50	320.52	307.68	0.57
Tajikistan	22.33	10.78	12.08	15.59	21.19	22.43	22.83	0.04
Tanzania	31.17	42.56	50.95	75.45	85.15	88.12	89.38	0.17
Thailand	221.90	305.63	381.18	447.45	449.40	455.67	463.87	0.86
The Gambia	0.97	1.27	1.53	2.20	2.24	2.30	2.34	0.00
Timor-Leste	0.60	1.02	2.04	3.67	2.58	2.57	2.48	0.00
Togo	3.57	5.24	6.06	8.30	10.38	10.81	11.09	0.02
Tonga	0.19	0.22	0.24	0.25	0.27	0.28	0.28	0.00
Trinidad and Tobago	18.19	28.47	51.84	55.97	47.26	45.33	45.91	0.09

Country	1990	2000	2005	2015	2020	2021	2022	2022 %
unit	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	Mton CO ₂ eq	% World Tot
Tunisia	23.92	33.17	36.50	44.36	42.09	48.99	49.82	0.09
Turkmenistan	86.64	73.97	100.27	126.75	123.48	128.00	128.92	0.24
Turks and Caicos Islands	0.01	0.03	0.04	0.09	0.10	0.10	0.10	0.00
Türkiye	228.09	323.04	336.52	521.91	614.49	666.80	687.53	1.28
Uganda	18.45	23.80	28.50	48.27	53.92	55.54	56.49	0.11
Ukraine	952.14	448.05	444.00	301.12	274.46	260.08	208.61	0.39
United Arab Emirates	84.79	127.72	169.63	272.73	271.28	286.76	295.11	0.55
United Kingdom	786.21	700.69	681.82	505.06	407.94	425.71	426.56	0.79
United States	6163.74	7188.18	7101.88	6288.54	5615.57	5923.30	6017.44	11.19
Uruguay	29.65	34.63	38.13	41.68	40.84	41.90	41.91	0.08
Uzbekistan	177.17	181.94	191.58	187.89	211.86	221.60	227.21	0.42
Vanuatu	0.48	0.55	0.56	0.67	0.61	0.60	0.59	0.00
Venezuela	166.75	226.31	247.49	264.02	148.68	159.98	169.52	0.32
Vietnam	112.02	174.90	239.90	358.06	499.45	496.73	489.16	0.91
Western Sahara	0.24	0.40	0.46	0.47	0.44	0.49	0.49	0.00
Yemen	18.24	33.24	45.38	35.07	35.65	36.99	38.01	0.07
Zambia	16.29	15.96	17.32	24.99	28.95	29.68	30.33	0.06
Zimbabwe	35.26	33.73	28.59	31.61	28.34	29.53	30.19	0.06