

The Role of International Policies in Regulating and Managing Waste Trade for Sustainability

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Abstract:

To ensure to protection of the sustainability of the waste trade it is important to introduce international policies by the government which are essential for regulating and governing waste products. A global strategy plan is required to prevent environmental damage and protect human health in an environment of rising waste output, which includes both hazardous and non-hazardous waste products. Hazardous waste is the waste that is more harmful to the environment as well as to human beings. Non-hazardous waste is waste which is not harmful to human health but can cause severe damage to the environment. Waste management can be described as the prevention of waste by the 3Rs recycling, reuse and recovery of the waste product present in the market. Management of waste plays a very crucial role in conserving natural resources and saving and generating the energy that is used by human beings. The energy generated by recycling the product does not cause any harmful damage to the environment.

KEYWORDS: sustainability, governing waste products, environmental damage, hazardous waste, non-hazardous waste, 3R's

1 INTRODUCTION

Trading of toxic materials and waste products at an international level seems to cause a significant damage in political terms as compared to actual degradation caused to environmental surroundings. Due to differences in waste management skills across different countries and the need for economical solutions, the globalization of waste business leads to numerous problems. The basis to resolve these challenges and promote sustainable waste management techniques and policies is required to be introduced by the government [15]. The Basel Convention was created in 1989 to regulate the disposal of hazardous wastes and the transportation of such wastes across international borders. The Basel Convention has over 180 members across all over the world which provides a structure for regulating the waste trade and promoting international collaboration all around the world. International policies establish guidelines on waste description, division, and labelling to control waste trade. This guarantees that waste products are correctly identified and ensures that they do not have any possible adverse effects on the environment and human health. The Basel Convention categorises waste products into different categories and specifies under what conditions they are suitable for trade. International rules and regulations help to find the illegal dumping of hazardous waste in underdeveloped countries that cannot dispose of such items properly by providing specific requirements in the countries [4]. Protecting the environment is one of the main goals of countries. According to rules and regulations, waste-exporting nations must

get prior informed consent (PIC) from waste-importing countries' governments. This makes it easier for people to provide information about the type of waste product, the potential risks of this waste, and the methods that will be used to dispose of this harmful waste material.

International trade in garbage has the potential to contribute to inequality towards the environment. Developed countries can export garbage to countries that are developing with weak limitations and have negative effects on the ecosystems and populations in the country. International laws promote the idea of shared responsibility in a way to correct these imbalances [9]. The Polluter Pays Principle (PPP), is established in several international countries by which garbage is transported to another location. The company that developed PPP is responsible for the proper treatment of these waste products. the improvements created by international laws also came up with several problems. Rules and regulations are still not regularly implemented, and different countries have different levels of authority and loyalty. The effectiveness of the international government gives rise to illegal waste trade, which involves mislabeling and illegal transportation of garbage [11]. Determining waste can be difficult because some products can be seen as resources in some contexts but as garbage in other countries.

To ensure to follow the rules, advanced tracking and monitoring systems can be used by the authorities which help in identifying shipments of illegal waste [5]. For instance, supply chain networks benefit from accessibility and control with the help of blockchain technology. By developing an economic strategy, the government can reduce the production of waste by putting a focus on manufacturing processes that are reliable, reusable, and recyclable. Governments can be allowed to implement these practices through international policies. International policies are an essential theory for controlling and regulating the waste trade in a way that is sustainable for the environment. to promote sustainable economic ideas, boost information exchange ideas, and resolve inequality in waste management procedures. international government develops procedures for the proper transfer and disposal of garbage. Rules and regulations are important for promoting international collaboration and also ensure that the waste transfer does not harm human well-being and the environment in any case [20].

2 LITERATURE REVIEW AND ANALYSIS METHODOLOGY

2.1 Complexities of global garbage trade

According to Watson et al., (2019), the complexities of the global garbage trade can be best understood by the use of electronic trash (e-waste) as an example. E-waste requires careful processing because it contains dangerous materials including toxic compounds and heavy metals. The Basel Convention's Ban Amendment which came into force in 2021, prohibits the export of hazardous waste from OECD countries to non-OECD countries, that includes the bulk of e-waste products [19]. this also helps to transfer hazardous waste from one location to another. To enhance and develop Institutional policies in regulating and managing waste trade for sustainability government needs to implement different strategies. Developing nations require help to develop their waste management infrastructure and knowledge. This requires the transfer of technology, training the employees, and providing financial help by the government. To provide a healthy environment to the country's citizens the government needs to ban products which include plastic. Based on views of Khan et al., (2021), govern should also ban harmful gases like CFC which are generally used in refrigerators for cooling purposes. CFCs hurt human health because they can cause bronchial constriction, breathing problems, brain dysfunction and many pulmonary diseases. International policies and structures play a crucial role in regulating and managing the waste trade around the world for sustainability [10]. Sustainable development is a key asset for the growth and development of international trading in every sector. In trading products internationally, a large

part of unwanted and waste trades sheds light on the importance of sustainable trading around the world. To manage and regulate these unwanted and waste trade products, different countries internationally have made unique policies to control the waste trade to promote sustainable growth and development. Due to the possible negative effects, it can have on the environment, the economy, and society collectively, international waste products trade has received a lot of attention.

2.2 Role of international policies in administration and management of waste trade

As per opinions of Ali et al., (2021), to ensure sustainability, the role played by international policies in the management and administration of waste trade is very important. Waste trade or unwanted trade can have a significantly higher global influence on different countries and the environment [1]. The difference between the waste management systems, cost advantages, and different environmental requirements, international trade in waste products and trade has experienced a fast rise globally. The development of the waste trade, factors that led to increasing waste trade, and the effects it has on both exporting and importing between countries have a great impact on the environment. The need for regulatory frameworks and international policies that find a balance between business objectives and environmental concerns is crucially important for sustainability. Countries can use valuable strategies and policies which can help in managing the waste trade for sustainability. Policies and strategies, Countries need to update and improve rules and regulations for waste trade reporting which will help in finding the correct data for waste trade. In accordance to Ostad-Ali-Askari (2022), developing and implementing strict rules and regulations for the prevention of waste trade circulating internationally. Countries can make policies and strategies that can help in educating people and businesses to prevent the waste trade. By implementing various campaigns and awareness programs to increase public awareness of the treatment of waste trade and data reporting for sustainable development. International businesses and different countries can implement strict and suitable laws for waste trade management and ensure penalties for companies that are not following the rules and regulations [13]. Setting up the authority will help in sustainable development. The negative effects of unregulated waste trading on the environment, include pollution, resource damage, and health dangers. The requirement for quick development of laws and regulations ensures sustainability while minimizing negative outcomes and waste trades.

2.3 Benefits provided by international policies

In words of Sazvar et al., (2021), innovating strategies including extended producer responsibility (EPR), sustainable development models, and technologies that convert waste into energy can be helpful for sustainable growth. These initiatives focus on resource efficiency, waste reduction, and recycling waste products with global sustainability goals [14]. The ethical and social aspects of waste trading, including its effects on underprivileged people in importing countries. It analyses concerns with equal benefit distribution, working conditions, and environmental equality. The role of international policies has helped in addressing these issues and improving ethical behaviour. There are new techniques available for analysing waste transfers and ensuring compatibility with the help of tracking technology, data analytics, and sensor technology. The capacity to increase transparency, responsibility, and accountability is a valuable aspect of these policies. It examines possible issues with data privacy and the capacity for sustainable development in developing nations. Effective policies that balance economic growth with environmental conservation are more valuable for international trade. The crucial role of international regulations and management in controlling and regulating the waste trade to promote sustainability is very important.

According to Awasthi et al., (2021), there are numerous difficulties and opportunities related to waste trading by combining results from studies, highlighting the need for cooperative worldwide initiatives around the world. An open and sustainable approach to waste management is essential as the world population works toward sustainability goals [3]. Constant regulatory framework evaluation is also necessary for achieving sustainability growth. These international policies help in regulating and managing the waste trade around the world. These international policies also bring challenges such as unreliable waste classification, illegal international border transfers, and a lack of standardised reporting methods while recognising the complexity of regulating waste trade. These obstacles make it difficult to carry out policies effectively, resulting in the need for organized international efforts. The influence of social, political, and economic issues on the development and execution of policies is very important to create a sustainable environment globally. Businesses, governments, and social groups must work together to implement successful waste management programs.

3 EMPIRICAL ANALYSES

3.1 Basic Statistics



Figure 1: Top 10 Global Producers of E-waste
(Source: Xavier et al., 2021)

According to global studies of E-waste in 2019, the entire world produced 53.6 Mt of electronic waste which was considered a warning of a 21% increase in this type of wastage in the last 5 years. This report also forecasted that the production of electronic waste will extend 74 Mt in the global aspect by 2030. This is an approximately doubled amount of 16 years of e-waste from 2014 (Xavier et al., 2021). In the quantity of this data, the waste of electronics becomes the frequent developing domestic waste flow across the world. The causes behind this rapid increase in electronic waste include shorter life spans, rapid transformation in technology, frequent changes in customers' demand and behaviour, as well as limited options for repairing electronic goods [22]. The above-mentioned statistical report showed that Asia ranked at the top in the production of electronic waste with an amount of 24.9 Mt. America positioned second with 13.1 Mt, and Europe placed its position in third rank with 12 Mt. Africa and Oceania placed their position at last ranks with respectively 2.9 Mt and 0.7 Mt of e-waste. This report recognised that the top-ranked continents such as Asia, Europe, and America could not implement the international policies of regulating waste management effectively.



Figure 2: Global e-waste production in 2019
(Source: Xavier et al., 2021)

The above-mentioned report stated that only 17.4% was accounted for and collected for research, on the other hand, 82.6% was considered speculative as well and its impact on human health and the environment varied across the world. Electronic waste is examined as an unprocessed treasure which may contain various types of processed and natural resources like platinum group treasures, plastic, base metals, and other non-metallic resources. These various metals are costly and valued at approximately 65 USD billion which is considered quite more or less the GDP in most of the countries. These valuable resources and metals were either incinerated or dumped instead of rectified at formal facilities to extend the life span of these resources by processing them as subordinate raw materials.

Indicators	MERCOSUR				NAFTA		
	Argentina	Brazil	Uruguay	Paraguay	Canada	Mexico	United States
Population (millions)	44.9	215.2	3.5	7.5	37.8	129.6	325.6
GDP (Million USD)	449.04	1819.76	38.15	36.05	1718.40	1228.29	21,744.02
GDP per capita (USD)	10,000.11	8717.19	240,438	10,198.11	45,194.73	9463.87	65,118.30
Area (million km ²)	2780	851.8	0.48	417.6	9985	1973	9824
EEW Poll (kg per capita)	12.7	15.3	19.6	15.7	23.8	11.0	29.1
E-waste generation per capita (kg individual)	18.1	19.2	21	18.5	20.2	9.7	21.8
Total e-waste generation (Mt)	403	2141	11	37	777	1229	6919
E-waste discarded to be collected and recycled (Mt)	11 (2015)	0.14 (2012)	NA	NA	9.9 (2014)	96 (2014)	1000 (2017)
E-waste Federal regulation	No	2018 - Law 26088	2008	2018	No	2003	No
Regulation	Law No 23,022 (1991)	Law No. 12,505 (2018)	1996/2009	1996/2009	NAFTA Electronic Products Recirculation Program (N.S. Reg. 21) (1996)	"Ley general para la promoción y gestión integral de los residuos" (2003)	California Electronic Waste Recycling Act (EWRA), Senate Bill 20 (January 2002)
Waste management responsibility model	Extended Producer Responsibility	Shared Responsibility	Co-responsibility	Shared Responsibility	Extended Producer Responsibility	Shared Responsibility	Extended Producer Responsibility
Harmonized Recycled Content	Yes (1991)	Yes (2002)	Yes (1991)	Yes (1991)	Yes (1992)	Yes (1991)	No

Figure 3: NAFTA and MERCOSUR main economic, politic, and e-waste management aspects in 2019

(Source: Xavier et al., 2021)

According to Xavier et al., (2021), NAFTA and MERCOSUR signified the electronic waste management and economic aspects in 2019 as the indicators of e-waste. MERCOSUR was founded in 1991, composed of Brazil, Argentina, Uruguay, and Paraguay as its full-time members. On the other hand, the NAFTA agreement was established in 1994 among Mexico, Canada, and the USA. This above-mentioned chart demonstrates the chosen characteristics of NAFTA and MERCOSUR regarding politics, economics, and electronic waste management among the mentioned countries. These indicators analyse the focus on the political, e-waste management, economic, and environmental factors with legal aspects. The above chart shows that Canada, Brazil, and the USA face the biggest issues for reverse logistics because of the population density, territorial area, and increasing volumes per capita [23]. Canada and Brazil have similar GDP, and economic actions with the pressure of livestock, agriculture, and mining. Brazil produces more

than double the amount of e-waste from Canada per year. Though per capita production of Canada exceeds the generation of Brazil by approximately seven times. So, it has been observed that the international policies of waste management face lots of challenges in the developing countries of South America due to the population and the USA and Canada provide other problems due to their increasing GDP that influences e-waste increase.

3.2 Analysis Result

Patent Position			H-Index Position			Final Position Index				
N ^o	Countries	Patents	N ^o	Countries	H-Index	Final Position	Main Countries	Patents	H-Index	Publication Number
1	United States	277	1	China	28					
2	China	271	2	India	25	1.50	China	277	28	137
3	India	176	3	Italy	23	2.50	India	176	23	398
4	South Korea	139	4	United Kingdom	22	3.00	United States	277	19	136
5	Canada	100	5	United States	18	7.50	Japan	96	15	75
6	Japan	96	6	Spain	18	7.50	Australia	74	16	66
7	Australia	74	7	Brazil	17	7.50	Brazil	50	17	97
8	Brazil	50	8	Australia	16					
9	Mexico	40	9	Japan	15					
10	Singapore	27	10	Malaysia	13					

Final Position Index = $\frac{H - \text{Index Position} \times \text{Patent Position}}{2}$

Figure 4: The ranking of different countries regarding average count of patent registrations as well as the H-index of scientific publications.

(Source: Anuardo et al., 2022)

From the above picture, it is defined that the United States, China and India, the top three nations, consisted of 40 per cent of total patents that were published and were located among the head of the h-index. In regard to this criteria, the aforementioned three countries contain an effective department of research that was done in mainly three steps, such as recognition of scenarios related to technology and science, classification and analysis of different opportunities as well as division and analysis of potential challenges [2]. In the first phase, proper analysis content can compile the primary inventions along with organisational, academic and governmental initiatives of the concerned nations. Multiple official documents such as national reports, official websites of governments and international agencies of the three countries were analysed in order to systemise the entire framework for both private and public authorities to improve the process of waste management. In the rest phrases, the opportunities for improvement as well as the challenges of waste management were evaluated and classified respectively on the basis of several relevant articles and the gaps that were chosen in the second phase. The addition of the technical-scientific scenario, opportunities and challenges to the experiences of authors can subsidise the formulation of a waste management framework.

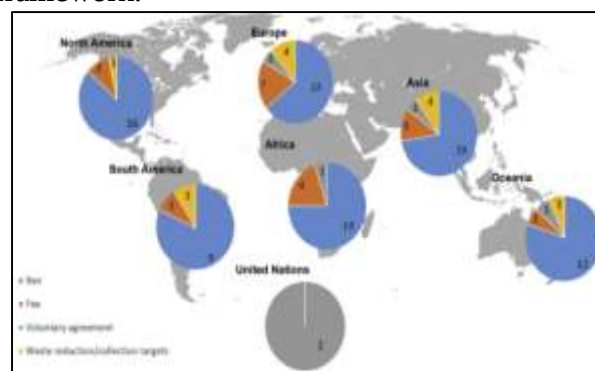


Figure 5: Most often utilised policy measures targeting plastic pollution implemented since 2018 in global aspects.

(Source: Syberg et al., 2021)

The above picture shows the various perspectives of different countries including Oceania, Asia, South America, the United Nations, Africa, North America and Europe. Different countries have separate regulations regarding plastic pollution. This particular type of pollution has transmitted gradually from previous bans on the usage of plastic bags and regulations concerning natural waste handling to promoting the change to a circular economy [8]. This transmission in concentration has an outcome of legislation, including the single-use plastic directive of Europe. This European legislation basically concentrates on regulating plastic at multiple stages in one's life cycle in spite of aiming at a particular phase of the life cycle, like the waste phase. In order to make the change more successful, it is important to incorporate proper and effective policy measures in practice. The above picture illustrates some measurements that have mostly been utilised since the year 2018 in a wide range of primary regulations internationally. Therefore, bans on plastic products, especially single-use goods such as plastic bags refer to the most frequently utilised policy measure. Concerning the aforementioned policy, Asia, North America and Europe are ranked in the top three positions respectively. Apart from this, fees also play a crucial role in this context, as different new fees have been incorporated in each and every part of the globe since 2018. Almost all the aforementioned countries except the United Nations have implemented fees and waste reduction or collection targets measurements. Along with the emerging number of legislations, there are some areas that are not effectively regulated, including pre-production pellets [16]. Most notably, the United Nations is regulated on the basis of voluntary agreement, whereas North and South America do not follow such agreements.

3.3 Relationships with existing studies and robustness

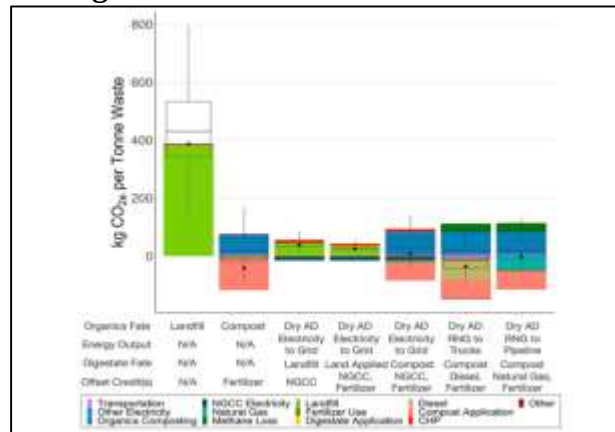


Figure 6: Greenhouse gas emissions life cycle
(Source: Nordahl et al., 2020)

In South African countries like Nigeria, it has been perceived that in the landfills, digestate is often utilised as conventional waste or is also utilised as the ADC or alternative daily cover for controlling fire, rodents, odours and many more. In both scenarios, identical material is placed in the landfill. Therefore, no such expectations can be observed that the utilisation of the digestate as ADC can result in considerable differences in the footprints of greenhouse gases or any other relevant emissions connected to conventional landfilling. The reason behind this is that the countries of South Africa have failed to implement proper international policies to manage and regulate waste trade for sustainability [12]. The result of scaling emission factors to landfills digestate depending on the content of volatile solids has shown a lower reduction of around 80%.

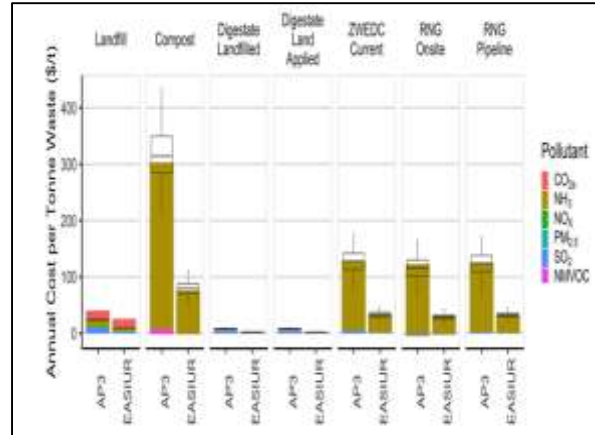


Figure 7: Life-cycle social cost of organic waste management
(Source: Nordahl et al., 2020)

In order to make a comparison, the authors of this paper have juxtaposed the primary and secondary social costs of greenhouse gas emissions and PM₂₅ exposure by utilising different models of integrated waste management. The models were namely EASIUR and APEEP through combining with 42 USD per tonne of carbon dioxide. The outcomes have revealed that landfilling's social cost was lying between 25-40 US dollars. The fundamental cause that has been recognised in this paper is that the damages related to GHG make up the greatest fraction of the comprehensive landfill damages. This value is altered based on the presumed carbon social cost.

As per the study of Eskander and Fankhauser, (2020), passing different types of climate laws and international policies consists of statistically crucial and pessimistic impacts on the emissions of carbon dioxide over the long as well as short term. However, as anticipated it has been discerned that there is a lower impact of these laws on the emission of non-carbon-dioxide gases where the effects of the laws are statistically essential over a long-term goal [6]. Passing a wide range of international laws is also considered highly important for lowering the discharge of carbon dioxide gases by around 0.78% in the first 3 years. On the other hand, the figure has deteriorated by almost 1.79% after completion of the subsequent three years.

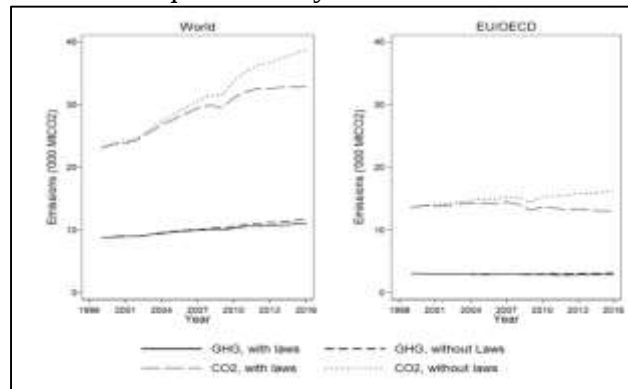


Figure 8: Path of Emissions in the Presence and Absence of Laws
(Source: Eskander and Fankhauser, 2020)

The statistical outcomes at the country-year standard can be utilised for estimating the historical effect of present climate law bodies on universal emissions. The diversity between the roughly calculated counterfactual emission standard and the discerned actual emissions inclusive of the climate legislation effect is small enough [7]. Talking about the case of carbon dioxide, the curves have begun to be deviated from 2004 while the legislative activities have started to be picked up

specifically in advanced nations like the EU or OECD. On the contrary, in the case of non-carbon-dioxide gases, the curves are close enough throughout the phase, backscattering the moderate effect on further greenhouse gases.

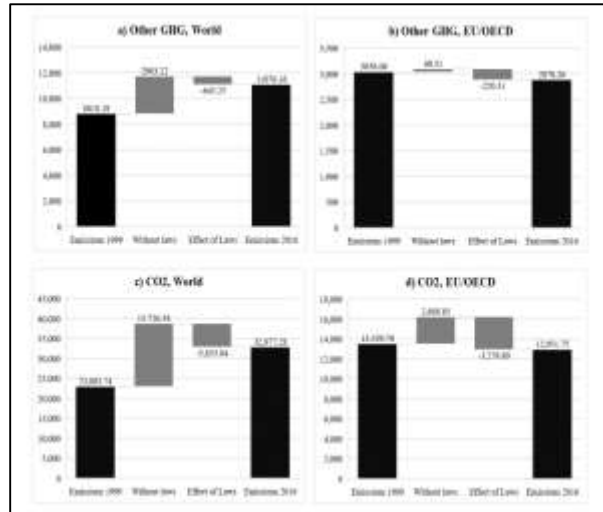


Figure 9: Alterations in Gas Emissions by Region
(Source: Eskander and Fankhauser, 2020)

The above figure is depicting the alteration in the emission standard because of the international laws between 1999 to 2016. Emissions in absence of laws have been permeated from the roughly calculated emission paths.

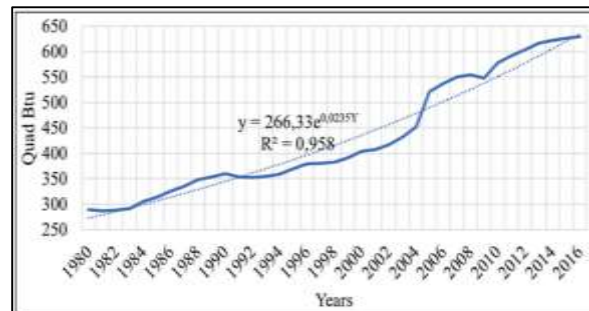


Figure 10: Dynamics of energy consumption in worldwide
(Source: Vertakova and Plotnikov, 2019)

In recent days, the rate of energy consumption worldwide has increased day by day. According to the report of Vertakova and Plotnikov, (2019), the range of this energy consumption between the years of 1980 to 2017 increased dramatically. Only for the 4 times, this upward line was replaced by the slight decrement [18]. In the years 1981, 1991, 1992, and 2009, the percentage of energy consumption was -0.72% , -1.83% , -0.34% , and -1.11% . The passage of energy consumption (y) of the entire world has been described with high accuracy ($R^2=0.958$) using an epidemic trend: $y=266.33 \exp (0.0235 y)$, where y is used to define the years.

Country	2000	2005	2010	2011	2012	2013	2014	2015	2016
Australia	100	96	97	98	99	100	101	96	97
Canada	100	97	100	100	97	99	95	94	91

Ireland	100	87	76	76	77	84	82	41	41
New Zealand	100	85	96	95	95	99	106	100	101
Poland	100	46	27	26	25	27	25	23	23

Table 1: Energy intensity of some countries for manufacturing
(Source: World Health Organization, 2022)

Besides the increase in energy consumption rate, at the same time, the decrease in energy consumption in some specific conditions was found worldwide (Table 1). Different developing countries from the year 2000 to 2016, faced fluctuation of energy intensity, in which most of the countries successfully maintained a high range of energy intensity in the year 2000. On the other hand, in the next year, the energy intensity rate decreased rapidly which was mostly visualised in the country of Poland, where the rate was 46 MJ/USD PPP which was 100 MJ/USD PPP in the previous year. This way, in a gradual manner, this reduction of energy consumption of these countries has shown continuously up to the 2016 year which has been mentioned here in where most countries' downfall had been shown [21]. So, there is a need to adopt international laws for managing and regulating this devastating condition. Through evaluating this rate of reduction of energy consumption, it can be said that there is a need to adopt different significant and affecting procedures and strategies for improving the efficiency of transmission, production, usage of energy, shortage, and many more. Different policies and rules regarding this case have played a very significant role. As an example, Russia adopted a federal law regarding improving energy efficiency and energy saving in the year 2023. This energy efficiency problem is interconnected with the problem regarding climate change. This study mainly refers to the function of different organisations where they have adopted different significant steps and procedures to mitigate the

Product	Volume of production
Scrap Metal	24.0
Gasoline	56.2
Synthetic oil	86.5
Fuel oil	30.3

issues of energy consumption or sustainability.

Table 2: Commodity product's production volumes
(Source: Tomov and Velkoska, 2022)

Commodity products' production volume has been designed with the help of standard volume to process 10 tons of waste per day [17]. Through this concept, it can be identified that this is a reason for pollution and for mitigating this, the internal policies in managing and regulating waste trade for sustainability will be helpful.

4 SUMMARY AND IMPLICATIONS

These waste trades pollute the environment and harm the nature and economy of a country. Managing these obstacles is very important for growth and development. Countries should take a sustainable approach towards the effects of waste trading. Sustainability will help encourage other businesses, communities and populations to work together to achieve one aim or goal. Sustainability will help in providing all the resources to future generations, so it is very important

to manage waste trade or products and work together to attain a sustainable environment. According to the research it takes around 20 to 500 years to decompose the plastic material. It is very necessary to ban such products because they have a very harmful effect on the environment. The harmful effect of plastic is also responsible for human diseases like prematurity, stillbirth, and abnormal lung growth and also causes cancer in some cases.

By developing a strong framework for collecting online information, gathering current data and accurate data will help in managing the waste trade. This will help in identifying the waste trade streams. The international market can update and build a waste data and information management system which will allow it to navigate the waste trade and help in controlling the waste products that are circulating globally. Successful waste management strategies with a focus on the way they can connect with international frameworks can help in achieving sustainability in international trades and the environment. This requires the potential benefit of strict regulation in international trading laws and regulation. The agreement known as the Basel Convention analyses the international policies that are crucial for the regulation of the waste trade. This evaluates the implementation of challenges and the need for greater collaboration among countries that participated after analysing the evolution and effectiveness of the agreement. It also highlights the necessity of regional frameworks and specifically developed strategies to deal with various waste trades to promote a sustainable environment.

CONFLICTS OF INTEREST

As per the author, there are no significant conflicts of interest.

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