Exploring Extended Producer Responsibility in Thailand: Progress and Opportunities for Alternative Waste Management Policy

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ABSTRACT

Waste management, particularly plastic waste, is one the significant environmental challenges in Thailand. Extended Producer Responsibility (EPR) has emerged as a key policy approach, holding producers accountable for their products throughout their lifecycle, including take-back, recycling, and final disposal. This study examines the progress of EPR implementation in Thailand through document reviews, content analysis, and interviews with the business sector. The study aims to identify key outcomes and challenges associated with implementing EPR. Findings indicate that Thailand has made considerable progresses in adopting EPR, notably through the introduction of the Sustainable Packaging Management Act and enhanced collaboration among industry, government, and citizens. These initiatives are fostering innovative and collaborative waste management strategies by integrating businesses and consumers into the process with shared responsibilities. However, the research also highlights challenges, particularly the need for greater industry acceptance and enhanced consumer participation. Effective EPR implementation relies on businesses' willingness to embrace their responsibilities and consumers' commitment to engaging in recycling and waste reduction practices. While supportive legislation provides a necessary framework, the ultimate success of EPR in Thailand depends on widespread commitment from both the business sector and the public. The study emphasizes the importance of fostering broad acceptance and cooperation from all stakeholders to address challenges and achieve long-term improvements in waste management and sustainability.

Keyword: Extended Producer Responsibility (EPR)/ Plastic waste management/ Sustainable Packaging Management Act/ EPR implementation/ Thailand

1. INTRODUCTION

The use of plastic has been increasing globally [1, 2] offering benefits to lifestyles and consumption patterns in many ways. The key driving forces behind this trend include population growth, rapid urbanization, and industrial expansion [3]. The durability of plastic enhances user convenience and ensures safety and freshness for food consumers, thus benefiting the economics of various products [4]. Furthermore, plastic is relatively inexpensive to produce and can be designed for packaging at low costs, with the potential for recycling at multiple levels [4]. Plastics are then used in many sectors ranging from household, domestic, food and product packaging, industry production [3]. Approximately one-third of plastic consumption is attributed to packaging applications, particularly plastic bags and containers [4]. However, the rise of plastic consumption has also resulted in significant sustainability concerns over plastic pollution and its environmental impacts on soil, rivers, climate change, ecosystem, wildlife, including marine species [1, 3, 5, 6].

Several disposal methods of reuse, recycling, incineration and landfill have been implemented to manage plastic waste. Emerging approaches such as thermal cracking and carbonization for the reutilization of waste plastics have also been developed [1]. It is predicted that the plastic production stage (processing and disposal) could emit 6500 Mt equivalent of CO_2 up from 1781 in 2015 [7]. While significant concerns regarding plastic waste and pollution stem from unsustainable production and consumption patterns, inadequate disposal methods post-consumption, insufficient collection systems, and mismanagement during post-collection or post-processing operations [3]. Furthermore, recycling is significantly promoted with the integration of circular economy (CE) concepts. Aiming to convert waste materials into valuable products, thereby improving effectiveness. Consequently, these strategies, along with waste reduction initiatives, are increasingly adopted as primary waste management policies

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[8]. However, recycling efforts have been facing challenges, particularly due to the mixing of plastic waste with municipal solid waste without proper sorting [9]. A lack of effective waste separation behaviour among consumers is also one of the major contributing factors [10].

Although global plastic production in industry decreased in 2020 due to the COVID-19 pandemic and lockdown measures [5, 11]. The pandemic also transformed consumer lifestyles, leading to increased reliance on online food delivery, plastic bags, food containers, and packaging for online shopping. As a result, there was a notable increase in the volume and composition of waste generation [12]. This indicates the need to also address consumer behaviours related to waste reduction and waste sorting. Increasing awareness of the consequences of waste can facilitate this change [4]. Overall, current waste management approaches for plastics illustrate the primarily focus on the post-consumption stage or end-of-pipe processes. This presents that there are still limitations in their effectiveness, as they rely on waiting for consumer behaviour changes or new innovations for disposal.

In response to the challenges posed by plastic waste, various policies and legislation are being implemented to ban plastic use or reduce plastic waste and its associated pollution [13]. One significant policy innovation is Extended Producer Responsibility (EPR), which shifts responsibility for plastic waste management to manufacturers. The European Union (EU) defines EPR as a policy principle to foster the entire life cycle of the product system, extending the manufacturer or producer's responsibilities to include take-back, recycling, and final disposal [14]. This approach requires producers to cover expenses throughout the product's life cycle, including waste collection, waste treatment, and consumer awareness initiatives [15]. It is more effective for producers to implement changes that reduce environmental, economic, and social impacts rather than relying solely on consumers. EPR provides incentives for manufacturers to improve product design towards eco-design and ensures responsible end-of-life management to improve recyclability [5]. The concept of EPR has been adopted and implemented in legislation across countries worldwide.

Thailand has faced a critical challenge in managing plastic waste. In 2023, the country generated 3.03 million tons of plastic waste, accounting for 11.25% of the total waste produced, with a significant portion consisting of single-use plastics (SUP). However, only 0.75 million tons (or 25%) was recycled, while 2.18 million tons (72%) was disposed of alongside other waste [10]. Historically, despite the extensive use of plastics in Thailand, there has been a lack of specific and stringent legislation regulating plastic waste, in contrast to many other countries. As a result, past approaches primarily relied on voluntary initiatives and awareness campaigns by organisations rather than formal measures to reduce plastic consumption [16, 17].

In response to the need for improved management various waste management plans have been developed, including the Plastic Action Plan, which intends to address critical issues related to plastic waste management. However, this plan has met with resistance due to its perceived inconvenience for daily use and its negative effect on plastic producers [17]. The country has also implemented a policy to ban the import of plastic scrap and promote the utilization of domestic plastic scraps [18]. Simultaneously, the mismanagement of plastic waste, particularly in packaging, has resulted in substantial economic costs [19]. The lack of adequate infrastructure for plastic waste management further complicates the situation, as limited consumer actions to reduce plastic waste and sort their waste have also increased costs and burdens on municipalities [10]. Furthermore, increasing plastic utilisation requires incentives to enhance recycling based on CE [17]. Considering these challenges, Thailand is currently in the process of adopting EPR principles, marked by the proposal of legislation focused on packaging waste management.

Therefore, this study aims to explore the current situation and progress of the implementation of EPR in Thailand, focusing on the ongoing progress involving relevant stakeholders, including the business sector. The study examines Thailand's interests and progress in adopting EPR, the legislative integration of EPR, and the perspectives of businesses and related organisations regarding EPR practices and how they respond to the adoption of EPR.

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2. METHODOLOGY

In this study, a variety of data sources related to the development and implementation of EPR in Thailand were collected and analysed as part of a qualitative research approach. This process aimed to describe the progress made and the rationales behind it. Multiple data collection methods were used. Document review is used to systematically collect and review documents relevant to EPR activities and progress in Thailand [20]. This also presents supporting evidence for assessing the progress over time [21]. While offering insights into stakeholders' accounts and opinions on EPR-related initiatives. Relevant keywords were searched in both Thai and English, such as "EPR", "EPR Act", "EPR activity", "plastic waste", "plastic law", "plastic packaging legislation" and "plastic waste management". It included not only government sources but also contributions from collaboratives, the business sector, international organisation and experts engaged in EPR initiatives and advancements. This comprehensive search aimed to cover a broad range of EPR related content, including research, reports, publications, policy documents, legislation, and business reports from diverse stakeholders. This effort also aims to explore regulations related to plastic waste management and EPR. Thus, establishing a foundational understanding of the EPR regulatory landscape, which is crucial for advancing EPR implementation in the country. Additionally, since EPR is a recent development, online news and articles were included to provide updates on EPR and its implementation. However, because this is secondary data, there could be limitations regarding the accurate interpretation of the content and the intentions.

The documents selected for this study were based on specific inclusion criteria, emphasising their direct relevance to the research topic and questions. Criteria included the organisation's (public or private) vision, strategies, and activities related to EPR or sustainable waste management, as well as previous challenges, particularly regarding plastic waste management. The review also considered policies, plans, and strategies on EPR and CE, including legislation on plastic waste management or packaging. Studies that primarily emphasised technical or scientific processes, such as waste calculations, recycling techniques, and incineration, were rejected, as were those that did not specifically address plastic waste or packaging. Additionally, studies focusing solely on the BCG (Bio-Circular-Green Economy) or 3Rs (Reduce, Reuse, Recycle) without mentioning CE or EPR were excluded. The selection process prioritised credible sources, including peer-reviewed articles and reliable publications, resources relevant to context of Thailand were included. This selection contributed meaningfully to the research objectives and the specific situation of EPR development in Thailand.

In-depth interviews were also conducted with representatives from two organisations, one business group and one international organisation engaged in sustainable use of resources. They were selected for their extensive experience and long-term involvement in EPR and waste management. Additionally, they have collaborated with various companies, stakeholders, and communities over the years. Their participation in several meetings also provides valuable insights, opinions, feedback, and information relevant to the development of legislation on EPR. Although the number of organisations selected for the interviews is small, the insights gathered from these experienced representatives are particularly valuable, especially given that EPR is a relatively recent concept. The aim of the interviews was to gather detailed information on EPR-related activities and to explore how stakeholders, aside from the government, perceive the overall progress of EPR and are concerned on its legislative aspects. Conducted in March 2024 via an online platform, the interviews featured a predetermined set of questions that captured perspectives on the EPR principle, sustainable waste management in Thailand, and the Sustainable Packaging Management Act.

The semi-structured interview format offered flexibility and allowed for the exploration of respondents' active involvement in EPR initiatives, including ongoing projects, future strategic plans, collaborative efforts, and the rationale behind these activities. Additionally, the interviews addressed respondents' views on the implementation of EPR through the Sustainable Packaging Management Act and their contributions to promoting environmental sustainability and effective waste management practices in Thailand. Interview guides were developed to align with the research questions and

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objectives to ensure the validity and reliability of the data collected from the interviews and its interpretations. Additional questions tailored to the specifically characteristics of each organisation were incorporated to collect more detailed insights into their opinions. This facilitated a more focused conversation and strengthened the validity of the findings by ensuring that the interviews addressed relevant topics. Additionally, the details of the pilot projects and their EPR related activities were cross verified with previous studies and reports to ensure accuracy.

The direct stakeholder engagement provides a detailed understanding of EPR progress by also considering the legislative landscape and the perspectives of key stakeholders. Ultimately, it offers a comprehensive view of the complexity surrounding waste management and EPR in the country. Subsequently, the research is then carried out using content analysis to analyse the information obtained as a descriptive response to the key themes related to EPR progress, the implementation of legislation, and EPR practices [22]. This analysis integrates various data sources and generates a wide range of stakeholder perspectives to support the arguments and conclusions presented in the study.

3. RESULTS AND DISCUSSION

Thailand's journey toward comprehensive waste management has been marked by significant milestones, notably the second National Waste Management Action Plan (2022–2027) developed by PCD. This plan follows the Solid Waste Management Master Plan (2016–2021) and aims to address the ongoing environmental and public health impacts of waste pollution, while also responding to evolving challenges and aligning with sustainable development goals and national strategies. Key initiatives include adopting CE principles such as BCG, 3Rs, implementing the Polluter Pays Principle (PPP), fostering public-private partnerships in waste management, and embracing concept of EPR [23]. Among these efforts, EPR is one of the most recent concepts introduced to waste management in Thailand.

The concept of EPR was introduced in Thailand in 2000 in response to concerns about the potential impacts of the EU's Directive on Waste Electrical and Electronic Equipment (WEEE) [24], given Thailand's status as an exporter to the EU. This initiative sparked interest among environmental organisations in applying EPR principles to manage challenging scrap products in the country. Although these initial efforts were unsuccessful, they laid the groundwork for later implementations of EPR in waste management. This section discusses Thailand's progress and efforts toward the introduction and adoption of EPR, as well as the challenges that lie ahead.

3.1 Progress and activities on the introduction of EPR in Thailand

Several progress developments have been made over the years, as follows:

1) Research

The potential of introducing and adopting EPR have been examined by various environmental research institutions and academic organisations. Research in 2009 highlights the prospect of implementing EPR in non-OECD Asian countries, including Thailand, specifically in relation to WEEE [24]. This study identifies challenges associated with the introduction of EPR legislation while also outlining opportunities for legislative development that could also be applied by other countries.

A more recent study conducted in 2022 appointed by the Pollution Control Department (PCD) aimed to prepare and develop legislation on packaging based on EPR and CE [25]. It presents collaborative projects involving multiple sectors, including PCD, environmental research institutes, and international development organisations [23]. It focuses on developing a policy framework for EPR for packaging waste, with activities that include the rethinking of plastics within the context of CE to address marine litter. The project aims to collect feedback on legal proposals for sustainable packaging waste management based on EPR principles. Various stakeholders, including government agencies, local organisations, academic institutions, NGOs, and the business sector were invited to meetings to provide data and insights. This project seeks the potential to transform waste management practices and promote CE through the proposal of a legal framework.

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Moreover, potential impacts and implications of plastics value chains, market and ecosystem based on the introduction of EPR in Thailand were studied, commissioned by an environmental research institute [26]. It also examined the changes of market, opportunities, policies, potential regulatory shifts in food-grade packaging of rPET. Information was collected through several methodology, such as review of EPR policy, desk research and in-depth interviews with plastic value chain stakeholders.

This illustrates that there are a number of studies on EPR, highlighting the recognition of its importance in promoting sustainable waste management practices and reducing environmental impacts. Additionally, these studies indicate that stakeholders in Thailand are actively obtaining knowledge to drive EPR principles forward.

2) On-going promotion effort on ERP by various stakeholders

Numerous efforts have been undertaken over the years to promote both knowledge and progress regarding the implementation of EPR in Thailand. In 2019, the Packaging Recovery Organisation Thailand (PRO-Thailand Network) was established and later officially inaugurated in 2023. Driven by the vision of seven major companies [27] to promote collaboration in advancing EPR. They aimed to work alongside other stakeholders, including brand owners, product manufacturers, packaging producers. Several activities have been carried out, such as partnerships in initiatives and pilot projects focused on post-consumer packaging collection, recycling, and educating the public [28, 29, 30].

Activities, progress, achievements, knowledge and updates on EPR have been reported across several platforms, including social media in recent years since 2020. Where they are presented in the form of posts, articles, news, infographics, and video clips. For example, Facebook pages of organisations such as PCD, the Thailand Institute of Packaging and Recycling Management for Sustainable Environment (TIPMSE), Greenpeace Thailand, Chula Zero Waste Project, SD Thailand, and PRO-Thailand Network provide updates covering a wide range of topics. These updates include basic information about EPR, collaborations and projects, developments regarding legislation and its mechanisms, the status of legal initiatives, upcoming meetings and projects, takeback programs, and concepts related to CE and packaging waste management.

Furthermore, seminars, workshops, and training sessions on EPR have been conducted. For example, TIPMSE organised seminars for the business sector to facilitate adaptation to international EPR regulations and policies, particularly those established by the EU, which mandates that all packaging on the market must be reusable or recyclable by 2030. Member countries are required to participate in EPR programs, taking responsibility for packaging throughout its lifecycle by gradually increasing recycling rates. Although this regulation has not yet been enforced with export partners, it is likely to be implemented in the future. In anticipation of these forthcoming regulations, producers are invited to share their perspectives and prepare for participation in the voluntary EPR PackBack program, which focuses on collecting packaging in advance of the mandatory phase [31].

This is in line with the seminars organised by PRO-Thailand Network in 2023, which focused on lessons learned from successful EPR mechanisms, PRO, in other countries. Thus, aimed to enhance awareness of EPR principles, policies and operations of voluntary PRO [29]. It also sought to engage producers within the packaging supply chain, encouraging their collaboration with the PRO-Thailand Network to support the implementation of EPR policies and prepare for the forthcoming waste management practices.

Government agencies have also organised Thai-EU expert workshops in 2023 to share knowledge and experiences regarding best practices in EPR for packaging and CE. It aims to support Thailand's establishment of a mandatory EPR system, a key component of the country's Action Plan for Waste Management. Participants from various sectors, including industry, academia, and civil society, attended the workshop. There was also a discussion on trade barriers related to environmental standards. Additionally, future meetings with the Bangkok Metropolitan Administration and recycling businesses were expected to prepare for the upcoming EPR legislation [32].

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These activities and collaborations illustrate the efforts of the business sector to prepare for the adaptation of EPR. They also present opportunities for businesses to align with international policies, which have significant impacts on their production processes and corporate strategies.

3) Pilot projects

Another significant effort driving voluntary EPR is the collaboration among various organisations, including producers, retailers, collectors, along with TIPMSE, under the Federation of Thai Industries, through the PackBack program. These stakeholders work together on projects to promote EPR principles, policies, and innovations in packaging management, such as recycling processes, storage systems, and drop-off points for used packaging. Pilot EPR projects were initiated in Chonburi province, known as the Chonburi CE City Model project, which demonstrates the potential of EPR in managing packaging waste and collecting data on glass recycling [33, 34]. This project aims to create a packaging waste collection and management model shaped by local circumstances [34]. It is anticipated that the program will expand from three pilot projects in three municipalities to eleven municipalities [35].

Interviews with participants provided additional insight into a collaborative community-based project in Koh Yao District, Phang Nga Province, which aims to strengthen a resilient waste management value chain from the islands to the mainland to tackle marine plastics. This project serves as a successful model for community waste management for other areas. It also benefits the food and beverage industry, especially considering the ongoing adjustments to packaging regulations. Highlighting the importance of building on community efforts to facilitate larger-scale collaborations, addressing environmental challenges and promoting sustainable practices through awareness campaigns, policy advocacy, and practical interventions.

Business groups and international organisations also collaborated on a project to support EPR practices, leading to significant changes in packaging return in Ngao and Bang Non, Ranong Province [35]. Interviews with respondents revealed that the project helped separate recyclable materials and involved local recyclers, enabling them to integrate these materials into an effective waste management system. It was designed to resonate with community behaviours and preferences. Thus, partnering with local stores to encourage customers to return post-consumer packaging in exchange for products. It sought to highlight the value of packaging even after use, promoting its return. The project achieved an impressive collection rate, recovering ten tons of used packaging [35]. It also encouraged business groups to further apply their strategies in other areas. The effort demonstrates another significant progress in adopting EPR feasibility of establishing a recycling system that integrated EPR principles while awaiting regulatory enforcement.

Therefore, as one of the respondents emphasised the critical role of the private business sector, particularly packaging producers, in receiving key information and actively participating in shaping the country's policy direction. These pilot projects provide invaluable lessons and opportunities for urban policymaking and infrastructure investment. Effective infrastructure planning is essential, as inadequate systems can pose significant challenges for waste management, especially with the city's expansion and the prospect of urbanisation in certain areas.

This section demonstrates that interest in EPR in Thailand has existed for some time. However, there is a notable gap between earlier research and more recent studies and developments. This could suggest there was either absence of interesting, lack of engagement, movements or delays in implementing EPR. It is criticised that despite recommendations for the country to advance its EPR initiatives over the past 10-15 years, one of the obstacles has been inequality within the business sector, with some larger companies expressing strong opposition to such measures [36]. Nevertheless, evidently EPR has recently received renewed attention. These ongoing efforts present collaborative commitments to adopting EPR principles among various stakeholders, including government agencies, businesses, producers, collectors. They underscore the importance of staying informed and adapting in anticipation of upcoming EPR legislation in Thailand and the broader international context. These

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efforts provide a valuable basis for businesses to rethink packaging design, productions and collection processes. Challenges also emerge, such as the lack of concrete measures to incentivise participation from the producer sector and insufficient recycling technology. Nevertheless, there is a continued push within Thailand to embrace EPR principles, as seen in the ongoing initiatives aimed at strengthening EPR compliance through enforceable regulations.

3.2 The introduction of the Draft sustainable Packaging Management Act (Draft Packaging Act)

Although pilot projects are already in place to drive voluntary EPR, it is also suggested that the establishment of EPR legislation may be necessary [37]. This legislation would facilitate the transition to mandatory EPR implementation in the future. In 2024, four legislative frameworks have been drafted and are currently undergoing a public hearing process to collect comments and recommendations for amendments. These frameworks aim to develop legal tools for waste and packaging management, incorporating EPR concept [34]. One of these frameworks is the Draft Sustainable Packaging Management Act (Draft Packaging Act) which aims to also incorporate EPR and CE in packaging waste management through legislation. This section discusses the key points of this Draft Packaging Act [38].

Key measures to promote sustainable packaging management outline the essential components of the EPR system. This includes specifying the types and categories of packaging covered, mandating a buyback or deposit and refund system, and restricting the production and use of certain packaging types, particularly single-use items. The framework establishes fees to compensate for environmental damage, which will support ecosystem cleanup and restoration efforts. Additionally, government agencies are responsible for reducing packaging use, promoting material efficiency, and increasing public awareness. An information system is also required to facilitate registration and compliance.

The industrial sector encounters additional requirements, including guidelines for support from local government organisations and those involved in collecting used packaging. It outlines methods for calculating management fees that responsible operators, who join as members, must pay. If used packaging cannot be collected and reused as targeted, these operators are required to pay a compensation fee for any resulting environmental damage. While municipalities facilitate the storage and reuse of used packaging, empowering local government organisations to manage packaging sustainably. As for waste sorting, no individual is permitted to dispose of used packaging with other waste. Used packaging must be placed only in the designated containers provided by the local administrative organisation. The owner or resident of the building is responsible for separating used packaging from other waste types before delivering it to the local government organisation.

The EPR concept in the Draft Packaging Act defines the responsibilities of organisations involved in packaging management, particularly in collecting, sorting, and reusing used packaging. It emphasises the importance of labelling requirements while also imposes fines for violations to ensure compliance, enforcement of buyback systems, restrictions on certain packaging, obligations for compensation fees, and establishes return points for packaging. It also requires detailed packaging management plans from producers and industries. While local government organisations are tasked with collecting, storing, and reusing used packaging, thereby promoting effective waste separation practices

One of the key mechanisms established is the Packaging Producer Responsibility Organisation (PRO), responsible for managing packaging in accordance with the Draft Packaging Act. Serving as a mediator between the legislation and producers, it facilitates networking activities and collaborations that promote sustainable waste management under EPR principles, highlighting significant involvement from businesses in various joint projects. Overall, the Draft Packaging Act intends to promote EPR and CE by aligning with solid waste management goals and providing a framework for sustainable packaging practices.

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3.3 Stakeholders perspectives on the adoption of EPR practices packaging waste management

This section presents key points from interviews with respondents, offering insights into stakeholders' perceptions of current EPR principles. It discusses their efforts to embrace EPR, the opportunities available to them, and their perspectives on the implementation of the Draft Packaging Act and the future of EPR practices.

As discussed in previous sections and highlighted in the interviews, information collected in this study is also partially aligned with the reviews of existing EPR implementations and stakeholder interviews and documentations [23, 26] that summarised and proposed key recommendations for the prepare of the adopting EPR system while also address plastic waste management Thailand. Several stakeholders have actively engaged in EPR activities, particularly in the business sector. This willingness is evidenced by collaborations among business companies and other stakeholders, including pilot projects aimed at strengthening community livelihoods. Respondents expressed that these projects focus on fostering cooperation and resilience between organisations and communities, creating interconnected and sustainable impacts. Their project also assisted local communities in developing and improving living conditions sustainably. This commitment is exemplified by the focus on sustainable waste management practices, such as offering products that are 100% recyclable or made from recycled materials. Nonetheless, while beverage packaging is recyclable, foil snack packaging poses a challenge due to its non-recyclability. In response, the producer also explores alternatives and innovations to address this issue. This demonstrates a proactive interest in supporting waste management and sustainable production practices, including eco-design, which reflects EPR principles among producers. Furthermore, respondents emphasised that sustainability is a key component of the production process, as reflected in their activities and projects. Stakeholders, particularly in the business sector and among producers, actively engage in initiatives aimed at enhancing environmental practices and promoting responsible waste management. Through these collaborative efforts, certain producers demonstrate their commitment to contributing positively to environmental conservation and sustainability.

Interviews offer the perspectives into the progress of introducing EPR to the business sector and other stakeholders with the claim that many organisations have already adopted EPR practices well before the introduction of the Draft Packaging Act and will continue to participate, although at varying levels of involvement. Some may engage more actively if their business is directly impacted, while others might step back to focus on different sustainability issues, given that the groundwork has already been established.

Despite their involvement in providing feedback on the Draft Packaging Act, there is still a lack of comprehensive understanding of its specifics, leading to confusion and uncertainty on some topics. Stakeholders suggested that the government prioritize circulating detailed information about the Draft Packaging Act and make it accessible to all parties, including producers and the public. This information should be distributed through various channels, such as official websites and public announcements, originating from a single, authoritative source for accuracy. Centralising this information would help stakeholders access key information and requirements, address compliance concerns, and focus on specific actions. Additionally, the government should provide the text of the Draft Packaging Act along with supplementary materials, such as explanatory guides, FAQs, and case studies, to clarify its implications and implementation processes. These resources would significantly assist stakeholders in understanding the Act and its potential impacts. Therefore, suggesting that by enhancing information distribution and ensuring consistency and reliability, the government can effectively reduce confusion and improve stakeholders' understanding of the Draft Packaging Act, especially for stakeholders that will directly comply with the Draft Packaging Act such as producers. This transparent and inclusive approach is crucial for fostering trust, encouraging compliance, and facilitating the smooth implementation of the Draft Packaging Act.

Respondents also noted that incorporating economic mechanisms and establishing a PRO present promising opportunities for sustainable packaging practices. However, careful consideration and ongoing assessment are essential to ensure that the Draft Packaging Act meets its goals while

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minimising the effects. Although incentives for producers to adopt sustainable packaging should include the true environmental costs in fee calculations, there are concerns about the challenges of accurately assessing the environmental impact of packaging materials. This could result in inequities or unintended consequences in fee structures, potentially undermining the intended benefits of the economic approach. While Thailand current is primarily focused on packaging, the successful EPR implementations in other countries, such as those in the electronics sector in Europe, highlight broader opportunities for Thailand to expand in the future. Additionally, the Draft Packaging Act requires producers to include EPR labels on their products, providing essential guidance on proper disposal and recycling practices [36]. This labelling not only informs consumers regarding information about the product and its packaging but also promotes responsible waste management in line with EPR principles.

3.4 Alternative waste management policy

The Thai government has prioritised waste management, particularly in response to plastic pollution, which was announced as national priority in 2018 [37]. The initiative includes policies and plans aimed at tackling plastic waste generated from two major sources of industrial processes and households. While previous management initiatives primarily relied on CE, BCG and 3Rs, the efficiency of plastic waste reduction could be further enhanced by considering the plastic value chains [39]. Therefore, EPR can be proposed as add-on strategy [39] or as alternative waste management policy that incorporates a broader range of responsible stakeholders. Importantly, as EPR would emphasise environmentally friendly packaging solutions and product life cycles. This would align with the targets set by the by Roadmap on Plastic Waste Management (2019-2030) and the Action Plan on Plastic Waste Management Phase 1 (2020-2022) that led to a nationwide ban on four types of plastic waste and the replacement of EUP with more environmentally friendly products [36, 40]. Furthermore, Thailand is also set to transition to sustainable plastic waste management, with the goal of recycling or reusing 100% of plastic waste by 2027 [41]. The adoption of EPR would also correspond with voluntary measures stated in Thailand's Roadmap. Which aims to reduce plastic production and SUP consumption while establishing effective management systems for post-consumer [42]. The adoption of EPR through the Draft Packaging Act then presents an opportunity to address the existing legal gaps, particularly regarding the responsibilities of plastic producers, including their financial obligations in post-consumption waste treatment [36, 43].

While the introduction of the Draft Packaging Act, is expected to generate positive economic outcomes, including reducing municipal waste management expenses due to decreased waste volume and improved waste collection system. Additionally, production costs may decline through material recycling, potentially enhancing the global competitiveness of producers. However, concerns exist that EPR could lead to higher operational costs for producers due to changes in product design from the beginning, designing, to disposal and the establishment of collection systems, which may ultimately result in increased product prices. It is important to ensure that these costs are not fully passed on to consumers. Nonetheless, it also faces uncertainties regarding its effectiveness in changing producer and consumer behaviours. Concerns have been raised about the potential impact on small and medium-sized enterprises (SMEs), which may struggle to adapt due to budget constraints. As EPR policies can negatively affect small producers, who often lack the resources to comply with regulations. Consequently, the costs of adoption and necessary changes may be passed on to consumers [5]. Additionally, effective post-consumption infrastructure, particularly for waste management and collection, is essential for adopting EPR. This infrastructure is crucial for achieving a zero-waste business model reducing overall waste [5].

In addition to government agencies, other sectors also play vital roles in facilitating and incentivizing sustainable approaches. The effective implementation of waste management legislation requires strict, transparent, and equitable enforcement to hold both consumers and producers accountable for their waste generation and management practices. Furthermore, transparency in both the legislation and enforcement not only builds trust among stakeholders but also fosters a culture of

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compliance. Significant changes in consumer behaviour are also essential for achieving sustainable reductions in plastic waste [44]. Therefore, addressing waste separation behaviour among consumers is then a crucial first step in fostering effective waste management and CE practices, similar to argument by Marks et al. [37]. Moreover, EPR policies must be equitable and inclusive, ensuring that all segments of society, including marginalised communities, have access to waste management services and resources. This involves addressing social and economic differences that could impact waste management practices. While also considering the community's unique socio-economic and cultural conditions, thus adapting to solutions that reflect local conditions and preferences are more likely to succeed.

Focusing on product's life cycle, including collection rather than solely on recycling, EPR can enhance recycling rates, expand waste collection locations and services, and reduce the amount of plastic waste that ends up in landfills. Thereby breaking the cycle of plastic pollution [45]. This comprehensive approach is particularly important due to the significant contributions of plastic to greenhouse gas (GHG) emissions [46]. Highlighting the needs to address this issue and lowering its GHG emissions which is currently accounted for 4.5% of global emissions [47]. The study on GHG emissions from plastic consumption in Thailand estimated that the country's plastic waste emits 2887.04 tonCO_2eq/day or 1.05 million tons/year [46]. Which lead to consequences such as an increase in Thailand's mean maximum temperature, climate change, and adverse effects on the natural environment [46, 48].

This underscores the necessity for strategies to reduce plastic consumption and improve plastic waste management practices, particularly in enhancing recycling efficiency and source separation. Such measures can increase economic value and reduce GHG emissions by approximately 3.87 and 3.17 times, as reported in the study conducted in Rayong [48]. The adoption of EPR can facilitate transformative changes by mitigating plastic pollution, promoting production efficiency, lowering GHG emissions associated with new material production, and ensuring that plastic producers take comprehensive responsibility for both their products and the collection process. Since GHG emissions from end-of-life plastic waste vary by country due to different waste management systems [45], the adoption of EPR as an alternative waste management policy presents another approach to potentially reduce GHG emissions. This can assist the country achieve its goal of GHG emissions reduction by 30-40% by 2030, with the target of reaching carbon neutrality by 2050 and net zero GHG emissions by 2065 [41].

The adoption of EPR for sustainable waste management depends not only on regulatory measures and industry acceptance but also on achieving alignment among all stakeholders toward a common goal. Together with awareness campaigns, collective understanding and commitment among consumers of sustainable waste management practices. Along with the fostering of shared vision and commitment to sustainability can create a lasting impact on waste management efforts. EPR can offer an approach to address the inefficiencies in current waste management practices. Thus, driving transformative changes by reducing plastic pollution, promoting production efficiency through CE, and GHG emissions reduction.

4. CONCLUSIONS

Thailand has actively promoted various policies aimed at improving waste management practices, with EPR emerging as a key alternative opportunity. This concept shifts responsibilities to producers, requiring them to oversee the entire lifecycle of their products, thereby promoting a more sustainable and responsible waste management strategy. Additionally, the commitment of consumers and stakeholders is also essential for establishing sustainable waste practices. The following conclusions can be drawn:

1. EPR is one of the waste management policies in Thailand to achieve sustainable waste management, highlighting efforts to adopt its principles for the future. Collaborative activities, projects and pilot studies highlight the potential of EPR in improving sustainable waste management practices.

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However, stakeholders have identified limitations within the proposed Draft Packaging Act, suggesting that the government should address these concerns to ensure effective implementation. While, achieving success will also require time, as consumer participation is necessary. Raising awareness and educating the public on this waste reduction and sorting practices is key for effective implementation.

2. The potential of the Draft Packaging Act could contribute to reducing the government's burden in managing used packaging, which previously relied on local municipality administrative organisations. Currently, they lack the capacity to effectively collect, and sort used packaging for sustainable management, including recycling or conversion to fuel energy. The Draft Packaging Act also addresses fee collection, directing fees from non-recyclable packaging waste to environmental agencies, which will use the funds to support the country's environmental maintenance.

3. The offering of economic incentives to producers for adopting EPR principles, along with penalties for non-compliance, can serve as a positive mechanism to foster a more responsible and eco-friendly manufacturing landscape.

4. The development of policies, legislation, strategies, and interventions based on EPR can contribute to alternative pathway for Thailand to achieve net zero emissions. By prioritising recycling, improving waste sorting, and promoting environmentally friendly packaging. These efforts facilitate the reductions in plastic waste and GHG emissions related to plastic production.

5. Future studies could explore deeper into policymakers' perspectives on the challenges and limitations identified by the business sector regarding the proposed Draft Packaging Act. By examining these perspectives, researchers can gain valuable insights into the regulatory landscape, potential policy changes, and strategies for overcoming barriers to effective waste management and EPR implementation.

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