Chapter 9

Mitigating the Adverse Impacts of the Circular Economy: Implementation and Role of Governments

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Chapter 9

Mitigating the Adverse Impacts of the Circular Economy: Implementation and Role of Governments

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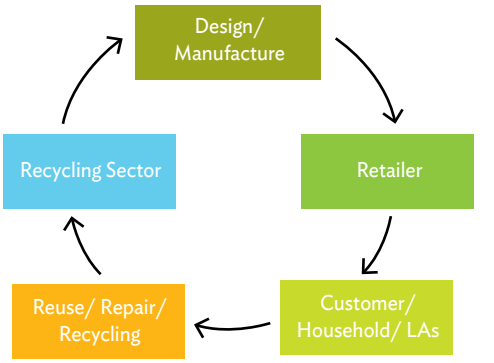
1. Introduction

The idea of a circular economy has its roots in industrial ecology, which explains the industrial economy and its processes as a human ecosystem. It involves the industrial system along the lines of an ecosystem, recognising the efficiency of resource cycling in the natural environment. The concept of a circular approach to the economy is the direction for society to move away from the 'take-make-dispose' process. Recently, many companies have noticed that this linear system increases their exposure to risks – most notably, higher resource prices and supply disruptions.

Many countries, including emerging economies, have had impressive environmental improvements in the past 2 decades. However, the overriding global patterns of production, consumption, and trade remain dangerously unstable (Preston, 2012). To cope with the issue, the United Nations Conference on Sustainable Development (RIO+20) in June 2012 renewed its focus on pursuing important activities to reduce resource and environmental stress.

The circular economy is an alternative to the traditional linear economy (make, use, dispose) where we keep resources in use for as long as possible, extract the maximum value from them while in use, then recover and regenerate products and materials at the end of each service life, as shown in Figure 1. The more complex process of the circular economy in industry is shown in the circular economy butterfly diagram.[1]

Figure 1. Simple Pattern of the Circular Economy



LAs = Local Authorities.

Source: WRAP and the Circular Economy. http://www.wrap.org.uk/content/wrap-and-circular-economy.

The waste and resources sector in the United Kingdom has been actively following the butterfly diagram approach, particularly in the outer circles (recycling, composting, anaerobic digestion, and the like), and some progress is being gained towards improvements in material recycling such as improving recycle quality and moving from down-cycling to closed-loop recycling. However, the more visionary aspects of the circular economy, involving new product life cycle supply chains and new business models that focus on the elimination of waste in the traditional sense, could avoid the waste and resources sector in its current form. Therefore, other circular economy activities such as repair, refurbishment, and remanufacture are not significant in the waste and resources sector now but could become so in the coming years (Chartered Institution of Waste Management, 2014).

[1] The diagram shows the value recovery for biological and technical materials. The drive to move the material composition of consumables from technical towards biological nutrients, and to have those flow through different applications before extracting valuable feedstock and finally reintroducing their nutrients into the biosphere, rounds out the core principles of a restorative circular economy through the economic system. The diagram shows a range of different processes and material flows in a circular economy (Ellen MacArthur and McKinsey & Company, 2014, p.24).

An industrial economy that is restorative by intention aims to rely on renewable energy; minimises, tracks, and hopefully eliminates the use of toxic chemicals; and eradicates waste through careful design. The term goes beyond the mechanics of production and consumption of goods and services in the areas that it seeks to redefine (examples include rebuilding capital, including social and natural, and the shift from consumers to users). The concept of the circular economy is grounded on the study of non-linear systems, particularly living systems (Ellen MacArthur Foundation, and McKinsey & Company, 2014). It includes activities that contribute to zero waste, but with a greater focus on the flow and ownership of materials in the economy and keeping materials in use for as long as possible. The circular economy also requires water and energy to come from renewable resources and that biological materials, such as food waste, are returned to the soil (Natural Scotland, 2013).

This chapter aims to elaborate on the extent that the Association of Southeast Asian Nations (ASEAN) countries, particularly Indonesia, can implement a circular economy. The two major contributions of this chapter are determining the role of governments and their relationships with the private sector in implementing a circular economy, and how to mitigate the risks and social impacts of a circular economy.

2. Progress in Implementing the Circular Economy

The circular economy presents many challenges to the way we think about, design, use, and handle products and the resources that they are made from. For those just beginning the journey, the implementation of basic, well-known waste management practices is a necessity. For those that are well along, openness to experimentation and innovation is key to creating new processes, practices, products, and markets.

It is critical that the local and regional waste management systems designed and built today are adaptable and flexible enough to become the regional circular material management systems of tomorrow, as development along the maturity curve cannot be radically short-circuited. City waste-reduction strategies are also essential (Zero Waste, Net Positive, and the Circular Economy, 2013).

Preston (2012) suggested that countries and companies could take several practical steps in pursuit of a circular economy. Some of these selected steps are as follows:

i. *Best practice and knowledge-sharing*. Companies with commitments to the circular economy or related concepts are already explaining the benefits to the industry and investors. Industry bodies can play a key role in facilitating dialogues between leaders of circular economy and other companies that stand to gain from making the transition.
ii. *Smart regulation*. Innovation and practice related to the circular economy will be led by the private sector when investment is abundant. Governments have a crucial role to play in areas such as support for innovation, setting the conditions for investments, and encouraging business-to-business and business-to-university linkages. The mix of policies will vary according to country and economic conditions, particularly the extent of market liberalisation.
iii. *Standardisation*. Technology standards can play a critical role in accelerating innovation in an industry by removing bottlenecks and encouraging economies of scale.
iv. *Raising public awareness*. A certification or labelling system for circular economy products will help build awareness amongst consumers, encourage rapid uptake by companies, and reward leading companies.
v. *Support for developing countries*. Many developing countries will need help with the transition to a circular economy. Multilateral development banks could target additional support towards circular economy investments.

Preston's ideas for countries and companies to implement a circular economy could be followed by Indonesia and other ASEAN countries, subject to credible regulations and government interventions to promote a circular economy.

2.1. The Circular Economy Model in ASEAN and China

Accenture (2015) identified the following five business models that could be implemented in ASEAN: circular supplies, resource recovery, product life extension, sharing platform, and product as a service.

Circular Supplies. The first model that Accenture proposed is the circular supplies business model. This model is based on supplying fully renewable, recyclable, or biodegradable resource inputs that strengthen circular production and consumption systems. Companies attempt to replace linear resource approaches by cutting waste and removing inefficiencies. For example, tyre manufacturer Omni United in Singapore has tied up with US footwear company Timberland to make a special line of tyres that can be easily recycled at end of life into crumb rubber. The rubber is then used by Timberland for making shoe outsoles.

Resource Recovery: Recover useful resources/energy out of disposed products or by-products. This model enables a company to eliminate material leakage and maximise economic value of product return flows. Singapore's waste management company Tes-Amm connects seamlessly with its clients' manufacturing processes to help dispose electronics scrap. Another example is PT Enviro Pallets located in Bali, Indonesia, that processes plastic waste to create shipping pallets. Offering up to Rp500 (US$0.05) per kilogram of plastic waste effectively incentivises locals to help clean up rivers, beaches, and grounds from mounds of plastic rubbish, and use these containers for feedstock. With this clever business model, the company aims to process 30% of plastic waste generated on the island.

Product Life Extension: Extend the working life cycle of products and components by repairing, upgrading, and reselling. In Singapore, the Sustainable Manufacturing Centre (established in 2009) and the Advanced Remanufacturing and Technology Centre (launched in 2012) have been working with companies to improve the longevity of products through topics such as green manufacturing, remanufacturing, repair and restoration, and product verification.

Sharing Platforms: Enable increased utilisation rate of products by making possible shared use/access/ownership. The sharing platforms business model promotes a platform for collaboration amongst product users, either individuals or organisations. These facilitate the sharing of overcapacity or underutilisation and increases productivity. Car sharing is one of the earliest sharing platform models. Tripid, a ride-sharing service based in the Philippines, connects drivers and passengers headed the same way. This platform helps create a community of drivers and passengers who opt to share rides with others, while also allowing users to act as drivers for others looking for a ride.

Product as a Service: The product as a service business model offers an alternative to the traditional model of buy and own. Products are used by one or many customers through a lease or pay-for-use arrangement. Sunlabob, a solar enterprise based out of Lao People's Democratic Republic (Lao PDR), has created a service-based approach to sustainable lighting in rural areas. Meanwhile ASEAN countries may select one or more business models created by Accenture (2015). Indonesia may focus on how to manage e-waste and get potential benefits from electronic waste.

China is the third country engaged in serious efforts to implement a circular economy on a large scale. The Chinese government likes to retain competitiveness and intends to initially introduce the circular economy framework on a smaller scale through several pilot studies so that it has a better basis for assessing its large scale and full coverage in the longer run. This policy is like economic liberalisation, which started with coastal free economic zones (Heshmati, 2015).

The limited existing evidence on the implementation of the circular economy in practice in China suggests that consensus has been reached on the concept of the circular economy, which in many ways resonates with the concept of industrial ecology. This concept emphasises the benefits of reusing and recycling residual waste materials. It includes energy, water, different byproducts, as well as knowledge (Jacobsen, 2006; Park, Sarkis, and Wu, 2010).

Dalian city in China is an important pilot study where the circular economy strategy was implemented during 2006–2010 (Table 1). The characteristics of the city's industrial and business area and the local government's initiatives led to the aspiration of transforming it into a leading environment-friendly city. The strategy had several objectives, including further improving resource-use efficiency and improving the level of material reuse and recycling, and recovering solid waste and waste water.

Table 1. Key Circular Economy Indicators in Dalian (2005–2010) and Goals Set in 2006

Dimension	Indicators	Actual 2005	Actual 2010	Goal by 2010	% Change in Goals	% Change in Actual
Resource efficiency	Energy consumption per GDP (standard coal, tonnes/104)	1.0	0.8	0.8	-21	-21
	Energy consumption per unit of industrial value added (standard coal, tonnes/104 RMB)	1.6	1.2	1.2	-27	-27
	Water consumption [per unit of industrial value added (tonnes/104 RMB)	37.5	18.0	26.2	-15	-52
	Water consumption per capita (m^3 per year)	186.9	62.1	-	-	-67
Waste discharge	Municipal waste generation per capita (kg/year)	163.7	136.4	-	-	-17
Waste treatment	Rate of municipal waste water treatment	73	90	90	17	17
	Rate of safe disposal of municipal solid waste, %	80	100	98	18	20
Waste reclamation	Rate of treated waste water recycling, %	10	42	35	25	32
	Rate of industrial solid waste reclamation %	62	96	75	13	34

GDP = gross domestic product, kg = kilogram, m^3 = cubic metre, RMB = renminbi.

Note: Municipal waste include waste from both industrial and residential sources.

Source: Dalian Municipality, 2006, Liaoning Statistical Yearbook, 2006, 2011.

The iron and steel industry is an energy-intensive and highly polluting industry in China. Ma et al. (2014) investigated the mode of the circular economy in this industry in China. A case study of private enterprises in Wu'an city shows significant improvements but there is much room for additional environmental quality improvements. Another energy-intensive and polluting industry is the papermaking industry. Li and Ma (2015) investigated how Guangdong Silver Island Lake Papermaking Park realises cleaner production and sustainable development by the circular economy through inter-industry resource integration.

ASEAN countries, including Indonesia can implement a circular economy based on the 3R principles of material use, i.e. reduce, reuse, and recycle. These principles are introduced in both production and consumption areas. Both areas are important as the flow of materials and energy penetrates them.

3. Risks and Adverse Impacts of the Circular Economy

The industrial model, which is also described as a 'take-make-waste' approach, is one main driver of the challenge of sustainability. As circular economy is a concept that claims to be more in line with the cyclical nature of earth and acknowledges the interconnectedness of economy and environment, it can potentially address the sustainability challenge by reducing resource extraction and waste streams.

To mitigate the adverse impacts of the circular economy, we can focus on its benefit to the economy. These benefits are not purely operational but also strategic; not just for industry but also for customers; and serve as sources of both efficiency and innovation.

The circular economy is about creating new value chains that decouple growth from the use of scarce and linear resource inputs. For instance, a company could promote using 'lasting' resources to break the link between scarcity and economic activity by using only inputs that can be continuously reused, reprocessed, or renewed for productive use (e.g. renewable energy, biomaterials, or fully recycled/recyclable resources).

Economies will benefit from the existence of the circular economy through significant net material savings, mitigation of volatility and supply risks, driving innovation and job creation, regeneration and improved land productivity, and paving the way to a strong economy (Ellen MacArthur Foundation, and McKinsey & Company, 2014).

Significant net materials savings. Based on detailed product-level modelling, the circular economy represents a net materials cost savings opportunity of US$340 billion–US$380 billion per annum at a European Union (EU) level of 'transition scenario', and US$520 billion–US$630 billion per annum for an 'advanced scenario'.

Mitigation of price volatility and supply risks. The net materials savings would shift the cost curve for various raw materials downward. For steel, the global net materials savings could add up to more than 100 million tonnes of iron in 2025.

Innovation and job creation. Adopting more circular business models would bring significant benefits, including improved innovation, across the economy. The circular economy might bring greater local employment, especially in entry-level and semi-skilled jobs.

Regeneration at work for land productivity and soil health. The circular economy will reduce the need for replenishment of soil with additional nutrients by moving more biological materials through anaerobic digestion or composting process, and then back into the soil.

Paving the way to strong economy. The circular approach offers developed economies a way to strong growth, reducing dependency on resource markets and reducing exposure to resource price shocks. Importantly, any increase in materials productivity is likely to have a positive impact on economic development beyond the effects of circularity on specific sectors.

Subsidies. Subsidies that encourage excessive use of resources need to be removed and all externalities should be incorporated into the price of resources and energy.

Significant upfront investment cost. At the macro level, a successful circular economy would raise growth and reduce vulnerability to resource-price shocks. But in the short term, there will inevitably be significant upfront investment costs and risks. Therefore, clear, strong, and predicable policy frameworks will be crucial to encourage investments.

Betchel, Boiko, and Volkel (2013) found that the main barriers or risks in the circular economy are on technological, legal, economic, and behavioural levels, i.e. the difficulty to change mindsets. Technological barriers refer to processes and technologies needed to establish closed loops and create technical and biological materials cycles. Legal barriers refer to the management of products, materials, and waste. Economic barriers refer to the complexities between regulations and business operations (e.g. regulations connected to packaging), international discrepancies, and outdated status of regulations. Finally, a successful transformation to a circular model involves a new way of thinking, acting, plus

communicating with others in the chain. However, an internal reluctance to move away from business as usual and to challenge current paradigms in a corporation is another risk.

Complexities in the international supply chain may hinder the implementation of the circular economy. In a circular economy, the supply chain must be recognised so that information and materials flow in both directions to facilitate reuse and remanufacturing. The other risk is the lack of consumer enthusiasm. For example, consumers need to understand and value what is the concept of a cradle-to-cradle product.

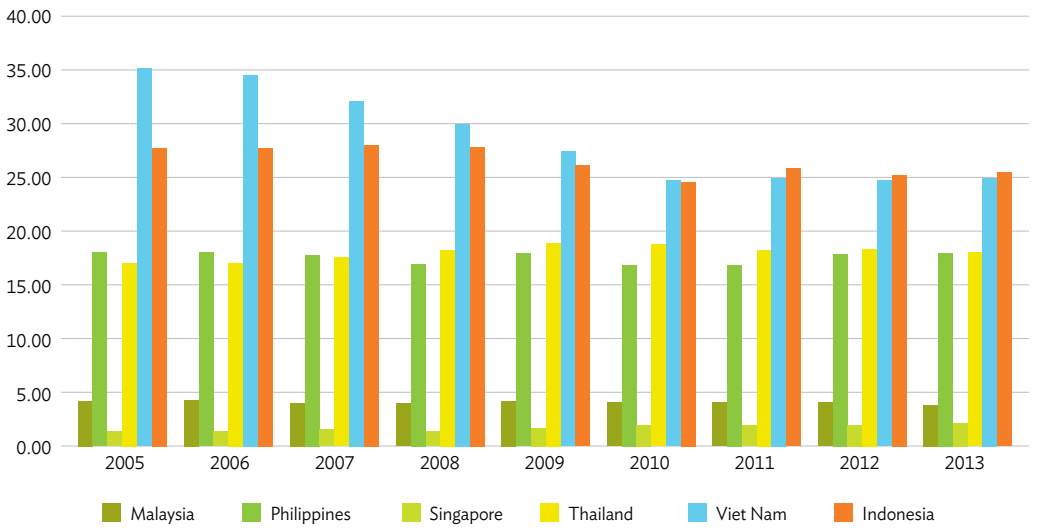
Rock et al. (2016) explored the impacts on business of moves towards a circular economy. The possible negative impacts of a move to a circular economy include reduced demand for virgin raw materials, changes to demand for employment in raw material production sectors and new product manufacturing, and stranded assets.

4. Role of Government and Waste Management

The considerable increase in Indonesia's population has increased the volume of waste. Furthermore, the consumption pattern in the community has significantly contributed to the production of various waste such as waste with hazardous packaging and/or waste that do not easily decompose by natural process. So far, the people still consider waste as unusable remnants, not as beneficial resources. In waste management, the community still depends on end-of-pipe approach, i.e. waste is collected, transported to, and disposed at the final waste processing. The end-of-pipe approach to waste management should be changed by a new paradigm of waste management. The new paradigm considers waste to have an economic value and could be utilised as energy, compost, fertiliser, or industrial raw material. Waste management is carried out comprehensively: from the upstream, before a product potentially becomes waste, to the downstream or the stage where products are used to produce waste and would return to the environment safely.

Amongst selected ASEAN countries, Viet Nam contributed the highest combustible renewables and waste from 2005 to 2009. However, since 2010, Viet Nam and Indonesia have almost similar amounts of combustible waste. Combustible renewables and waste comprise solid biomass, liquid biomass, biogas, industrial waste, and municipal waste.

Figure 2. Combustible Renewables and Waste
(% of total energy)



Source: Author's compilation; World Development Indicators (WDI), World Bank, 2015. Measured as a percentage of total energy use – IEA Statistics © OECD/IEA 2014 http://www.iea.org/stats/index.asp subject to https://www.iea.org/t&c/termsandconditions/

The new paradigm of waste management is implemented with waste reduction and waste handling. Waste reduction includes limitation activities, reusability, and recycling, while waste handling includes segregation, collection, transportation, processing, and final processing. Rapid economic growth in Asia and the increasing transboundary movement of secondary resources will increasingly require both 3R activities in each country and appropriate control of international material cycles.

Developing countries are seeing rapid growth in the generation of waste, including electrical and electronic equipment or electronic waste (e-waste), agricultural biomass waste, and plastic waste. Effective and efficient management of waste, including the application of 3R, is an essential element for promoting sustainable patterns of consumption and production.

Integrated solid waste management and recovery of useful materials or energy from waste streams is an effective approach to enhance resource efficiency while reducing the adverse environmental impacts caused by waste disposal.

The potential revenue from recycling of sorted recyclable waste based on primary data on the quantity of recyclable waste from households and the selling prices of recyclable materials obtained from field surveys in Jakarta are shown in Table 2.

Table 2. Potential Revenue from Recycling, Jakarta (2013)

Waste Category	Subcategory	Average Selling Price (US$ per kg)	Average Quantity Sold per household (kg per month)	Revenue Potential (US$ per annum-million
Paper and Cardboard	Newspaper	0.17	3.57	14.68
	Magazine	0.21	1.75	8.87
	Carton boxes	0.25	4.43	27.13
Plastic	Refuse plastic sacks	0.33	1	8.12
	Plastic bottles	0.27	1.75	11.62
Metal		0.45	1.04	11.53
Glass		0.23	1.36	7.67
Textiles	Used clothes and fabrics	1.04	1	25.32
TOTAL		**2.95**	**15.9**	**114.94**

kg = kilogram.

Source: Household Solid Waste Management in Jakarta, Indonesia: A Socio-Economic Evaluation.

The Medium-Term Development Plan (RPJMN) Indonesia 2015–2019 clearly states that solid waste and poisonous toxic and hazardous waste substances could be reduced by about 755.6 million tonnes in 5 years. It also states that solid waste could be reduced by about 85 million tonnes in 5 years through the extended producer responsibility programme. The Government provided US$31.2 million to the reduction of waste programme in 2016 (Table 3).

Table 3. Programmes/Activities Related to Waste in 2016 and 5-year Planning (2015–2019)

No.	Programmes/Activities	Target 2016	Allocation 2016	Executing Agency
1.	Garbage, and poisonous toxic and hazardous waste substances		US$31.2 million (Rp405.7 billion)	Ministry of Environment
	Total garbage (solid waste) is 124.6 million tonnes from 380 cities			
	Total hazardous and poisonous toxic waste substance is around 755.6 million tonnes in five years	52,98 million tonnes		
	Reduction of solid waste (garbage) by 85 million tonnes during five years through extended producer responsibility .	300 million tonnes		
	Reduction of solid waste (garbage) by 124.1 tonnes during 5 years through recycling centres (capacity 20 tonnes per day)	30 million tonnes		

Source: Medium-Term Development Plan (RPJMN) Indonesia, 2015–2019; Government Action Plan (RKP) 2016.

Regarding waste management, the Government of Indonesia issued Act No. 18 of 2008. The management of waste is conducted based on the principle of responsibility, sustainability, profitability, justice, awareness, togetherness, safety, security, and economic value.

The objective of the management of waste is to increase public health and environmental quality as well as to utilise waste as an energy source. The Act also explains the separation in the management of waste between the central government and the local government.

The tasks of the central government and the local government are as follows:

i. developing and increasing the public awareness on waste management;
ii. conducting research, developing technology for reducing and handling of waste;
iii. facilitating, developing, and conducting efforts to reduce, handle, and utilise waste;
iv. carrying out waste management and facilitation in providing the facility and infrastructure for waste management;
v. encouraging and facilitating the enhancement of the benefit of waste management outcomes;
vi. facilitating the application of specific local technologies in the local community in reducing and handling of waste; and
vii. conducting coordination amongst government institutions, society, and industry towards an integrated waste management.

In carrying out waste management, every level of government has authority to manage waste. The central government has the authority to:

i. stipulate national policy and strategy of waste management;
ii. stipulate norms, standards, procedures, and criteria for waste management;
iii. facilitate and conduct cooperation amongst local governments, partnerships, and networks for waste management;
iv. conduct coordination, development, and monitoring of local government performance in waste management; and
v. stipulate policy for dispute settlement in waste management amongst regions.

The provincial government has the authority to:

i. stipulate policy and strategy for waste management in line with the government policy;
ii. facilitate cooperation between regions within one province, partnership, and network for waste management;
iii. conduct coordination, development, and monitoring of district and municipality performance in waste management; and
iv. facilitate for dispute settlement in waste management amongst districts/municipalities within one province.

Finally, the district/municipality governments have the authority to:

a. stipulate policy and strategy for waste management based on national and provincial policies;
b. carry out waste management at district/municipality levels in line with the norm, standard, procedure, and criteria stipulated by the government;
c. carry out development and monitoring of other agencies' performance in waste management;
d. determine the location of the temporary collection site, integrated waste treatment site, and/or final waste processing site;
e. carry out monitoring and evaluation every 6 months within 20 years on open dumping systems' final waste processing sites that have been closed; and
f. issue and carry out a waste management emergency response system in line with their authority.

The Act also states that every producer should label or put a symbol on the packaging and/or the product regarding waste disposal and handling. The producers are obliged to manage the packaging of their products and indicate those that are difficult or cannot be decomposed.

In terms of administrative sanctions, the head of the district/mayor could impose administrative sanctions on waste operators who violate the regulations stipulated in their licence. The administrative sanction could be an imposition of fee/fine and/or permit withdrawal.

Financing and Compensation for Waste

Financing and compensation for waste in Indonesia is clear. The central and local governments are obliged to finance the implementation of waste management. The budget should be provided under the national budget and the local government budget. For example, the Ministry of Environment allocated US$31.2 million in 2016 for managing garbage and poisonous toxic and hazardous waste substances (Government Action Plan, 2016). In 2016, the Badan Pengusahaan Kawasan Perdagangan Bebas dan Pelabuhan Bebas Batam (BPKPBPB) or the Batam Free Trade Zone and Free Port Authority provided US$0.1 million (Rp0.98 billion) budget for supporting the waste activities of local governments, particularly the city government of Batam which supports the Batam Free Trade Zone Authority.

Furthermore, the central and local governments, including the provincial and district/municipality levels, could provide compensation to a person who suffers from the negative impact of waste handling activities. Compensation includes relocation, environmental rehabilitation, and health and medication costs (Waste Management Act, 2008).
To implement Act No. 18 of 2008, the government issued Government Regulation (PP) No. 101 of 2014 [2] on the management of toxic and hazardous waste substances. This regulation regulates the management and disposal procedures for toxic and hazardous waste substances. In general, it covers:

i. methods of identifying, reducing, storing, collecting, transporting, utilising, processing, and hoarding hazardous waste;
ii. procedures for dumping hazardous waste into the open sea or land;
iii. risk mitigation and emergency responses to address environmental pollution caused by hazardous waste; and
iv. sanctions for non-compliance.

This regulation is of relevance to producers, importers, exporters, and managers of hazardous waste.[2]

In terms of specific waste like e-waste, Indonesia is still developing the specific e-waste regulation that covers e-waste from household and industry sources. The coverage of recycling of e-waste is still limited. The locations and number of industries that recycle e-waste are also limited (Table 4).

Table 4. Recycling of E-waste (2013)

Location	No. of Industries	Kind of Collection
Batam Island	1	Rejected small parts of electronic components, plastic-waste, used printed circuit boards, computer monitors, electronics, and electronic parts (only dismantled items and those that can be used as raw materials in smelter industries)
Central Java	2	Dry cell batteries collection and smelters
West java	3	All e-waste materials (only collection; the waste is exported or goes to smelter industries and other smelter industries in Jakarta)
Tangerang	1	All e-waste (only collection)
Central Java	1	Used monitors (stop processing of cathode ray tube for reuse since 2011)

Source: Ministry of Environment, Indonesia, 2013, 3rd Global E-Waste Management, San Francisco.

[2] The 2014 Regulation repeals and replaces the 1999 Regulation and has been in force since 17 October 2014.

Compared to other selected countries in Asia and ASEAN, Table 5 indicates regulation from countries to manage e-waste.

Table 5. Recycling of E-waste (2013)

Country	Items	Regulation	Brief Explanation
China	TV sets, refrigerators washing machines, air conditioners, personal computers	Management for e-waste Management of recycling of home appliances and electronics	Distributors (retailers) have responsibility for collection and then transiting to recyclers.
Japan	TV sets, refrigerators, washing machines, air conditioners	Home Appliances Recycling Law (enacted 1998 and enforced 2001)	Retailers are obliged to accept appliances discarded by consumers. Manufacturers are obliged to take these from retailers and to implement measures for reusing and recycling. Retailers and manufacturers can charge consumers for collecting, transporting, and recycling their discarded appliances.
	Personal computers (both for business and household use)	Law for the Promotion of Effective Utilization of Resources (2001 for business PCs, 2003 for household PCs)	Manufacturers are obliged to accept discarded PCs for recycling. Recycling fees are added to the sales prices.
Rep. of Korea	TV sets, refrigerators, washing machines, air conditioners, personal computers (2003), vehicles equipment, mobile phones (2005)	Extended Producer Responsibility in Recycling Law (2003)	Government allocates mandatory quantity for recycling every year. Manufacturers must pay the standard expenses to recycling bodies per item.
Taiwan	Waste home appliances (TV sets, refrigerators, washing machines, air conditioners), and waste IT products (PCs, monitors, printers, notebooks) as due recycled waste	Waste Disposal Act (amended 1998)	Producers should take financial responsibility only (not physical responsibility). Producers submit recycling-clearance disposal fee to the recycling management bodies.
Philippines	Consumer electronics (radios, stereos, TV sets, and many others) and white goods (stoves, refrigerators, dishwashers, washing machines, dryers, and the like)	Solid Waste Management Act of 2000 (RA 9003)	Consumer electronics and white goods are classified as special waste requiring separate handling from other residential and commercial waste.

IT = information technology, PC = personal computer, RA = Republic Act, TV = television.

Source: Mater, 2006.

The public–private partnership (PPP) scheme is an alternative to finance waste management in ASEAN countries, including Indonesia. Municipal waste management and recycling contracts may follow procurement methods under a PPP scheme (Zen and Regan, 2015).

The government of Indonesia and the ASEAN countries should support the major technologies necessary for a circular economy, including waste management, through accurately identified key technological areas and projects in line with current medium- and long-term requirements, and some initiatives to improve the public awareness and participation activities related to the concept of a circular economy such as television promotions, newsletters, exhibitions, and workshops, which should be carried out periodically.

4.1. Public–Private Partnerships[3] in Waste Management

The recent regulation regarding the PPP scheme in Indonesia is Presidential Regulation No. 38 of 2015 regarding cooperation between government and business entities in infrastructure provision. The infrastructure relates to economic and social infrastructures. Some types of economic and social infrastructures include transportation, roads, water resources and irrigation, drinking water, centralised waste water management systems, local waste water management systems, and other economic infrastructures including waste management infrastructure systems.

The PT Sarana Multi Infrastruktur (Persero) (PT SMI) is an infrastructure financing company that was established on 26 February 2009. PT SMI plays an active role in facilitating infrastructure financing as well as in preparing projects and providing advice for infrastructure projects in Indonesia. PT SMI performs these functions through partnerships with private and/or multilateral financial institutions in PPP projects. PT SMI can serve as a catalyst in accelerating infrastructure development in Indonesia. Sectors that can be financed by PT SMI include toll roads and bridges, transportation, oil and gas, telecommunications, and other social and economic infrastructure including waste management.

One of the projects under PT SMI is the waste management project in Batam in 2014. The project aimed to overcome waste management in Batam City. The project included how to collect, carry, and end waste dump.

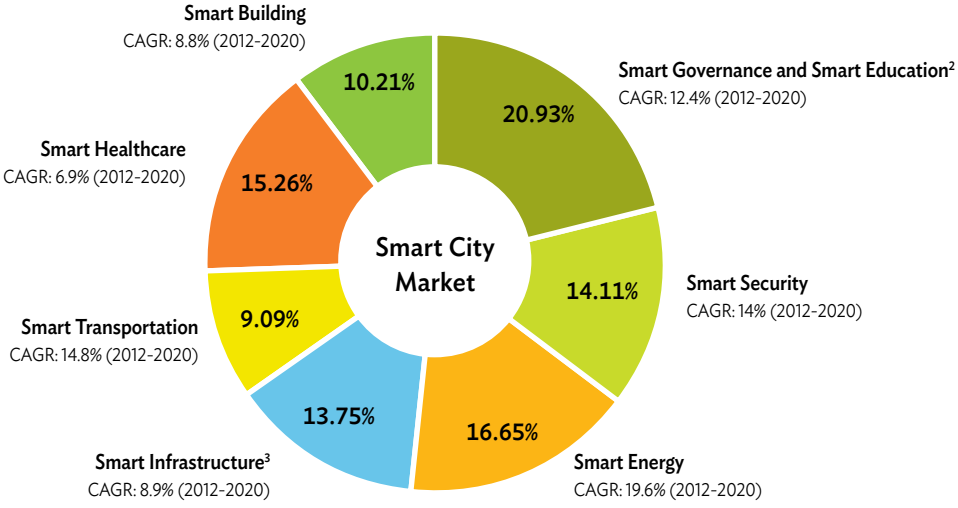
[3] Public–private partnership is the cooperation between the government and a business entity in infrastructure provision for the public interest in accordance with the specification previously determined by the minister/head of institution/head of region/state-owned enterprise/regional-owned enterprise, which partially or fully uses the business entity's resources, with particular concern for the allocation of risk between the parties.
Source: Presidential Regulation No. 38 of 2015.

4.2. Smart City

The application of the circular economy concept at a city scale is fundamental to creating a smart city (Circulate, 2015). A holistic understanding of the circular economy tries to balance material and energy exchanges between nature and society, and within society itself, then working towards eco-effectiveness and long-term resilience.

Urban conglomerations compete to attain 'global city' or 'world city' status by attracting big corporations to establish headquarters in their city. The global smart city concept reached Indonesia and it launched the Smart City Index in March 2015. It was initiated to answer challenges around how to wisely manage a city and increase residents' welfare and quality of life. The index emphasised that rural–urban migration was an inevitable trend and would make cities ever denser. The World Bank pointed out that 2025 will see the peak of Indonesia's urbanisation, with 57% of the population living in cities. Currently, the population living in cities is 52%.

Figure 3. Smart City by Segment,[1] Global 2020



CAGR = compound annual growth rate.

Notes: The graph represents the market share of each segment in the smart city market.

1 These numbers represent the entire smart solutions eco-system in each segment for both urban and non-urban panoramas.

2 Smart Education includes eLearning services for schools, universities, enterprises, and government entities.

3 Other Smart Infrastructures such as sensor networks for digital management of water utilities are not included in other segments.

Sources: Indonesia International Smart City 2016 Expo and Forum -IISMEX, 2016.

A smart city may create enormous business opportunities with a market value of US$1.5 trillion in 2020. Smart governance and smart education, smart energy, and smart security may contribute 20.9%, 16%, and 14.1%, respectively, to total global market.

Indonesia introduced the Smart City Index in 2015 by applying the main criteria: economic conditions (smart economy), social interaction between the public and administration supported by information technology (smart society), and environment (smart environment).

Indonesia's Smart City Index has been implemented and smart cities are being developed in 98 cities, which have attracted big industry players to invest and contribute to the country. Smart City Index 2015 has eights indicators: smart information and communications technology, smart development planning, smart green open space, smart transportation, smart waste management, smart water management, smart building, and smart energy.

Fifteen cities were selected amongst 93 cities to receive the Smart City Award 2015. The five winning cities with more than 1 million residents are Depok, Bandung, Semarang, Surabaya, and Tangerang.[4] Bandung was one of the finalists in the World Smart City Awards 2015.[5]

Bandung Smart City. Bandung's population is estimated to reach 4.1 million by 2030. With rapid urbanisation, the city is starting to face several challenges such as traffic congestion, rising crime rates, waste management, air pollution, and housing shortages.

The local government may increase the budget for its smart city programme, from Rp25 billion (US$1.8 million) in 2015 to Rp100 billion (US$7.3 million) in 2016. The budget may be used to build up the city's digital infrastructure.[6]

Bandung Command Centre [7]

In 2015, the government launched and built the Bandung Command Center at a cost of Rp27 billion (US$2 million). The centre is a state-of-the-art facility that monitors and manages city operations. It consists of 26 monitors, a control room, an operator room, and a meeting room.

4 For populations between 200,000 and 1 million, the winners were Balikpapan, Pontianak, Yogyakarta, and Surakarta. For the fewer than 200,000 residents category, the winners were Madiun, Malang, Mojokerto, Bontang, and Salatiga.

5 Bandung competed with Buenos Aires, Argentina; Curitiba, Brazil; Dubai, United Arab Emirates; Moscow, Russia; and Peterborough, United Kingdom.

6 Over the years, the city government has installed about 5,000 free wi-fi hotspots across the city and has set a target to install up to 40,000 hotspots to provide more citizens with access to free connectivity.

7 http://www.enterpriseinnovation.net/article/bandungs-smart-city-initiatives-246675038 (accessed 21 May 2016).

E-Government Initiatives

The Bandung administration is currently working to launch various e-government initiatives to provide public services more effectively.[8]

Bandung Technopolis

To attract foreign investment and develop Bandung into a centre of entrepreneurship, the city government has started the construction of Bandung Technopolis, a satellite city which may serve as the centre of Indonesia's technology industry. It is located in Gedebage, South Bandung, and has a planned investment of US$800 million.

Jakarta Smart City

The Jakarta administration launched the Jakarta Smart City programme in 2014 to establish a technology-based service for the residents (Jakarta Post, 2016). The city introduced the Jakarta Smart City website (http://smartcity.jakarta.go.id) and smartphone applications (Qlue)[9] for residents and the Cepat Respon Opini Publik Jakarta for civil servants and officials.

The Jakarta Smart City Lounge at the city hall provides facilities to support the implementation of Jakarta Smart City.

The Jakarta provincial government already allocated Rp30 billion for the smart city project in 2015. About 60% of the budget may be allocated for infrastructure and 40% for operation costs and human resources.

[8] There are plans to build 1,000 government applications by 2017 to ease the strain on bureaucracy and provide digital government services to citizens. The city now has 320 applications and the remaining 680 applications will be built by a new team of programmers hired by the government.

[9] Qlue is a crowd-sourcing smartphone application that enables users to report various incidents such as flood, crime, fire, or waste, and city officials will respond through the Cepat Respon Opini Publik Jakarta smartphone application. Civil servants and officials nearest to the reported incident will be detected through their smartphones and must respond to the report.

5. Conclusion and Recommendations

This chapter examines the extent to which ASEAN countries, particularly Indonesia, are implementing the circular economy. How much progress have countries, including Indonesia, made in implementing the concept of the circular economy. What is the role of government in mitigating the risks and social impacts of the circular economy?
For those just beginning the journey, the implementation of basic, well-known waste management practices is a necessity to implement a circular economy through the R3 waste activities – reduce, reuse, and recycle.

Some countries in Asia have policies to mitigate e-waste. Indonesia is still developing specific regulations to manage e-waste. Law No. 18 of 2008 and Government Regulation No. 101 of 2014 are policies issued by the Government of Indonesia to manage waste. However, both regulations do not manage how to control specific waste, i.e. e-waste.

The implementation of a smart city may be an initial step to implement Industry 4.0. One of Indonesia's smart cities, Bandung, was one of six finalists for the Global Smart City Award 2015.

Economies will benefit from the circular economy through significant net material savings, mitigation of volatility and supply risks, drivers for innovation and job creation, regeneration and improved land productivity, and path to a strong economy.

Some of the recommendations that may be taken to support the circular economy are as follows:

i. strengthen waste management policies and regulations to implement the circular economy;
ii. improve the 3Rs – reduce, reuse, and recycle – through the involvement of the private sector, local and central governments in ASEAN countries;
iii. establish clear regulations and law enforcement regulations to manage e-waste at national, regional, and municipal levels, as well as incentive systems to encourage electronic producers with extended producer responsibility;
iv. establish smart cities and other activities that involve full cyber technology for a better life as an initial step to support the circular economy and Industry 4.0 in selected ASEAN countries;
v. continue to support the major technologies necessary for the circular economy; and
vi. undertake initiatives to improve public awareness and participation in activities related to the concept of the circular economy in ASEAN countries.

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