

Research Article

Circular Economy of Used Cooking Oil in Indonesia: Current Practices and Development in Special Region of Yogyakarta

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Abstract

Used Cooking Oil (UCO) has become an inherent lifestyle of Indonesian people as frying is the main cooking method. As UCO ways of disposal have not been properly managed, the question on how UCO should be managed contributes to the adaptability of circular economy strategies moving away from throw-away culture. This study adopts desk research methods collecting relevant information from articles, journals, and books. Utilizing six dimensions – governmental, economic, environmental, technological, societal, and behavioural – of CE research for built-in environment and its conceptual limitations, this study finds that the absence of UCO governance networks contributes to the establishment of UCO collection initiatives from private sectors and community-based programs. The adoption of CE in terms of its definition and conceptual frameworks are accentuated with varying levels of emphasis on waste separation and collection systems. This study also argues that the dimensions of CE and its limitations in terms of governance and management, and social and cultural definitions are strictly attributed to incentivized UCO collection models while business sectors tend to foster limited energy recovery of UCO.

Keywords: Used Cooking Oil (UCO), Circular Economy, Private Initiatives

Introduction

The amount of cooking oil that is being used in industrial, restaurant and household sectors is large. Domestic consumption of cooking oil from palm oil is 16,2 million KL in 2019 (Ministry of Energy and Mineral Resources, 2020). These cooking oils, after evaporating and reaching a maximum number of usages, need to be safely disposed. From the cooking process, 40-60% of cooking oil (6,46-9,72 million KL) becomes used cooking oil (UCO). However, UCO actually generates economic, social, and environmental benefits provided that their disposal management are well coordinated. These advantages include job opportunities from recycling activities, energy recovery, and the potential to prevent spillage of UCO disposal to the environment. Paradoxically, in Circular Economy (CE) frameworks, the potential of UCO entering a few product cycles can pose a drawback for the three pillars of sustainability, which are the social, economic, and environmental dimensions (Murray et al., 2015). The main reason is that UCO is underregulated in Indonesia, in which only several provinces have policy instruments in dealing with UCO management. Therefore, it is essential to consider UCO management to have thorough innovative solutions for redressing existing barriers and lack of concerted efforts from top-down and bottom-up approaches.

The concept of CE in Indonesia is considerably in the early phase in terms of governance, policy, and implementation. In 2021, the Ministry of National Planning and Development (BAPPENAS) has just recently published a study on the benefits of Circular Economy in Indonesia from the economic, social, and environmental dimensions which acknowledge that the study is an initial step in enacting coherent Circular Economy frameworks (UNDP, 2021). The top-five priority industries which include food and beverages, construction, electronics, textiles, and plastics are determined to be the pioneers that achieve development targets in non-linear economic models. Although the proper method of minimizing the speed of the environmental deterioration is waste prevention, UCO has become an inherent lifestyle of Indonesian people as frying is the main cooking method. As UCO ways of disposal have not been properly managed, the question on how UCO should be managed contributes to the adaptability of circular economy strategies moving away from throw-away culture. In response, recent regulation on Environmental Protection Management, Government Regulation No. 22 Year 2021, still does not specifically regulate UCO (GOI, 2021).

The framework of governance on UCO management contributes to lingering structural problems. The Ministry of Energy and Natural Resources notes that only 18,5% (3 million KL) of UCO is collected through various channels. In 2020, collected UCO mainly serves export markets where only a relatively small amount of UCO (570 KL) has been converted into biodiesel feedstock (APROBI, 2021). Current practices suggest that UCO disposal methods rely heavily on consumer behaviour to dispose and separate their UCO or household waste at home. Only half of the households that participated in a survey in five big cities in Indonesia (Jakarta, Bandung, Semarang, Yogyakarta, and Surabaya) perform such activities. (Katadata Insight Center, 2020). This survey indicates that the Ministry of Forestry and Environment, as well as any other government authorities, are relatively unable to respond to growing concerns over waste management issues at the local or national level. Thus, it can be assumed that the main issue faced in the initial efforts of implementing UCO circularity lies in the absence of research-based policy identifying UCO benefits and harmful effects as well as its potential at the regency or city level. To this end, CE frameworks are expected to be a transformative tool in interpreting challenges on the complexity of UCO's social and environmental impacts while leading to the creation of sustainable economic opportunities.

CE frameworks offer a systematically linked process where resources are used in a circular manner or infinite number of times. Ideally, such systems are strived to be a measurement of success moving away from linear models. From this perspective, UCO will never be able to shift into a circular supply chain, as it cannot be used as new cooking oil. Therefore, environmentally friendly UCO treatments at home include utilizing UCO to create soaps, fertilizer, and cleaning solutions through simple chemical processes (Utami, 2021). On the other hand, industrial-scale treatment of UCO led to the discovery of its greater potentials, which is its ability to be used as a biofuel feedstock through the addition of a special catalyst that corresponds to Waste-to-Energy (WTE) strategy. This is when solid and liquid waste is converted into energy through combustion, gasification, and anaerobic digestion (Pan et al., 2015). In respect to various working definitions and frameworks of CE, Saidani et al., (2017) notes that recycling activity is considered as the least preferable CE strategy compared to an ideal circular energy and product loops. Thus, focusing only on recycling campaigns would yield limited contributions to the CE strategy unless UCO conversion into biofuel is included as the main activity.

This study aims to investigate the concept of CE in both conceptual and practical levels in the Indonesian context by looking at the circularity models and governance of UCO. From the institutional perspective, many government policies primarily support recycling as their main CE goal (Ranta et al., 2018). Despite the lack of existing institutional frameworks at the local, regional, and national level, some UCO business models initiatives have emerged. These initiatives to some extent adopt circularity values into their businesses. However, most of them tend to be isolated, and how those projects are supported by stakeholders remain critical discussions. As an early analysis of CE potential has just been conducted by the government, another purpose of this study is to

highlight possibilities and limitations of current UCO business models. It is necessary to put environmental dimensions as the main driver of sustainably developing UCO management, while also avoiding neglect in its economic benefits.

Literature Review

CE is a broad concept in the field of sustainable development. The term appeared as early as 1990s addressing how economic activities are linked with environment deterioration (Pearce & Turner, 1990). While many argue that it is still on the early phase of academic development, some studies have conducted a systematic literature review of CE studies. To conceptualize embedded elements in CE, Kirchherr et al. (2017) identified several inherent indicators of CE studies, which are the 4R framework, waste hierarchy, systems perspective, and sustainable development. These indicators are coded into their analysis of 144 definitions which are deemed to be fit of their criteria. While their sample is sufficient to illustrate the current debates on CE definitions, the proposed definition from their study is also paradoxically constraint to the strengthening of frameworks of CE research.

Another CE research that focuses on measuring its conception is the attempt of formulating CE metrics. This study navigates CE complexities by compiling economic metrics and approaches to accentuate their relations to other relevant metrics (Parchomenko et al., 2019). From 63 selected CE studies, they concluded that the top five elements of CE are waste disposal, primary vs. secondary materials, resource productivity or process efficiency, recycling efficiency, and energy consideration respectively. Moreover, some other CE elements seem to be clustered into three, which are resource efficiency, material stocks and flows, and product-centric cluster. Their metrics analysis is proved to be useful in understanding the implication of CE in large industrial scales which promotes product innovation and other measures as they have identified. To this end, it is noted that the roles and behaviours of consumers are largely ignored as a driven factor of CE strategies.

From 565 articles on CE themes, several related concepts revolving around environmental sustainability with waste management are strongly relevant topics (Merli et al., 2018). In their study, CE is also mainly proposed in reducing environmental degradation through cleaner production process of manufacturing, while the discussion was limited around the dynamics of social and institutional aspects. As for the geographical focus, Merli et al. (2018) also notes that many CE studies are conducted in Europe and China. Aside from academics, think tanks such as the Ellen MacArthur Foundation has also been a firm advocate of CE, defining it as "... based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems." (Ellen MacArthur Foundation, 2021). In the EU, European Academies Science Advisory Council (EASAC) launched the indicators for CE in 2016 as a guide for policymakers in the EU parliament.

The white paper from the Ministry of National Planning and Development (BAPPENAS) on CE integrated policy in collaboration with the Embassy of Denmark and UNDP is used to determine the trajectory of Indonesian government's perspective on CE concepts (UNDP, 2021). They propose an official definition that "Circular economy is a closed loop economy system approach in which raw materials, components, and products are maintained as useful and valuable as possible so as to reduce the amount of waste material that is not reused and disposed of to landfills". This definition emphasizes on limited upcycling and downcycling of waste materials. While it can offer more practical approach for policymakers, the prolonged issues that might occur in regards to this definition is a narrow comprehension of regional or local authorities who devise the CE strategies. Data limitation issues might be another critical problem to tackle as it generates inaccuracies for calculating the amount and type of waste produced at the city or household level.

Determining a single definition of CE across industries, geographical focus and levels of analyses has proved to be less relevant to the development of the field. In this light, for practical reasons and to avoid confusion and oversimplification for the readers of this study, a definition proposed by Korhonen et al. (2018) is adopted. CE is

stated as, “Circular economy is an economy constructed from societal production-consumption systems that maximizes the service produced from the linear nature-society-nature material and energy throughput flow. This is done by using cyclical materials flows, renewable energy sources and cascading-type energy flows. ... Circular economy limits the throughput flow to a level that nature tolerates and utilises ecosystem cycles in economic cycles by respecting their natural reproduction rates”. This definition accommodates economic, social, and environmental aspects, which is strongly against the notion of linear production and consumption processes. Thus, CE frameworks can be applied as alteration strategies to challenge the current practices across economic systems and industries particularly through innovative projects and policies.

A comprehensive and substantial research framework of the field of CE is developing. Previous interdisciplinary studies of CE signify a pattern of its dimensions and limitations. Pomponi and Moncaster (2017) formulated six dimensions of the CE framework – economic, environmental, technological, societal, governmental, and behavioural – in bottom-up and top-down approaches. This analytical framework aims to assess and describe the current CE trends whilst evaluating the consequences of the phenomenon. This framework also accommodates the notion that economic, environmental, and social objectives of CE will not be fully achieved due to several limitations. These limits include thermodynamic, system boundary, physical scale of the economy, path-dependency and lock-in, governance and management, and social and cultural definitions (Korhonen et al., 2018). Hence, circularity models that promote reuse, recycling, remanufacturing and other “R” concepts will eventually lead to resource depletion, pollution, and waste generation. It is obligatory for the economic system to be redesigned and rebalanced with limits of planetary resources and energy use to foster sustainable growth. (See Figure 1.)

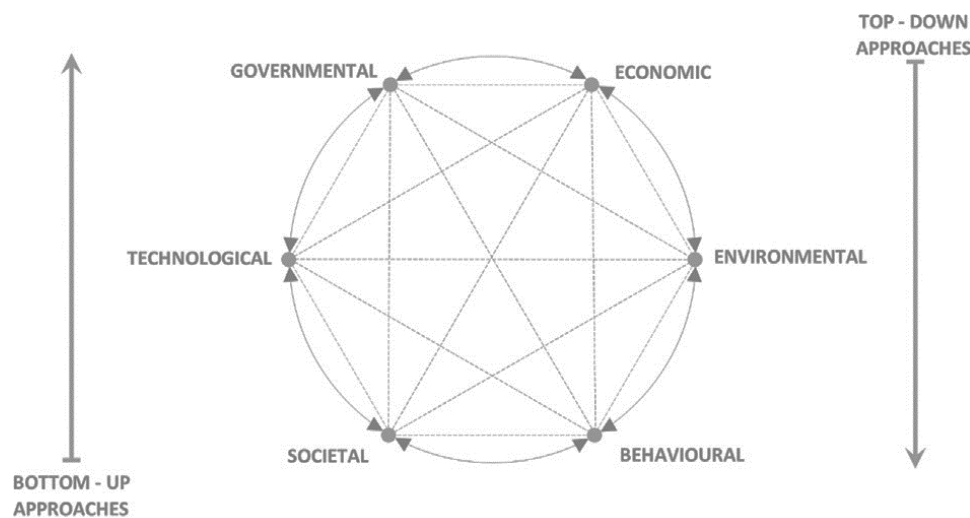


Figure 1. Six Dimensions for Building Research in a Circular Economy
Source: Pomponi & Moncaster, 2017

This paper discusses the dimension of CE and its limitations in terms of governance and management, and social and cultural definitions. These limitations are selected because the UCO circularity models are still in the early phase and there is an absence of national regulations (CNN Indonesia, 2020a) (UNDP, 2021). Moreover, the possibility of closing the loop – retaining the same value as original products – is currently impossible, as UCO cannot be processed into new cooking oil anymore. As a result, a tertiary degree of recycling is performed, which is similar with down cycling, as it does not enable a full cyclical flow of resources (Bocken et al., 2016). The tertiary recycling of UCO emphasizes on the recovery of chemical constituents through the process of transesterification to produce Fatty Acid Methyl Esters (FAME). In comparison to other products of UCO treatment such as soaps and candles, a large amount of UCO is more beneficial and effective if the conversion programs into biofuel and collection systems are in place.

Table 1. Six Limits and Challenges for Circular Economy Concept

No	Limit	Explanation
1	Thermodynamic limits	Cyclical systems consume resources and create wastes and emissions. Recycling for raw-material value only and combustion for energy are less desirable and should be avoided. It is important that cycles are increased, maintained, and utilized before recycling for raw-material value or for combustion for energy. The landfill disposal is the last option. But all of these processes are subject to laws of physics.
2	System boundary limits	Spatial: problems are shifted along the product life cycle, Temporal: short term non-renewables use can build long-term renewable infrastructure. There are many examples of efficiency, environmental and social gains in local and regional economies that have resulted, either directly or indirectly, through supply chains, value chains, product life cycles and their networks, into difficult problems in other locations.
3	Physical scale of the economy	100% complete nature-economy-nature-economy etc. cycles will not be achieved any time soon, perhaps never, the growth of the physical scale of the economic subsystem within the parent ecosystem will remain the key question of sustainability.
4	Path-dependency and lock-in	First technologies retain their market position despite of in-efficiency. the recycling market just like all other markets, has established structures, cultures, and operational routines. CE-type high value product reuse, remanufacturing and refurbishment, and not least the sharing economy, will have to compete with these cultures, routines, and management models.
5	Governance and management	Intra-organizational and intra-sectoral management of inter-organizational and inter-sectoral physical flows of materials and energy. The physical flows of materials and energy extracted from nature travel through many different interdependent parts within the economic production-consumption system before they end up as wastes and emissions in ecosystems. The flows do not respect man-made/defined administrative, geographic, sectoral, or organizational borders and boundaries.
6	Social and cultural definitions	The concept of waste has a strong influence on its handling, management, and utilization. The concept is culturally and socially constructed. The concept of waste is always constructed in a certain cultural, social, and temporal context and this context is dynamic and changing.

Source: Korhonen et al., 2018

Methodology

This study examines a selected CE framework for navigating governance frameworks, analysing private initiatives, and identifying barriers and opportunities for the development of UCO circularity in Indonesia. For analytical purposes, a case study is drawn from the Special Region of Yogyakarta, Indonesia to highlight current practices on UCO policies and practices. The main method used in this paper is desk research, combining accounts from news outlets to gather information on the current state of UCO in Indonesia. The arguments on the implications of CE in UCO governance are discussed and presented from governance contexts, cultural and behavioural barriers, and the likelihood of CE implementations in UCO development in Indonesia.

Results and Discussions

The Dominance of Private Initiatives in UCO Collection Schemes: The Case of Yogyakarta

In Indonesia, there are notable UCO collection centres which are initiated by private sectors. This part of the study will attempt to discover the roles of those initiatives by shaping the circularity of UCO business models. For this purpose, identifying the supporting dimensions of a CE project will reveal the weakest link in that given locality and in doing so propose new approaches. Kharina et al. (2018) found that UCO collection systems are dependent on regional or local authorities, which specifically emphasize the growing number of private UCO collectors. Due to the limited data gathering process - interviews were not conducted for this study - media coverage and previous studies will be the main source of analysis. Hence, behavioural, and societal dimension will not be sufficiently highlighted. However, this does eliminate the underlying assumption of benefits that are usually grounded on the lack of scientific arguments for developing and amplifying the mentioned CE activities. For better understanding of the UCO supply chain, it is illustrated in figure 2. (See Figure 2). In addition, the sources of UCO can be categorised into two main sectors: business/public and households.

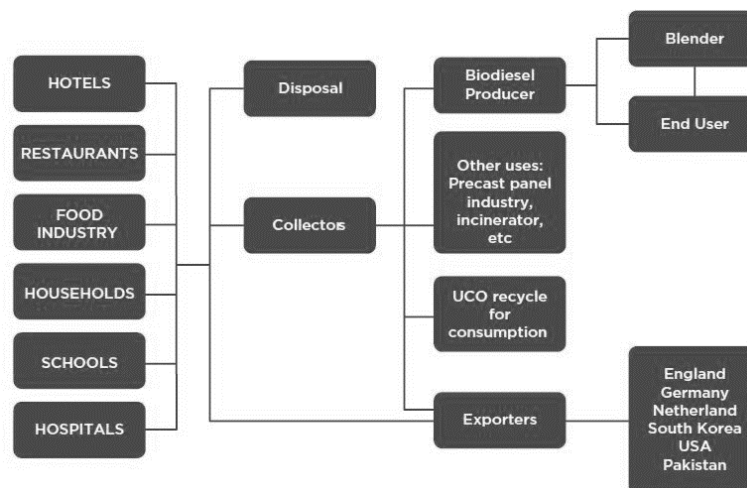


Figure 2. UCO Supply Chain in Indonesia

Source: The International Council on Clean Transportation, 2018

The Special Region of Yogyakarta is a suitable geographical focus for exemplifying the implementation of CE in UCO governance and initiatives due to several reasons. First, Yogyakarta does not have a specific policy instrument for UCO management. To date, the only province in Indonesia with special regulations for UCO collection is Jakarta Province (Governor Regulation No. 167/2016). In the context of governance, the absence of technical regulations on UCO processing in Yogyakarta indicates that the role of the provincial government is weak. This can also be seen from government budget spending, where 80-90% of the budget for waste management is spent on collecting activities (Kurniawan et al., 2021). The provincial government encourages the establishment of informal agencies initiated by communities, namely waste banks (Bank Sampah), to assist waste management systems in the province (Putra et al., 2018). In the city of Yogyakarta alone, the number of waste banks are increasing to more than 400 in 2020 (Republika, 2021). The dependency on such systems is likely to be less effective in terms of data collection and integration of each waste bank. It also important to note that UCO waste management is a part of larger waste governance network.

Another reason for Yogyakarta as an illustrative case is the emergence of servicing activities for UCO collections. In Bantul regency, a village chief in Panggungharjo established a small-scale refinery to treat UCO into biodiesel that feed for Danone Aqua plant, through village owned business entities (BUMDes) in collaboration with Danone Aqua Klaten (Gewati, 2019). This system is built on incentivized schemes, which intend to alter the behaviour of the villagers who used to dump their UCO in rivers. As of 2017, Panggungharjo had delivered 42

thousand litres of biodiesel to Danone Aqua Klaten (BUMDes Panggung Lestari, 2018). However, despite of the income they generate, the assessment of environmental, societal, and technological impacts is still based on assumptions rather than scientific tools and studies. This signifies that the amplification efforts are stalled. Seemingly, the success in attitude shifts for greater UCO collection and waste separation in households correlates to a certain degree to similar incentive systems.

One of the prominent UCO collection initiatives, RAPEL, has been intensifying their business strategies by tapping into larger consumers through mobile application. RAPEL, which stands for “people care” (Raykat Peduli), has championed to endorse CE activities by connecting upstream to downstream stages of their waste management services (Rapel, 2021). Their main activities include educating about households’ waste separation and collection. Their strategies aim to integrate online marketplace models in advancing new format of incentives for households to encourage waste separation and prevention of waste leakage into the environment. Unfortunately, due to the unavailability of statistical data on the amount of waste they collect and income they generate, contribute to the possibility that their performances are built in marketing purposes rather than impactful environmental transformation. Sudibyo et al., (2017) conclude that waste management in Yogyakarta is built in landfill systems in Piyungan, where only two CE activities – recycling and composting – are performed to a limited extent. They also warn that without a significant reduction in waste sourcing, in this case at household levels, the number of landfills are estimated to rise to 30 units by 2030. This number would be a dramatic increase from today’s landfill sites, which are only 3 (Bappeda DIY, 2021). This prediction is important to be taken into consideration as Yogyakarta does not have sufficient area for new landfill sites.

UCO Collection Systems: Social and Cultural Barriers

This part of the study will discuss the factors that hinder the improvement of UCO collection systems. While there is no current study examining this concern in Yogyakarta, let alone in Indonesia, a common belief is that this occurs due to the behavioural aspect of waste management. For instance, in the European Union, UCO is usually dumped into the kitchen sink or toilet drainage at home while UCO disposal is also not encouraged by special regulations (Urban Waste, 2019). To this end, similar situations persist in Indonesia, where only the Jakarta province produced a special regulation for UCO management. Another concern is that insufficient knowledge about recycling activities of UCO might lead to difficulties in integrating and expanding the existing waste collection system. Self-reliance of UCO collection practices are not yet widespread, incentivized schemes should be promoted while examining coherent and sustainable UCO collection systems in the future. Therefore, this study proposes the idea for enhancing UCO collection opportunities.

One concept that is beneficial to contribute to the CE framework for enhancing UCO knowledge is through Zero Waste campaigns. This concept is generally applied in solid wastes, so that the incineration stages and the throwaway systems can be avoided (Pal et al., 2021). Although UCO is not exclusively categorised as solid waste, in practice they are sometimes thrown away together with solid waste, as the majority of households do not separate their waste. For food waste treatment, the proper method to exterminate harmful effects to the environment is by being mindful of our food intake to avoid producing waste. However, this strategy is not always possible in UCO as most people seem to enjoy frying food and the price of cooking oil is relatively cheap. In addition, food waste treatment centres should be built near houses, offices, or food courts to avoid transportation of waste which would create air pollution (Gao et al., 2017). These location-based systems have been implemented in Panggungharjo village in Bantul, Yogyakarta.

More academic insights are needed, as currently there are no thorough and specific studies that focus on UCO management in Yogyakarta. To date, existing studies are divided between waste prevention through religious means and healthy life promotion, waste to energy concepts, as well as empowering waste banks as important collecting actors (Purwanto et al., 2020) (Prihandoko et al., 2020) (Putra et al., 2019).

In addition, UCO seems to not be a favourable academic interest among scholars, as societal and environmental concerns do not yet provoke behavioural changes at households' level. For example, in Sukoharjo Village, Ngaglik District, Sleman Regency, Yogyakarta, waste management preferences are influenced by the level of income and land availability to burn the household waste (Prakoso et al., 2020). Wealthy households pay garbage workers monthly to send their trash to landfill sites. Thus, there are insufficient concerted frameworks for UCO management to locate the role of consumers as the main enabling actors in CE efforts. Consumer roles can effectively be reshaped, as lifestyle change would reduce the usage of cooking oil and the method of UCO disposal. These have the potential to be key research topics in the future.

More UCO Strategies in Indonesia: Dispersed activities

There are several bottom-up approaches in collecting UCO in several cities in Indonesia. In Bali, Lengis Hijau has been working on UCO collection programs and biodiesel conversion which they purchase UCO from restaurants and cafes. From its website, their biodiesel is used for several school buses in Bali (Lengis Hijau, 2021). Similar business models are also appearing in Malang, for example Zerolim, that utilize their agents to pick up UCO from households and hotels and conducting knowledge dissemination on UCO disposal (Zerolim, 2021). Another interesting business model for UCO collection is the attempt to integrate religious values through charity and donation models as proposed by Rumah Kutub in Jakarta (Rumah Kutub, 2021). Among all the UCO collection businesses, the most promising and ambitious one is Arkad that operates in Jakarta and Surabaya. This company targets industrial scale UCO treatment, as the minimal UCO pick-up amount is 20 litres and the company has ISCC (International Sustainability and Carbon Certification) that is approved by the European Commission according to RED (Renewables Energy Directives) (Arkad, 2021). However, there is a tendency that these bottom-up approaches are not supported by top-down policies in terms of financial and technical assistance. This is apparent in the case of the biodiesel industry, which still relies on virgin oil feedstock from palm oil rather than UCO.

Low UCO collection intake is not only attributed to a dominant behavioural aspect of consumers but also government target policies. For instance, Project Recoil (Promotion of Used Cooking Oil Recycling for Sustainable Biodiesel Production) that launched in Europe in 2012 and ended in 2015, strived for a replacement of 1.5% diesel consumption with biodiesel from UCO in the EU in 2020 (European Union, 2021). This project had successfully identified barriers for developing pilot projects in promotion, collection, transformation, and commercialisation of UCO. Another finding is that public awareness could be raised through promotional campaigns of UCO conversion to biodiesel and vehicles that are powered by biodiesel. This means that above all, the significance of campaigning activities and the ability of government and private sectors in conducting collection services, are essential to be guaranteed in terms of the quality and stability of the system (De Feo et al., 2020). Thus, the missing link of UCO collection initiatives from the private sector, as well as between local and provincial governments, signify the need to harmonize the CE concepts and practices for UCO management and business.

One of the supportive policies and enabling environments for increasing the amount of UCO collection is the conversion program of UCO into biofuel. This program can serve as the enabling factor to collect more UCO for biodiesel feedstocks. The current production state of biofuel in Indonesia is generated from Crude Palm Oil (CPO) to produce B30 products. The production of biodiesel was 7,1 Million KL in 2020, which also claimed to save IDR 43,3 trillion from fuel import budget (CNN Indonesia, 2020b). The biofuel industry is markedly subsidized from Indonesian Oil Palm Plantation Fund Management Agency (BPDPKS), in which IDR 29,2 trillion was allocated for biodiesel incentives (Yuniartha, 2020). This policy and financial intervention sacrifice the possibility of conserving water and soil as well as risking public health from UCO disposal. If the policy is revisited by subsidizing biodiesel from UCO collected at urban restaurants only, the government would save IDR

345 billion (Kharina et al., 2018). Thus, if the environmental policy design undermines UCO as a threat and stakeholders are reluctant to take UCO as biofuel feedstocks, UCO will not be able to operate in circular manner of biodiesel supply chain.

In comparison to manufactured products such as electronic equipment or garment, which are able to innovate their products through circular product design strategies, cooking oil from palm oil lacks such privileges. In this case, all UCO collection businesses are based on service activities that extend resource value for energy recovery. This asserts the fact that value proposition of such businesses is propagated by turning waste into something of value, while becoming appealing for consumers who are aware of green initiatives (Bocken et al., 2016). From this, it can be assumed that the production loop is closed when UCO enters a new biofuel production chain. Waste4Change offers completed services from upstream to downstream phases of UCO management for both public and household waste by attracting investors in their start-up like business models (Waste4Change, 2021). From these service activities, the likelihood of UCO entering new biofuel production chains can improve significantly. However, lingering issues for business actors are related to the cost structure for their service activities, as greener practices tend to increase production cost.

Conclusion

This study has sought to provide a conceptual overview of UCO strategies while illustrating several policies and business models for stakeholders. For this purpose, unclear goals of CE initiatives might be the result of the absence of a common ground or oversimplification of CE definition for relevant actors. The CE framework for UCO management in this study calls for an integration of policy and business plans, as well as empowerment of the roles of consumers. Government institutions should determine their drivers – factors that support them – and barriers – factors that inhibit them – of designing CE policies because policies should be the goal of any CE initiative (Ranta et al., 2018). It is certain that regulatory networks today solely encourage recycling activities that is driven by expectation to generate income and foster economic growth. For instance, waste collection services will provide thousands of unskilled workers jobs at sorting facilities or other informal jobs such as garbage workers and scavengers. However, such visions might be counterproductive in the long term. The underlying reason is that the CE framework does not support the notion of endless economic growth. As a result, CE strategies and goals must include not only short-term economic gains but also long terms environmental conservation with emphasize on the acknowledgement of finite resources.

Determining CE metrics for UCO management for coherent assessment and measurement of the effectiveness of CE programs is essential. However, it is important to note that such efforts may not produce any implications at all, as there is no single metric agreed by academics and government institutions. The most common metric used to measure the performance of waste disposal, primary vs. secondary use, resource efficiency/effectivity and recycling efficiency are the aspects of longevity, supply risk and scarcity, and systems stability (Parchomenko et al., 2019). For this reason, government actors must be able to evaluate the limitations of any metrics they employ, while business actors should avoid only pursuing incentivized business models in the long run, particularly for waste collection systems.

The ultimate strategy for business actors is that they should be able to assess their business performances and increase systems transparency, where the public could review and audit their value creation. In addition, consumers retain huge enabling factors for establishing the success of UCO collection systems. Academic discussions on this matter are currently insufficient. In the short term, certain incentivized schemes can enhance consumer participation in the transition process of UCO supply chains. In the future, ad hoc research should extrapolate on results driven by data gathering to avoid oversimplification and estimation of UCO spillage to the environment. Ultimately, rather than formulating ideal business models and polices, empirical settings and evidence-based policy should be promoted at all costs.

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Endnote

¹ Katadata Insight Center conducted a survey on consumers attitude towards waste separation in Jakarta, Bandung, Semarang, Yogyakarta, and Surabaya from 28th September to 3rd October 2019. They managed to get 354 respondents for the research.