United Nations
Centre for Regional Development

Country Chapter

State of the 3Rs in Asia and the Pacific

The Kingdom of Thailand

November 2017

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Co-ordinated by:
The Secretariat of the Regional 3R Forum in Asia and the Pacific,
United Nations Centre for Regional Development (UNCRD),
Institute for Global Environmental Strategies (IGES)
Financially Supported by:
Ministry of the Environment, Government of Japan

Disclaimer

This country chapter for Thailand was prepared as an input for the 8th 3R Forum in Asia and the Pacific. The purpose of the report is to assess the status of 3R implementation in Asia and the Pacific and to share knowledge on 3R activities in the region.

ACKNOWLEDGEMENT

This publication is intended to provide expert-based assessment of regional progress of 3R policy implementation in selected countries and regions in Asia and the Pacific, particularly in response to the Hanoi 3R Goals (2013-2023) adopted at the 4th Regional 3R Forum in Asia and the Pacific in Hanoi in March 2013.

The State of the 3Rs in Asia and the Pacific project is a collaborative initiative involving Institute for Global Environmental strategies (IGES) and United Nations Centre for Regional Development (UNCRD), supported by the Ministry of Environment. We acknowledge expert contributions from the Institute for Global Environmental Strategies (IGES), Institute of Developing Economies – Japan External Trade Organization (IDE-JETRO), Kyoto University, Tottori University, University of Tokyo, National Institute for Environmental Studies (NIES) of Japan, Japan Waste Management & 3Rs Research Foundation, ISPONRE of Viet Nam, Green Amity Co., Ltd., Chulalongkorn University, Tsinghua University, University of the Philippines Los Baños (UPLB), North South University, BRAC University, SPREP, Anna University, Royal University of Phnom Penh, CSIR Indian Institute of Petroleum, National Environment Agency of Singapore, University of Malaya (UM), Asia Institute of Technology (AIT) and Institut Teknologi Bandung.

Special acknowledgement for the authors of this Country Chapter, Ms. Tharee Kamuang and Associate Professor Dr. Orawan Siriratpiriya. We also express gratitude for drafting works made by the Institute for Global Environmental strategies (IGES). This project is financially supported by the Ministry of the Environment of Japan (MOEJ) with intention to support the policy consultations at the Regional 3R Forum in Asia and the Pacific.

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ABBREVIATION

AFOLU	Agriculture, forestry, and land use
B.E.	Buddhist year, formerly used for the policies and acts, known as “an Act on Economic Instruments for Environmental Management B.E. ...”
BMA	Bangkok Metropolitan Administration
CDM	Clean Development Mechanism
CSR	Corporate social responsibility
DEDE	Department of Alternative Energy Development and Efficiency
DEQP	Department of Environmental Quality Promotion
EPR	Extended Producer Responsibility
IEE	Initial Environmental Examination
LAOs	Local Administration Organizations
MONRE	Ministry of Natural Resource and Environment
MSW	Municipal Solid Waste
ONEP	Office of Natural Resources and Environmental Policy and Planning
PCD	Pollution Control Department
PPPs	Public Private Partnerships
RDF	Refuse-derived fuel
RF	3R Foundation
SAO	Sub-district Administrative Organizations
TECDA	Thai Environment and Community Development Association
TEI	Thailand Environment Institute
TIPMSE	Thailand Institute of Packaging and Recycling Management for Sustainable Environment,
WTE	Waste to Energy Technology

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A: INTRODUCTION

Thailand, covering an area of approximately 513,115 km^2, from North 5° 30' to 21° and from East 97° 30' to 105°, is the world's 50th largest country, while its population of approximately 67 million ranks it as the world's 20th most populous country. The GNP per capita was 186,276 Baht (5,478 US$) (Bank of Thailand, 2015). The GDP was 386.9 billion US$ and GDP per capita was 5774.65 US$ (NESDB Economic Outlook, 2015). Geographically, Thailand is located in the tropical zone and has a monsoonal climate with an average temperature of between 23.7 - 37.5°C. It consists of 76 provinces, 926 districts (Amphoe)/minor districts (Ging-amphoe), 7,426 sub-districts (Tambon), and 74,944 villages. Some areas, including all the provincial capitals, are designated as municipalities. The capital Bangkok has an area of 1,568.737 km^2, a registered population of 6,710,883 with the number of households being 2,280,145, and population density 4,200 persons/ km^2, while the average population density of the whole country around 140 persons/ km^2 (Strategy and Evaluation Department, 2015).

In general, the average generation rate of municipal solid waste (MSW) in Thailand is 0.6 kg/capita/day varying from 0.3 to 1.1 kg/capita/day based on the density of population. The moisture content of MSW ranges between 40 and 60%. In 2015, around 71,778 tons MSW/day were produced, whereas the capacity of the sanitary disposal was approximately 53% (Pollution Control Department, 2015). The society has suffered from waste mismanagement as a result of insufficient know-how, a lack of realistically applicable technology that is suited to circumstances and a weakness in the process of public participation, policy implementation and institutional support. Hence, the failure to optimize waste as a raw material in addition to reuse and recycling processes has occurred within and beyond administrative boundaries.

A positive sign of change in the role of environmental management has taken place with the promulgation of the constitution for the Kingdom of Thailand in August 2007. The 2007 Constitution contains many more provisions affirming the rights and freedoms of the people in relation to their participation in the management of natural resources and environment. In addition, a draft master law for the promotion of waste reduction, reuse and recycling has been produced in order to control waste management from generation until final disposal. In this integrated solid waste management with resource conservation and recovery, the polluter pays principle, and public rights have been included to set up systematic and efficient waste management in Thailand (Pollution Control Department, 2009). The drafted master law under the 2007 constitution provides the public right to be involved in waste management in term of the laws on waste reduction, separation, re-utilization as well in relation to information receiving and building up networks to co-ordinate activities. In addition, under the current constitution and in the coming master law which promotes the 3Rs, waste management is a National agenda.

B: WASTE DEFINITION

I. Waste Definition

The word “waste” in Thai terms means anything generated in daily life from any activity. This includes organic waste and recyclable waste but by function of waste practices, waste within the community includes infectious waste, hazardous waste, waste electrical and electronic equipment (WEEE) and packaging waste. Therefore, the definition of waste in Thailand involves the meaning of the phrase and a pragmatic function. It can be concluded that waste means unwanted materials and/or substances generated in a municipal area or a city including industry and the components of which generally include food/organic waste, infectious waste, hazardous waste, WEEE and packaging waste. Clear definitions in Thai law of waste, solid waste, hazardous substance, hazardous waste, infectious waste are as follows:

Waste means refuse, garbage, filth, dirt, wastewater, polluted air, polluting substance or any other hazardous substances which are discharged or originate from point sources of pollution, including residues, sediments or remainders of such matters, either in a solid, liquid or gas state [National Environmental Quality Act, B.E. 2535 (1992)]

Solid waste means used paper, worn out cloth, discarded food, waste commodities, used plastic bag and food container, soot, animal dung or carcasses, including other matters swept from roads, market places, animal husbandry or other places including municipal infectious waste, hazardous or toxic waste [Section 3, Public Health Act, B.E. 2550 (2007)]

Municipal Solid Waste means solid waste created by municipal activities e.g. residence, shop, business, service provider, marketplace, and institutes, i.e. organic and food waste, leaf and grass, etc., recyclable waste e.g. glass, paper, metal, plastic, aluminum, rubber, etc. and general waste e.g. fabric, wood, and material debris, excluding municipal hazardous waste [Pollution Control Department, Ministry of Natural Resources and Environment, B.E. 2550 (2007)]

Organic Waste means organic waste and/or food waste left over from preparation, cooking, and meals, pieces of vegetable, fruit, foods e.g. cooked rice, fruit peel, meat, etc. excluding mollusk shell, fish bone, bone, corn stub, twig [Pollution Control Department, Ministry of Natural Resources and Environment, B.E. 2550 (2007)]

Infectious Waste means body parts or carcasses of humans and animals from surgery, autopsies and research; sharp items such as needles, blades, syringes, vials, glassware; discarded materials contaminated with blood, blood components, body fluids from humans or animals, or discarded live and attenuated vaccines and items such as cotton, other cloths and syringes; waste from wards [Regulation of Ministry of Public Health B.E. 2545 (2002)]

Hazardous Substance means explosive substances, inflammable substances, oxidizing and peroxiding substances, toxic substances, pathogenic substances, radioactive substances, genetic transforming substances, corrosive substances, irritating substances or other substances, whether chemical or not, which may cause danger to human beings, animals, plants, property or the environment. [National Environmental Quality Act, B.E. 2535 (1992)]

Hazardous Waste means waste that contains or is contaminated with hazardous substances or exhibits hazardous characteristics including being flammable, corrosive, reactive, toxic or having specified constituents e.g. explosive substance, flammable substance, oxidizing substance, peroxide substance, toxic substance, infectious substance, radioactive and genetic mutation causing substance, corrosive substance, irritating substance, and other chemical substance or substance of harm to human, plant, property, or environment. [The Notification of Ministry of Industry on Disposal of Waste or Unusable Materials B.E. 2548 (2005)]

Community Generated Hazardous Waste means solid waste or toxic waste, or hazardous waste from residence and business places e.g. hotel, airport, gas station, photography shop, dry clean shop, including battery, light bulb, car battery, used lubricant, etc. [Pollution Control Department, Ministry of Natural Resources and Environment, B.E. 2550 (2007)]

Recycling Material means glass, paper, metal, plastic, aluminium, rubber, etc. and waste in general e.g. fabric, wood, and various materials [Pollution Control Department, Ministry of Natural Resources and Environment, B.E. 2550 (2007)]

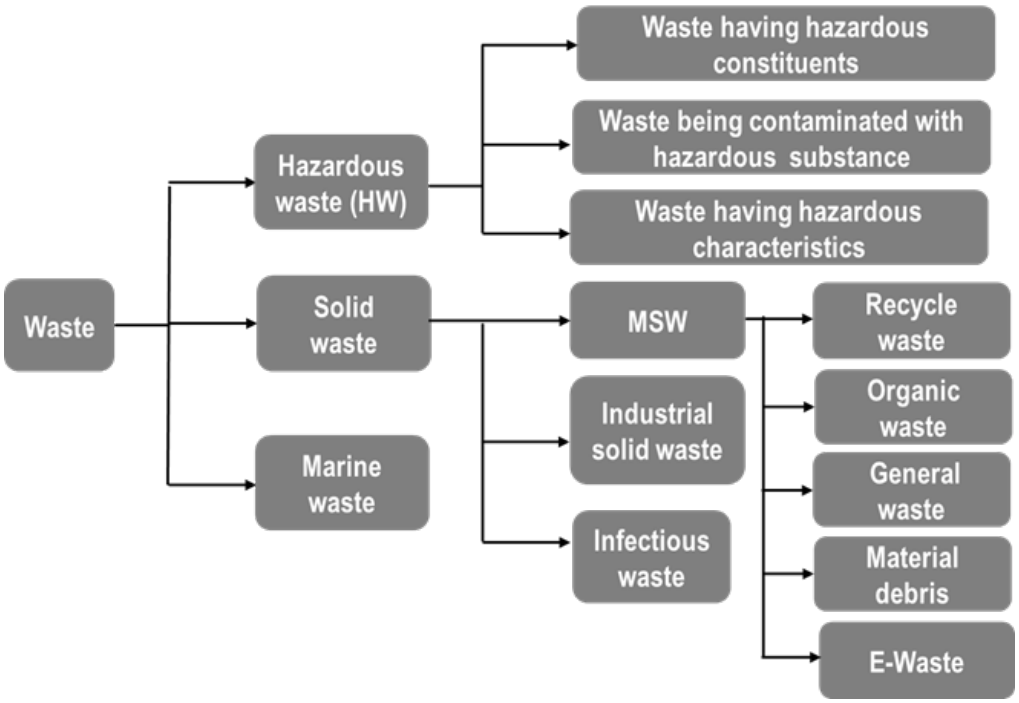
Electrical and Electronic Equipment means appliance or equipment which is dependent on electric currents or electromagnetic fields in order to function properly. These products when becoming waste electrical and electronic equipment and being improperly treated may cause impacts to the environment and human health. These shall include the products which contain recyclable parts or materials. [Pollution Control Department, Ministry of Natural Resources and Environment, B.E. 2550 (2007)]

Waste Electrical and Electronic Equipment (WEEE) means electrical and electronic equipment, including any parts or accessories of the products, which reach the end of their useful life or become deteriorated or obsolete. [The draft act on Management of Waste Electrical and Electronic Equipment and Other End of Life Products, Ministry of Natural Resources and Environment, B.E. 2558 (2015)]

End-of-Life Product means Waste Electrical and Electronic Equipment and other end-of-life products [The draft act on Management of Waste Electrical and Electronic Equipment and Other End of Life Products, Ministry of Natural Resources and Environment, B.E. 2558 (2015)]

Other End-of-Life Products mean any other equipment or devices, other than waste electrical and electronic equipment, that reach the end of their useful life, or become deteriorated or obsolete. With improperly treatment, these products may cause impacts to the environment and human health. These shall include the products which contain recyclable parts or materials. [The draft act on Management of Waste Electrical and Electronic Equipment and Other End of Life Products, Ministry of Natural Resources and Environment, B.E. 2558 (2015)]

Marine Waste or **Marine Debris** means a manmade product littered or washed into the sea, or waste from any production carried to the sea or marine environment by one way or another. Most types of marine debris are made of long-lasting materials e.g. plastics, glass, wood, metal, and rubber [Department of Marine and Coastal Resource, Ministry of Natural Resources and Environment, B.E. 2552 (2009)]



Source: author

Figure B-1 Classification of Waste in Thailand

II. 3R Definition or Definition of 3R Concept in the National Policy/Regulation

The Thai National Economic and Social Development plan as a paradigm of national development plans has evolved in the context of global and domestic changes. There was a significant shift in the country's development from a growth-oriented approach to holistic "people-centered development" since the Eighth Plan (1997-2001) and further to adoption of the Philosophy of Sufficiency Economy as a main guiding principle in the Ninth Plan (2002-2006), with its practical applications becoming evident during the Tenth Plan (2006-2011) lead the country toward sustainable development and a "Happiness Society". During the Eleventh Plan (2012-2016) focus on necessity to utilize the existing resilience of Thai society and economy, and to prepare individuals and society to manage the impacts of complicated encounter in both local and external changes plus fluctuations besides pave the way toward well-balanced development under the Philosophy of Sufficiency Economy.

His Majesty the King Bhumibol Adulyadej of Thailand graciously conferred the philosophy of sufficiency economy based on Buddhist principles of self-reliance, self-satisfaction and the middle path on the entire nation in 1997. The philosophy as it is trusted to lead the nation to balanced development in a more secure way and it will lead to a more resilient and sustainable economy, better able to meet the challenges arising from globalization and other changes, while preserving Thai national identity. The characteristics of sufficiency included moderation, reasonableness and effective self-immunity as risk management related to 3R conditions for decisions and activities based on knowledge and virtue (awareness, honesty, heart). The middle path is the best

consideration for action such as moderation linking with reduce plus reuse and choose the right resources to reduce waste, reasonableness linking with reduce plus recycle besides consideration of factors involved rationally and careful anticipation of the outcomes or consequences, while effective self-immunity as risk management linking with well preparation to cope with impact and change. All plans and every step of implementation should be ensured by intelligence, attentiveness, knowledge, extreme care, the common interest, the public benefit and keeping abreast of ethics and morals. The approach is to maintain balance and be ready to cope with surrounding rapid physical, social, and environmental changes. The concept is applicable to every person in every profession, living in both urban and rural areas, and thereby to the 3Rs campaign and the integrated management of waste to meet the country sustainable development.

C: COUNTRY SITUATION

I. Country's Basic Policy Direction Past and Future

1. The National Economic and Social Development Plan

Management of natural resources and the environment has been ineffective, and has revealed the conflict between environmental conservation and economic development because of natural resources depletion and degradation of environmental quality. Though Thailand's food security remains favourable despite facing challenges from climate change exacerbated the problems and demand for fuel crops.

The main concept of the Eleventh National Economic and Social Development Plan has adhered to the Philosophy of Sufficiency Economy. Development of capacity building, society, economy, environment and politics are integrated holistically to increase capability for resilience and adaptation at the level of the family, community and the nation. People-centered development and participation are applied throughout the national development process. Development for balance and sustainability by strengthening and utilizing capital endowment including empowering of social capital (human, social and cultural aspects), strengthening of economic capital (physical and financial aspects), restoring natural resource and environmental capital focused on community, natural resource and environment security, as well as a low-carbon and environmentally friendly economy and society.

The Eleventh Plan aimed at achieving the vision of the year 2027 as "A happy society with equity, fairness and resilience" followed the path of Sufficiency Economy. Thai people live in a caring and sharing society in a safe and sound environment. Production process is environmentally friendly, and food and energy resources are secure. The economy is based on self-reliance, local wisdom, knowledge, innovation, science and technology, innovation, creativity and increasing linkages lead to knowledge-based and Environmental friendly society. Secure natural resource and environmental quality are built by supporting community participation and improving resilience to cushion impacts from climate change and disasters. Moreover, managing natural resources and environment toward sustainability by conserve, restore and create security of natural resource, shift the development paradigm and direct the country to low carbon and environmentally-friendly economy and society, and control and reduce pollution at source and increase efficiency of solid waste disposal and utilization besides set up management system for hazardous, electronic and infected wastes, improve waste water treatment system and sludge, develop warning system and response system for toxic accidents.

2. National Policy

The national policy and plan of the Thai government regarding the waste aspect, will be to implement an environmental-friendly waste disposal system, enhance the waste disposal capacity

of local administrative authorities, and promote the role of the private sector in research and development for recycling of raw materials and clean technology. Moreover, the government will not allow any area of Thailand to become an end receiver of waste, which has to bear the costs of waste and pollution. The National integrated waste management plan has been focused on the sustainable consumption of natural resources and the application of the 'cradle to cradle' concept, including control waste generation at source, increased waste segregation and the enhanced efficiency of waste utilization prior to final disposal. The target for waste minimization is 30% of the total waste generated within 2009. The concept of the Polluter Pay Principle (PPP) is used to encourage responsibility in producers, importers, and consumers. The 3Rs is promoted as a vital tool for environmentally sound management. The life cycle approach is also integrated in waste management plan to minimize the large volume of packaging waste (Thongkaimook, 2006).

The Pollution Prevention and Mitigation Policy 1997-2016 aimed to (1) reduce or control solid waste generation to a rate of not more than 1.0 kg/capita/day, (2) have Bangkok and communities throughout the country utilize waste of not less than 15% of the total solid waste generated, (3) all solid waste left from collection in municipal districts was to be collected, and for outside municipal districts not more than 10% of total solid waste was to be left, and (4) ensure that each province has a master plan for sanitary solid waste disposal (Pollution Control Department, 2009).

The Pollution Control and Management Policy are driven by limitations of associated resources for waste management and arising of pollution in environment. For sustainable socio- economic development, prevention of deterioration or extinction of natural resources by incorporation of all stakeholders including government, private sector, and NGOs in conservation and recovery of resources. An attempt of waste management approach as "Integrated Solid Waste Management" is introduced. The concept focuses mainly on 3Rs principle (Reduce-Reuse-Recycle) by control and reduction of waste at sources, increasing effectiveness of waste separation, recovery and utilization as well as proper disposal of waste residues lead to systematic and effective waste management countrywide. Moreover, Sound Material Cycle Society Principle is used as model-based management technique consisted of (1) waste and pollution reduction in production and consumption processes (2) reuse of wastes and products after consumption (3) recycling of no reusable products and wastes and (4) proper disposal of unrecovered wastes.

The Pollution Control and Management Plan 2012-2016 is a master plan for pollution control and management considering all sources of pollutants. The 3R principle is a priority for cost effective management. The evaluation criteria consisted of promotion 3R activities, recycling business, waste to energy, green industries, eco town development. Management of pollutant content within standard of environmental quality is expected.

The Environmental Management Plan 2007-2011 was formulated to create a balance between the use for development and the need to preserve, conserve and rehabilitate natural and environmental resources at their optimum level, consistent with the carrying capacity of ecologies and rising life standards of people. The goal is that people can participate and receive benefits from the sustainable maintenance of natural resources and the environment. This plan also promoted solid and hazardous waste management to attain Thailand as an Asian tourism hub as well as the world's kitchen. In

relation to 3Rs and waste management, the plan has targets to reduce waste generation rate at 1 kg per person, promote waste recovery and recycling up to 30% of total generation and proper disposal of solid wastes at least 40% of all generated wastes. (ONEP, 2009).

The Environmental Management Plan 2012-2016 is a specific plan for management of natural resources and environment by applying six principles including sustainable development, ecosystem approach, precautionary principle, polluters pay principle, public-private partnership and good governance. In relationship to 3Rs and waste management, this plan has focused on strategies about (1) minimize waste generations by apply 3Rs (Reduce Reuse Recycle) principle (2) integrated waste management technologies for promoting waste utilization and reducing landfill spaces (3) clustering solid waste management among municipalities (4) Public Private Partnership for solid waste management (5) economic instrument (6) incentives for pollution prevention such as promotion for cleaner technology and production (CT/CP), zero waste technology, green product. In addition, there are strategies to increase capacity of local authorities in waste management, especially waste water, municipal waste, hazardous waste, infections waste, and waste from electrical and electronic equipment (WEEE) (ONEP, 2012).

The Constitution of the Kingdom of Thailand B.E. 2550 (2007) advanced environmental management and provisions affirming the public right to access information (Section 56) and to participate in the prevention and alleviation of public hazards, protecting and passing on the national conservation of natural resources and the environment (Section 73). For the planning of any project or policy that might cause a serious impact on the quality of the environment, on natural resources, and on the health of the people, comprehensive public hearings before implementation must be held before they are initiated (Section 67). The State shall promote and lend support to research and development and make use of alternative energy that is naturally acquired and advantageous to the environment (Section 86). Local governmental organizations have powers and duties in connection with the promotion and maintenance of the quality of the environment (Section 290) and must report their work to the people to enable them to participate in monitoring its administration and management (Section 287).

While the draft master law for the promotion of waste reduction, reuse and recycling is in the enactment process (Pollution Control Department, 2009), MSW management in Thailand has been under the following existing laws and regulations: Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992) is the fundamental environmental law governing environmental standards, including planning, and monitoring environmental quality and establishing a system for environmental Impact Assessment (EIA).

The Public Health Act B.E. 2535 (1992) provides a legal role for local administration to manage MSW by issuing and setting ordinances or regulation to control and protect environmental sanitation and covers collection, transportation and the disposal of waste. This is the most comprehensive law dealing with MSW.

The National Health Act B.E. 2550 (2007) specifies that state agencies have the duty promptly to reveal and provide data and information to the public, and individuals shall have the duty to

cooperate with state agencies in creating a good environment.

The Hazardous Substance Act B.E. 2535 (1992) provides a legal basis to control the import, export, manufacturing, storage, transport and disposal of hazardous substances. The Act governs the methods of managing hazardous materials, hazardous waste and infectious waste.

In addition, other regulations which are partly related to solid waste management are the Public Cleansing Act B.E. 2535 (1992), Determining Plans and Process of Decentralization to Local Government Organization Act B.E. 2542 (1999), the Industrial Estate Authority of Thailand Act B.E. 2522 (1979), the Factory Act B.E. 2535 (1992), the Land Transportation Act B.E. 2522 (1979), the Industrial Products Standards B.E. 2511 (1968), the Petrol Act B.E. 2521 (1978), the Land Traffic Act B.E. 2535 (1992).

Highway Act B.E. 2535 (1992), the Building Control Act B.E. 2522 (1979) and B.E. 2535 (1992), and the Official Information Act B.E 2540 (1997).

II. Current Status and Challenges on 3Rs and Waste Management System

1. Major 3R Initiatives and Achievement

The national 3R strategy applied integrated waste management by considering cradle to grave technique from production, distribution and consumption and recovery treatment and disposal based on waste management in sound material cycle society principle of Japan. During development of national 3R strategy, 3Rs programs were introduced and implemented in all sectors and stakeholders including government, manufacturer's communities and NGOs. In 2011, waste recovery rate was 26% of total generation which is mainly from recyclables recovery, composting and waste to energy.

Problems found in waste management systems, among others, include limited areas for landfill, waste disposal costs, the emission of greenhouse gases and dioxins, and concern over health and environmental quality, all of which can be solved more easily in combination rather than individually. In 2008, MSW 3.405 million tons (23% of total) was utilized by recycling (89%), as bio-fertilizer and biogas (7%), and alternative energy for electrical generation (4%) (Pollution Control Department, 2009).

The 3Rs campaign was initiated to reduce the waste quantity and reuse plus recycle based on an increasing awareness of the linkage between waste generation and resource consumption. Activities for the 3Rs in Thailand are encouraged through cooperation among various stakeholders to implement effective waste management. The activities are, for example, a recycle-oriented society, community 3Rs activities, resources efficiency, recycled materials and products, source separation and re-utilization, providing incentives for the 3Rs operation, public participation in the 3Rs, in-house segregation, reuse and recycling activities (waste bank, waste donation etc.), safe composting, etc. The recycling business has been informally established in Thailand for decades. Local waste collectors or scavengers using a tricycle known as a "Saleng" roam around town to trade used

materials from villagers with money or used clothes. The Wongpanit Company is the leader whose concept waste is gold. The company has been operating recycling work since 1974 and has expanded throughout the country with 500 networks and franchises, plus international franchises now.

Campaign 3Rs Activity has been promoted nationwide to enhance the effectiveness of MSW management leading to the awareness and participation of Thai people. Campaigns about integrated waste management systems for waste reduction, sorting, reuse and recycling have been constantly promoted through outreach (brochure, booklet, radio, TV spot, forum, conference etc.) towards municipal administrations, government organizations, communities, NGOs, universities and school networks. The examples for campaign activities that sustain the growth towards a sustainable Thai society are as follows:

- **Magic Eyes** was the pioneer campaign in the early 1980s to reduce littering in Bangkok conducted by the Thai Environment and Community Development Association (TECDA). The famous quote 'Ah! Ah! Don't litter! The Magic Eyes watch you!' had a big impact on environmental awareness and the responsibility of individuals to improve environmental quality. With community-based participation and a social marketing approach, this campaign was highly successful in making the corporate partners of government agencies, private companies, schools, the media, communities, and NGOs put their social responsibility into action, resulting in a long term effect of redefining behaviour and the lifestyle of Thai people.

- **Green label** is an environmental certification awarded to specific products or services, excluding food, drink, and pharmaceuticals. The criteria to get the label is that the products or services performed must have a minimum detrimental impact on the environment when compared with others serving the same function. Participation in the Thai green label scheme is on a voluntary basis. As of 2009, there are 231 products (fewer than 18 groups of products) by 43 companies that have been awarded green label certification. The campaign has been initiated by the Thailand Business Council for Sustainable Development, Thailand Environment Institute (TEI) since 1993.

- **Waste Bank** is a campaign for handling waste by buying back waste in terms of a deposit like banking system resulting in efficiency in waste segregation. People are stimulated to use each product to its maximum benefit and realize the value of solid waste, so that it can benefit the community by not only providing a clean environment but also cash flow for extra savings. Moreover, students involved in the project have gained through the learning process and the knowledge repertory of waste management, and the networks have exchanged both external and internal learning. Each bank is believed to have reduced the waste generated by 3-5 tons per month or a total of 18,000-30,000 tons/year from all banks together. The waste bank was initiated in 1999 in Phitsanulok province by the personnel of the Wongpanit Company who saw poor students selling recycled waste and depositing the earnings in the bank. In order to help the students, waste banks were set up as pilot project in school. Leaflets with a list of prices were distributed leading to the students progressively realizing the unexpected value of waste becoming eager to sort the waste and deposit it directly in the waste bank. At present, the waste

bank is one of the most popular 3Rs activities in school, universities and the community nationwide.

- **Used Lead-acid Battery Recycling** is a campaign programme to encourage recycling through tax incentives by taking into account the environmental and operational monitoring system. Up to now, 84% of used lead-acid batteries have been recycling. The campaign initiated in 2000 by the Pollution Control Department.

- **Tod Pha Pa Recyclable Waste** is a campaign to create a momentum for participation in the segregation of reusable solid waste for donation to monks as a Buddhist activities. People have been stimulated and now realize the handling problem of MSW. The activity was started in 2005 at Tesco Lotus in the Bangapi district, where 142 tons of recycled solid waste were donated. On June 4, 2005 alone, on the occasion of Environmental Day, 164 tons of recycled solid waste were donated throughout all 50 districts in Bangkok Metropolitan Area. All of the donated waste was sent on to be utilized as recycle products or raw materials for other products at Suan Kaew Temple where unemployed people are trained for careers and which serves as a recycling market. This is one of activities initiated by the Bangkok Metropolitan Administration (BMA) to achieve a 10% reduction in MSW generation annually.

- **TIPMSE:** Thailand Institute of Packaging and Recycling Management for Sustainable Environment, is a non-profit organization was officially established on 20 December 2005 founded by the industrial clubs under the Federation of Thai Industries, associations and member from packaging and consumer products manufacturers. TIPMSE was established with an aim to promote (1) at-source segregation of used packaging from garbage in order to reduce amount of used packaging in the waste countrywide (2) appropriate management system for used packaging and recycled materials through the concept “Packaging creates value Separate them out”. The research indicated that recycle rate of packaging materials in Thailand during 2013 was around 85% (TU-RAC, 2013).

- **3R Foundation (RF):** Resources Management for Sustainability (3R) Foundation was officially established on August 27, 2012 under the advisory of Dr.Sumet Tantivejkul of Chaipattana Foundation. The aims of 3RF are promote environmental conservation through the concepts of Reduce, Reuse, and Recycle. The 3RF received its starting grant given by the venerable Abbot Phra Dhramabundit of Rama IX Temple under the campaign “84 Million Kg Recycled for Dad” in celebration of His Majesty the King’s 84th Birthday, organized by TIPMSE together with the generous donation from Thai Namthip Co., Ltd.

- **Zero Baht Shop** established with experience from TIPMSE and 3RFoundation to provide a sustainable solution to community waste management. In particular “at-source segregation” resulted in reducing the amount of waste needed to be disposed from the communities. This leads to reduced living costs, a concept whereby it can be realized that goods can be purchase without money. The first Zero Baht Shop opened at Onnut 14 Rai Community in Prawet district and is now spreading nationwide.

The outcome of these 3Rs campaigns can be viewed as an illustration of the philosophy of a sufficiency economy and show how the least technically complex can be the most cost-effective solution when small communities participate in MSW management. At the heart of these 3Rs activities is the network established to involve people into the development process. Since the work requires not only coordination with central government and local government agencies but also planning processes jointly devised by meaningful participation of all stakeholders, all of these can certainly be lessons to be learnt by other communities.

2. Waste Treatment and Disposal System

Waste treatment and disposal in Thailand are still viewed as serious problems due to improper segregation at source and insufficient sanitary landfills. Sanitary principles are lacking in practice during the segregation of waste at treatment and disposal facilities. It is very difficult to establish sanitary landfills because local protests, even though suitable landfill sites exist and disposal site selection requires initial environmental examination (IEE). Nevertheless, the technical skills of responsible staff and the maintenance budget for waste treatment and disposal systems are insufficient.

Based on the existing high percentage of its organic components and its moisture content, composting is a basically sound treatment for MSW. The BMA has subcontracted a private company to operate a composting plant situated at Onnuch transfer station with the capacity of 1,000 tons MSW/day and a production of 300 tons of compost per day. However, the treatment affected by poor separation of biodegradable waste at source resulted in low-quality organic fertilizers (Department of Environment, 2008). In the meantime, the BMA has introduced Takakura Home Composting Method to 33 districts to convert food waste into organic fertilizer. In addition, vermicomposing using earthworms has become a popular alternative for producing organic fertilizer from organic waste throughout the country.

Sanitary landfill is the preferable disposal method in Thailand compared with engineered landfill, controlled dumps, and open dumps. Of the 1,000 disposal sites nationwide, only 119 sites have been constructed to appropriate standards through national government funding. Disposal practices in provincial capitals are mainly engineered landfill (54%), followed by open dumps (20%), controlled dumps (17%), and sanitary landfills (9%). Conversely, sub-district (Tambon) municipalities appear to have open and controlled dumps of up to 92% (Pollution Control Department, 2008).

The incineration of MSW is a costly option that requires less space, saves money with regard to transport and produces neither leachates nor gas, when compared to landfill but there is increasing public health concern regarding the pollutants that are emitted from incomplete combustion. Thailand has had operational experience with a capacity of 140 tons/day and 250 tons/day on Samui Island (Surat Thani province) and Phuket province respectively.

In addition, through related government agencies and academic institutions, Thailand has been conducting a feasibility study of waste to energy technologies, such as anaerobic digestion, gasification and refuse-derived fuel (RDF), to produce energy from MSW and to look for the

possibility of further developing projects under the Clean Development Mechanism (CDM).

As of 2008, there are three waste-to-energy plants with their construction finished and their operating systems approved in Thailand. These are the incineration plant (1.5-2.5 MW) in Phuket province, the MSW landfill gas recovery project in Samutprakarn province (1 MW) and the energy and fertilizer plant (MSW anaerobic digestion) in Rayong province (625 kW). The other three waste-to-energy plants that are undergoing operation systems tests include an incineration plant (70 kW) in Trat province, a MSW landfill (870 kW) in Nakornpathom province and a MSW elimination centre (950 kW) in Chonburi province. In addition, a RDF project (10 MW) in Chiang Mai province is still under construction and a MSW gasification project (50 kW) is still at an experimental stage in Bangkok metropolitan area (DEDE, 2009).

During recent years, the MSW situation in Thailand has shown a tendency of becoming even worse due to the volume of waste that has been growing every year paralleling with the growing population, national economic growth, and changes in consuming behaviours of people. Moreover, only 4,179 Local Administration Organizations (LAOs) provide waste transport and disposal services. The number is only about 54% of the entire number of more than 7,700 LAOs throughout the country. Besides, some of the waste collected within the serviced areas of some LAOs was not suitably disposed of by being openly burnt or openly dumped in an old pit or undeveloped area without proper control and management. This action might affect the environment of the surrounding areas and people in the neighbourhood of the unsuitable dumpsites. As for the local administrative organizations that did not provide any waste management services, people in the areas need to be responsible for their household waste, and some of them might illegally dump the waste in public areas or by the roadside.

From the survey in 2013, out of 7,782 Local Administration Organizations (LAOs), 4,179 (54%) of them provided waste transport and disposal services. About 7.421 million tons, or 20,332 tons a day, equal to 52% of the total volume of the collected waste is delivered to suitable waste management facilities. On the other hand, 6.938 million tons, or 19,008 tons a day, equal to 48% of the total volume of the collected waste, especially in small LAOs, were unsuitably disposed of by open burning or open dumping into old abandoned pits or undeveloped areas. The volume of 14.359 million tons of the collected solid waste was disposed of at one of the 2,490 waste management facilities scattered throughout the country.

The waste treatment facilities can be divided into 5 systems;

1) Suitable disposal facilities are the major treatment system in Thailand, referring to 446 sanitary landfills, engineered landfills, control dumps with a capacity of less than 50 tons/day
2) Incinerators with air pollution control systems,
3) Waste to Energy Technology (WTE),
4) Composting, and
5) Mechanical biological treatment systems.

Table C-1 Suitable waste disposal sites in Thailand in 2013

Suitable waste disposal sites 466 sites in total			
Public sites		Private sites	
Type	Amount	Type	Amount
Sanitary landfills/ engineered landfills	64	Sanitary landfills/ engineered landfills	9
Control dumps with the capacity of less than 50 tons/day	341	Control dumps with the capacity of less than 50 tons/day	26
Incinrators with air pollution control system	1	Incinerators with air pollution control system	1
Incinerators with the capacity of less than 10 tons/day and have an emission control system (cyclones)	8	Waste to Energy Technology	1
Integrated system	12		
Mechanical biological treatment system	1	Mechanical biological treatment system	2
Total (public sites)	**427**	**Total (private sites)**	**39**

Source: PCD, 2014

On the other hand, "Unsuitable waste disposal sites" refer to 2,024 open dumps, control dumps with the capacity of at least 50 tons/day, open burning sites, and incinerators without air pollution control systems.

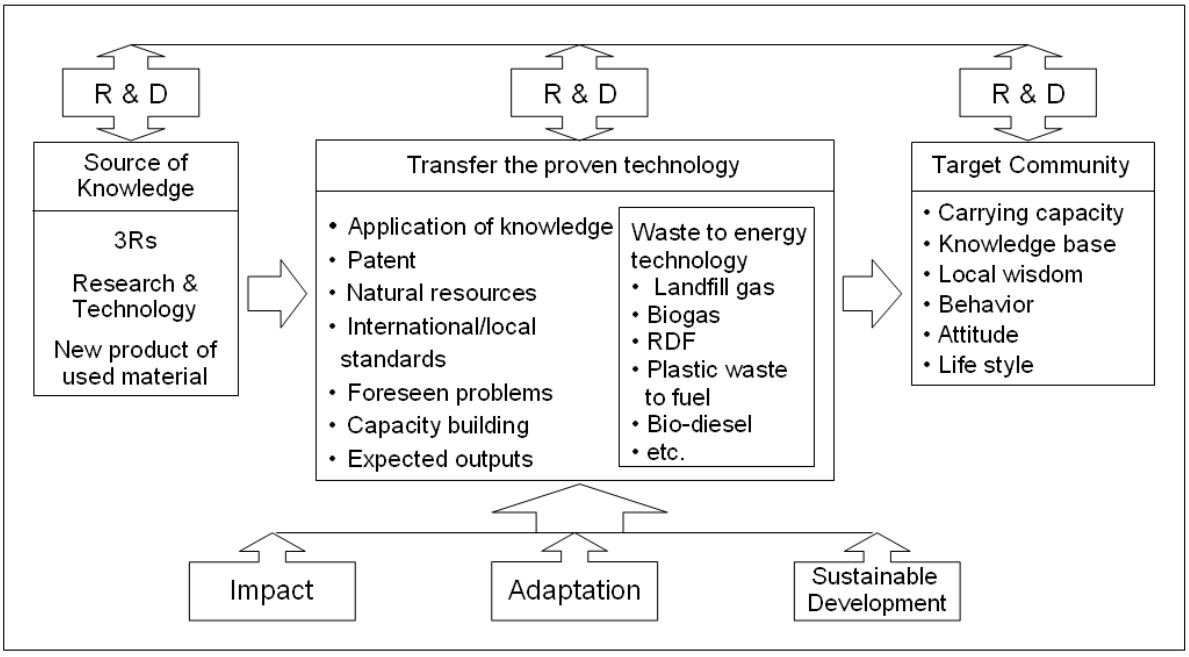
III. Current Potential and Future Market Needs for Waste Management and 3R Related Business

1. Research and Development Opportunities for Municipal Solid Waste Management

One of the most challenging issues is how to utilize waste as raw material while including the 3Rs properly and safely for the people, the environment and the quality control of manufacture. As a result the opportunities to involve the business community in 3Rs enterprises are growing following the increasing awareness and realizable the value of waste connected with natural resources and environmental quality. In addition, MSW management should also expand opportunity on CDM and waste to energy technology to serve climate change mitigation perspectives.

The next question is how to utilize management technology to ascertain sustainable development without knowing first what is good for us. Many severe effects on human health and environmental quality have resulted from the mismanagement of MSW and the lack of source separation indicates that the implementations of the regulatory procedures (pollution control standards, waste collection fees, etc.) in Thailand have failed to bond MSW management with institutional functionality and have jointly affected the environment.

To identify the most practicable technology for targeting communities from various sources of knowledge through the transfer of the proven technology, an investment should be made in R&D at an initial stage in order to assure the suitability for the country contexts, and this can be developed into cost-effectiveness, socially acceptance, and environmental sound business practice in the long-term perspective (Figure C-1). Consequently, to enable prompt action for the transferring of the proven technology to target communities, R&D study is also required at every stage when developing specific laws, regulations and guidelines, sanitary standards as well as applying the technology into pragmatic work of MSW management. This must be conducted based on the Thai environment, the carrying capacity of the target area, the knowledge base, local wisdom, behaviour, attitude and lifestyle in conjunction with culture and politics.



Source: Siriratpiriya, 2007

Figure C-1 Conceptual framework for R&D applied to municipal solid waste management

The application of the "Polluter Pay Principle" to make waste collection and disposal fees closer to waste generation rates is suggested at policy level for both the public and government. In this regard, further R&D study is required for setting up criteria to identify different stakeholders in order to resolve the disparity between residential and non-residential sources. The business community has great potential for direct user charges which will allow commercial, institutional and industrial waste for self-financing. The general community must also actively participate in the solutions by modifying its behaviour. For instance, there is a need to exert discipline in separating waste and exercising environmentally friendly purchasing habits. However, proper waste services and capacity building to develop an attitude for proper MSW management and social values reinforcement are needed for communities that consist of the poor and minorities.

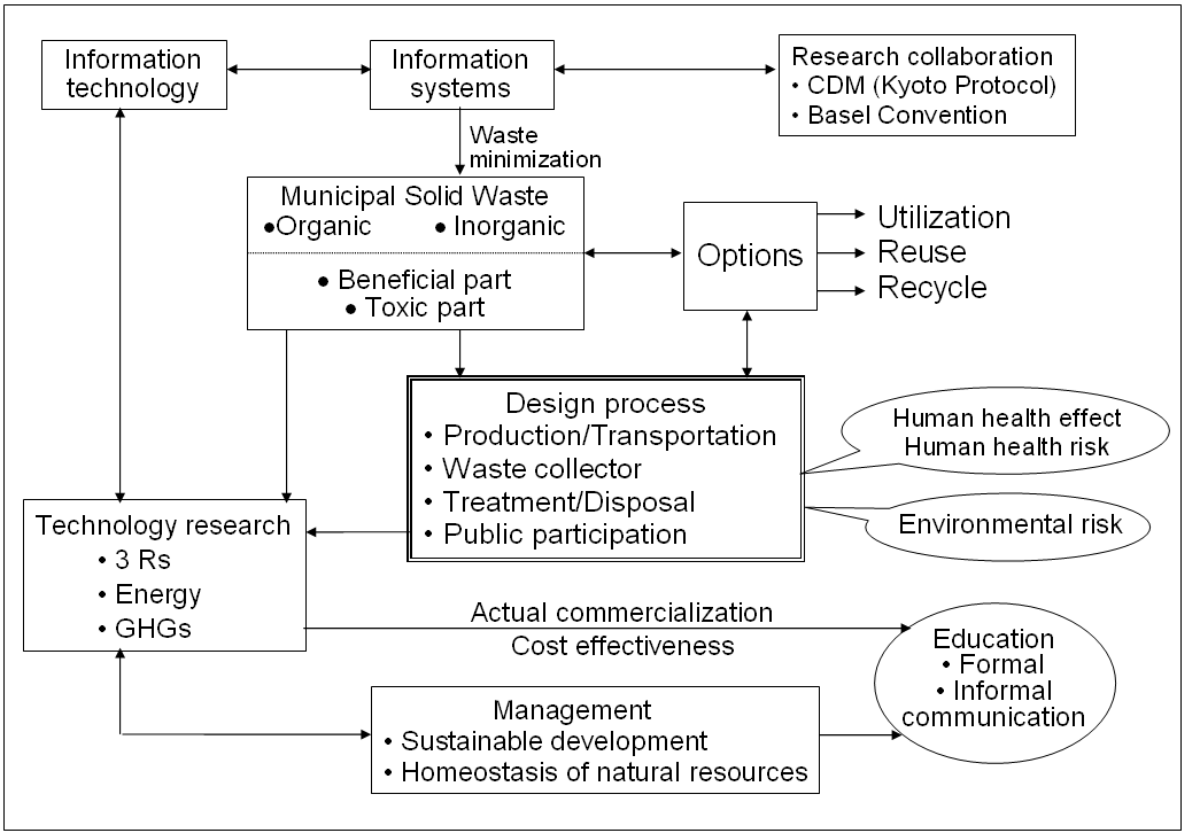
MSW management in Thailand is going in the direction of sustainable development through an

integrated waste management system, including the minimization of the production of waste and the maximizing of the waste recycling and reuse. The things to overcome include efficiency of segregation at sources, excluding infectious waste and hazardous waste from general waste in addition to collection, transportation, treatment and disposal.

Prerequisite factors to be considered for R&D applied to MSW management are proposed in Figure C-2. These are a holistic approach suited to any process designed for production, transportation, segregation, collection and disposal of waste mainly including options for waste management and interaction with human health and environmental risks, public education, technology, research and collaboration, etc. In addition, more locally suitable technologies are needed for recycling agricultural and household waste to bioenergy as well as for reducing greenhouse gas emissions from waste.

The Pollution Prevention and Mitigation policy 1997-2016 reflected the current status of MSW management in Thailand, particularly waste segregation and household hazardous waste that obstruct the waste to be utilized downstream as well as solid waste disposal site under pollution control standards. This implied the urgent need to put strategies into practices for all types of waste beginning with urban community. In addition to specific policies and regulations as well as financing mechanisms, successful MSW management requires cooperation from local government and other levels of government, business and the general community because there is no strategy that will work if people do not feel it necessary to engage with one another on the follow-up activities.

Significantly, one prerequisite factor that is not yet clearly seen from the policy but should be seriously emphasized is the need to have public participation in MSW management in the real sense. Although the rights to public participation are already guaranteed by the current constitution, there is still a lack of clear measures to promote public participation towards the society. From the national assessment of environmental governance (Nicro and Vassanadumrongdee, 2007), people are still unable to participate at the level of decision-making, operations, monitoring and implementation. It is crucial to note that most public hearings are held after some major decision has already been taken. In addition, there is no clear evidence to show that opinions and recommendations acquired from public hearings have been used in the decisions made by government and state agencies.



Source: adapted from Siriratpiriya, 2005

Figure C-1 Prerequisite considerations for research and development (R&D) applied to municipal solid waste management

Public participation in MSW management related to policy and planning processes is still limited due to lack of skillful resources and tools to put it into effect. The meaningful inclusion of public participation needs more details of the significant stakeholders to be involved, employed knowledge, actual procedures, collaboration and coordination among government agencies, and the serious development of approaches for public relation (PR) to build up people's trust in the state administration of MSW management.

Last but not least, national policy must also target the provinces to prepare suitable land for the long-term disposal of solid waste. Constructing waste disposal facilities such as landfills and incinerators causes arguments about environmental and health impact and often generates most of public concern. Involving the community and following a technically sound and transparent site selection process are suggested to be the best way to minimize public opposition to new facilities (Hoornweg and Thomas, 1999). However, this paradigm still contradicts what happens with public participation in reality. The general public is entitled to participate only at the information and the consultative levels, whereas only the authorized decision-makers of the representative from all the stakeholders participate at the partnership level. The barrier factors mainly include the culture of political and institutional dominance in decision making, the need for more specific legislation and guidelines for MSW related issues, clarifying procedures and the continuity of measures, and the pragmatic mechanism of effective management. Hence, to build up public trust, public participation should be

taken into account from the beginning of the project and prior to decision-making on land use as well as into the monitoring programme of the disposal facility (interval time within 25 years of operation) to prevent the dispersion of pollution.

2. Future market needs at waste management market (e.g. potential needs on incinerators, willing to upgrade to sanitary landfill from open dumping etc.)

The national policy statement by the Prime Minster Prayuth Chan-ocha on natural resources security between sustainable use and conservation on September 12th, 2014 was "Integrated management to keep balance among economy, society, natural resources and environment by promoting waste reduction, technologies for reuse and recycling as well as promotion for environmental friendly products". However, the waste management is the first priority to be solved urgently by:

- Waste separation promotion, in order to maximum reuse and recycle;
- In waste disposal location and critical area, mostly public property, accelerate the disposal of accumulated solid waste;
- Enhance waste to energy recovery in any possible area;
- Establish specific management measures for industrial waste, which has to be disposed using an appropriately established, segregated, and standardized industrial waste disposal;
- A development of controlling and monitoring system for hazardous waste, electronic waste, and infectious waste to prevent inappropriate disposal.

Solid waste has become a crucial issue and the government has promoted "Solid Waste Management as a National Agenda". The guidelines to put this national agenda into action are suggested as follows:

- Implementing recycle communities by reducing unnecessary consumption to reduce solid waste and hazardous waste generation; promoting use of environmentally friendly products; encouraging waste separation and reuse of solid waste and hazardous waste to maximize practicality and efficiency.
- Organizing packaging or product take-back programs in accordance with Extended Producer Responsibility (EPR) principle by encouraging producers to be responsible for their products once they expire. This included collection, transportation and disposal of the products to ensure environmental safety.
- Clustering of Local Administrative Organizations in order to implement the entire and centralized municipal solid waste, hazardous waste and infectious waste management system.
- Processing Solid Waste into Energy by promoting the plan for concrete results.
- Promoting a research and development plan of using efficient technology to manage solid waste and hazardous waste that suited the area, quantity and components of each type of waste. This included operation, maintenance, energy processing cost efficiency and the management of Local Administrative Organizations.
- Participating with the private sectors in Public Private Partnerships (PPPs) to enhance efficiency of the proper management of solid waste, hazardous waste and infectious waste from collection, transportation, recycling and disposal.

These actions show that Thailand will have a bright future market needed for waste management as

well as appropriate technology on waste disposal such as waste to energy, old landfill upgrading, low pollution incinerators, etc.

D: 3R INDICATORS

I. Total MSW Generated and Disposed and MSW Generation Per Capita (by Weight)

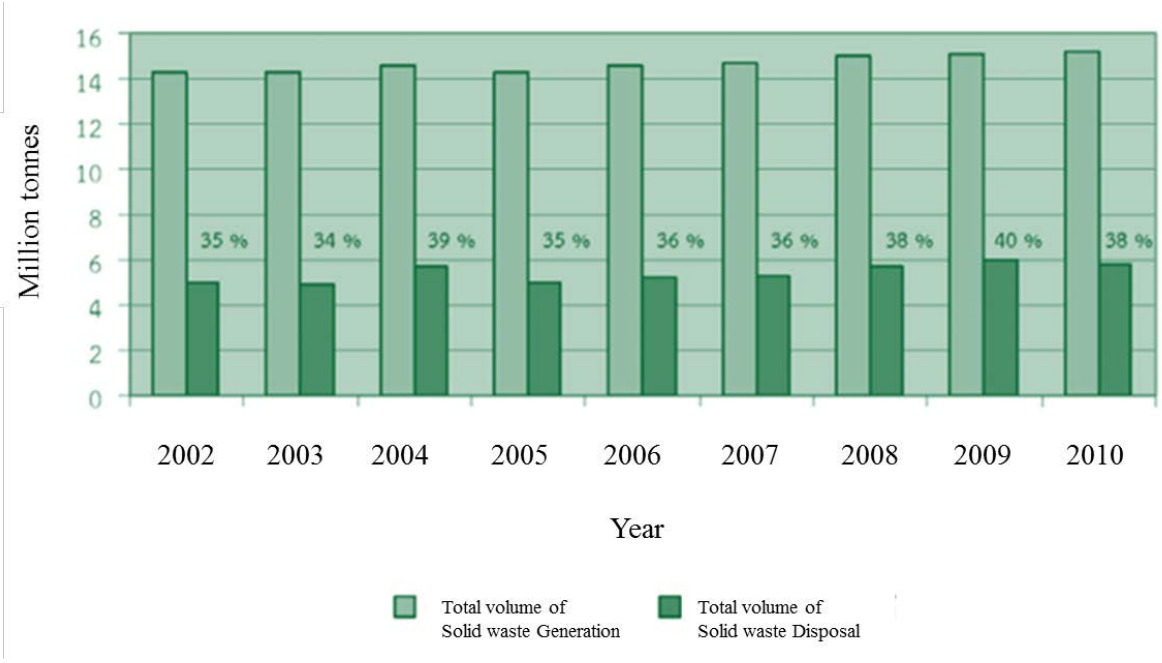
In Thailand, solid waste is a serious and troubling issue due to the lack of a proper waste management system. The Pollution Control Department (PCD), Ministry of Natural Resource and Environment (MONRE) conducted a survey annually on the volume of solid waste generated in the country using questionnaires and field surveying. The target group of the survey was 7,782 Local Administration Organizations (LAOs) throughout the country including 2,273 municipalities and Pattaya City, 5,508 Sub-district Administrative Organizations (SAO), and Bangkok Metropolitan Administration (BMA). The volume of solid waste generated, waste utilization, and suitable disposal during the years 2008 – 2014 have been shown in Table D-1.

Table D-1 The volume of municipal solid waste generated, suitable disposal, and MSW generation per capita during the years 2008 – 2014

Indicators	Data	Unit	Year	Reference
Total MSW Generation	23,930,000	Tonne/year	2008	Thailand State of Pollution Report 2014, Pollution Control Department, MONRE
	24,110,000		2009	
	24,220,000		2010	
	25,350,000		2011	
	24,730,000		2012	
	26,770,000		2013	
	26,190,000		2014	
Total MSW with suitable disposal	5,600,000	Tonne/year	2008	Thailand State of Pollution Report 2014, Pollution Control Department, MONRE
	5,970,000		2009	
	5,770,000		2010	
	5,640,000		2011	
	5,830,000		2012	
	7,420,000		2013	
	7,880,000		2014	
MSW generation per Capita	1.03	kilogram/capita/day	2008	Thailand State of Pollution Report 2014, Pollution Control Department, MONRE
	1.04		2009	
	1.04		2010	
	1.08		2011	
	1.05		2012	
	1.15		2013	
	1.11		2014	

Table D-1 above shows that the volume of MSW generated from 2008 to 2013 increased slightly. In 2011, the total amount of MSW was increasing due to major floods in Thailand. But in 2013 the total amount of solid waste volume was about 26.774 million tons, or about 73,355 tons a day. It has increased more than 2 tons against previous years from 2008-2012. However, in 2014 the total volume of MSW generation decreased by almost 600,000 tonnes compared to 2013. The volume of MSW with suitable disposal has also significantly increased in 2013 and has been gradually increasing in 2014 as well.

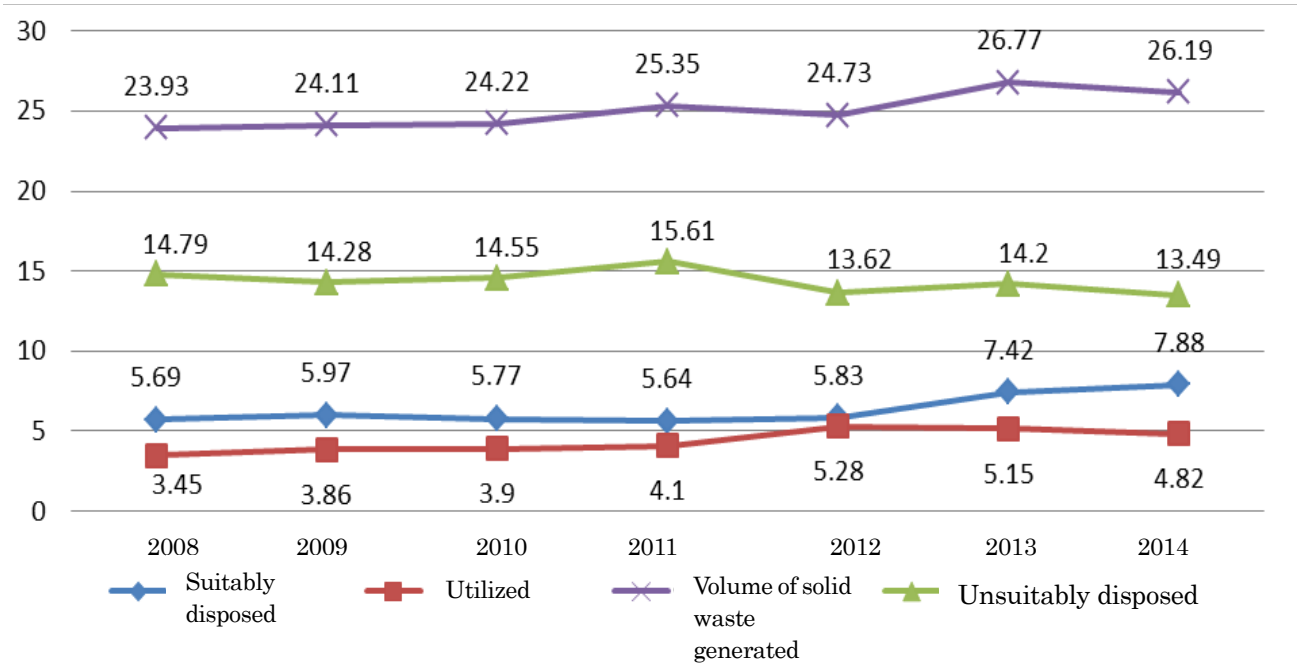
For total MSW disposed, it is found that Thailand has fairly low waste disposal rate, according to the volume of waste created. From 2002 to 2010, capacity of waste disposal was only 36.77%



Source: PCD, 2014

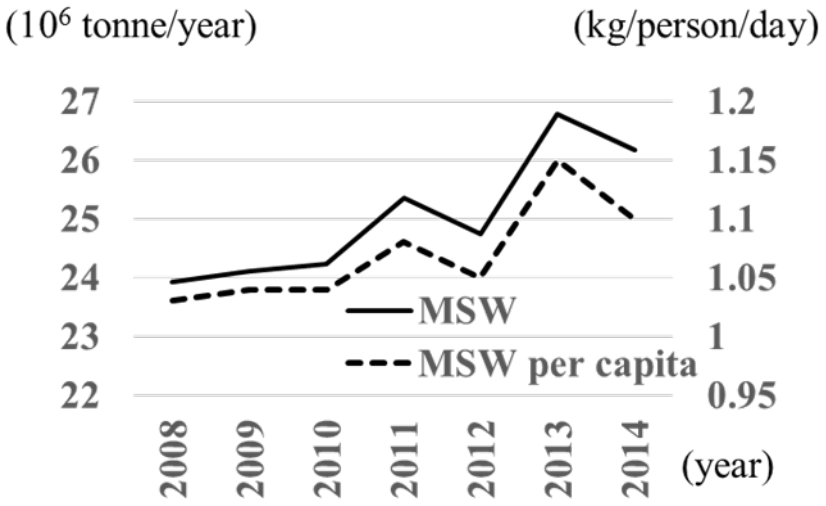
Figure D-1 Total volume of solid waste generation and disposed from 2010-2002

In 2013, among 26.774 million tons of the total waste, 53.5% or 14.359 million tons were disposed. However, only 7.421 million tons (27.5%) were properly disposed and 6.938 million tons (26%) were improperly disposed. This indicates that of the total waste generated, only 25% was properly disposed. Meanwhile, there were 7,782 Local Administrative Organizations in Thailand and 4,179 that used waste disposal services. However, there were 2,490 waste management sites and out of those, only 466 were proper waste treatment sites, representing 6% of the total number of Local Administrative Organizations. The remaining 2,024 were improper disposal sites, for example, open dumping and open burning. However, in 2014 the volume of suitably SW disposed has increased from 7.42 million tonnes in 2013 to 7.88 million tonnes. The rate of suitable MSW disposal has increased by 30.11% over the last 5 years as can be shown in Figure D-2.



Source: PCD, 2015

Figure D-2 The volume of solid waste generated, waste utilization, and suitable disposal during the years 2008 – 2014



Source: PCD, 2015

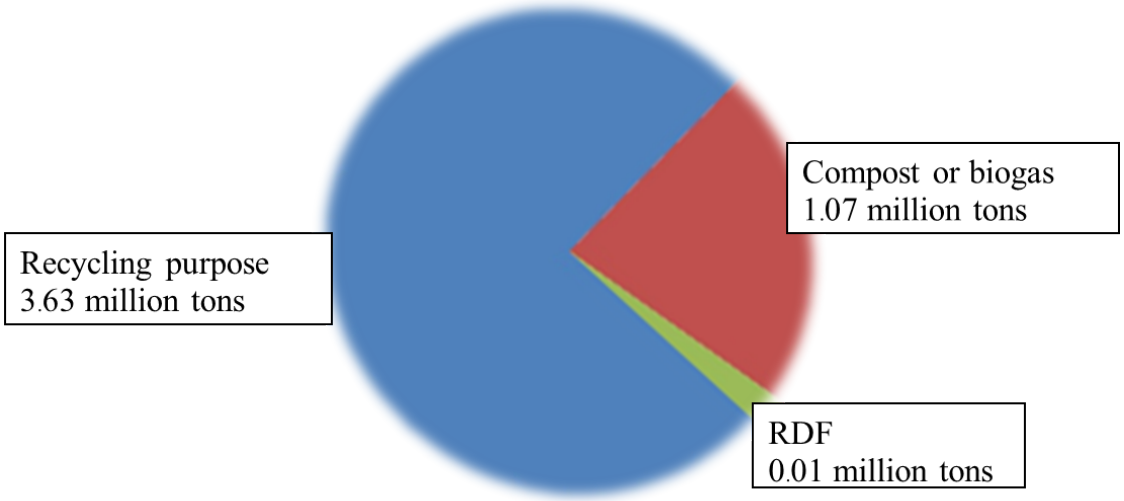
Figure D-3 Total MSW generation and total MSW per capita during 2008-2014

As a result, the amount of residual waste in waste treatment areas did not decrease while the rate of solid waste generation per capita has increased from 1.03 kg in 2008 to 1.15 kg per person/day in 2013 as shown in Figure D-3 and Table D-1. However, in 2014 the waste generation per capita is 1.11 kilogram per capita per day. It decreased 0.04 kilogram per capita per day compared to 2013.

II. Overall Recycling Rate and Target (%) and Recycling Rate of Individual Components of MSW (Primary Indicator)

Out of the volume of 26.19 million tons/year of municipal solid waste generated in 2014, 4.8 million tons, or 18.32%, of the volume was utilized. The methods of waste utilization can be divided into 3 methods as follows:

1) Recycling method is processed by the separation and recovery of recyclable waste including glass, paper, plastic, steel, and aluminium from junk shops, community recycling centres, waste banks, packaging buyback/return systems, and product inventions from waste. The volume of waste collected for was around 3.63 million tons, or 76%, of the total volume of the utilized waste.
2) Sorting organic waste including food scraps, vegetables, and fruits in order to make compost and enzyme ionic plasma used as fertilizer processes organic waste utilization, and to make biogas used as an alternative energy source. The volume of organic waste collected for this purpose was around 1.07 million tons, or 22%, of the total volume of the utilized waste.
3) Waste-to-Energy method is processed by putting solid waste in the processing procedure to generate energy in the form of electricity or an alternative energy source of refuse derived fuel (RDF). The volume of waste collected for this purpose was about 0.10 million tons, or 2%, of the total volume of the utilized waste.



Source: PCD, 2015

Figure D-4 The proportions of the utilized MSW in 2014

By the government promotion of 3R, leading to national natural resource and environmental plan development, goals are set up in the 2 national plans;

1) The 11th National Economic and Social Development Plan; (2012-2016): the goal of solid

waste recycle is not less than 30% of total solid waste in the country. It also focuses on the better change of consumption behavior toward eco-friendly society. Economic incentive tool is used for waste reduction, community business promotion, and recycling private business.

2) Environment quality plan (2012-2016), Ministry of Natural Resources and Environment (MONRE): focusing on maximum reduction and recycling of solid waste before final disposal through 3Rs principle, using integrated technologies to reduce the size of land fill and to recycle solid waste. It focuses on the cooperation and group management among local administrations for solid waste disposal, and to invite private sectors to co-invest or collaborate in local solid waste disposal. The goal set in terms of reduction and recycling of solid waste before final disposal in 3Rs strategic plan is to reduce the volume of solid waste for final disposal to at least 31% by 2012 – 2016; 65% by 2017-2021, and 95% by 2022-2025. These are 4 indicators.
   (a) Reduction of solid waste by 1% by 2012-2016, 3% by 2017-2021, and 5% by 2022-2026
   (b) Material Separation and Recovery at community level by 20% by 2012-2016, 22% by 2017-2021, and 25% by 2022-2026
   (c) Waste to Energy recovery of other unused materials by 5% by 2012-2016, 10% by 2017-2021, and 15% by 2022-2026
   (d) Biodegradable Recovery in form of Compost and Biogas by 5% by 2012-2016, 30% by 2017-2021, and 50% by 2022-2026

Table D-2 Summary of Recycling Target of Thailand

Indicators	Data	Unit	Year	Reference
Overall Recycling Rate	30	%	2016	11th National Economic and Social Development Plan
Target of Recycling Rate at community level	20	%	2016	Environment Quality Plan (2012-2016), MONRE
	22		2021	
	25		2026	
Waste to Energy Recovery Rate	5	%	2016	Environment Quality Plan (2012-2016), MONRE
	10		2021	
	15		2026	
Biodegradable Recovery Rate	5	%	2016	Environment Quality Plan (2012-2016), MONRE
	30		2021	
	50		2026	

For achieving the above target and implementing the 3R concept nationally, high priority of Thailand needs to be given to the issues of technology transfer to businesses and local authorities to improve the manufacturing process and also to promote recycling, reuse, treatment and disposal of wastes. Additionally, the role of the central government in direction-setting, notably in the field of R&D, to promote the 3R technologies should be a priority. Financial incentives, such as subsidies and tax exemptions in 3R businesses and related technologies, are vital importance for promoting 3R related technologies.

The specific policy and strategy for promoting 3R technology consists of the following:

1) *Technical and financial support*: Central government has provided technical support as well as financial support for local governments and private sectors in order to improve the existing waste management system to the more reliable and more environmental friendly system. As a result, 3R technologies are being implemented such as biogas plant development, composting system and refuse – derived fuel production.
2) *Capacity Building*: Capacity building on the waste management has been implemented by conducting workshops and training courses for waste-related administrators, waste management managers and workers, as well as initiating pilot projects on the proper waste management regarding segregation, reuse, and recycle in communities. These can help to promote understanding 3R and waste management technologies to local authority and community
3) *Guidelines, measures, and standards*: The instructions on proper waste management, such as ways to reduce, reuse, and recycle wastes as well as the ways to dispose of properly, have been developed and disseminated as guidelines for the local community. In 2003, the standard concerning the specification of the waste containers had been announced in order to stipulate the proper waste containers for different types of waste with a view to enhance the 3R businesses. Quality control standards for products and packages that are produced from recycled materials have been studied and published in order to improve product quality and to promote the use of recyclable products and related technologies.
4) *Incentive Policy*: Government has promoted co-incineration of waste in cement kilns as one optional waste disposal other than landfilling, since 2001. The benefits of this program are both energy and material recovery. The program also supports energy replacement for coal or coke and promotion for alternative waste management technologies. Currently, there are incentives from the Ministry of Energy for waste to energy promotions such as adders for electricity produced from waste and subsidy of oil produced from plastic waste. The program brings in 3R related technologies such as waste to oil plants and facilities producing electricity from waste.

III. Amount of Hazardous Waste Generated and Disposed in Environmentally Sound Manner (Primary Indicator)

Pollution Control Department (PCD) has defined the difference between the definitions of "Hazardous waste" and "Community Generated Hazardous Waste" as mentioned in B. In 2013, approximately 3.3 million tons of hazardous waste was produced in the country consisting of 2.69 million tons (81.5%) of industrial waste and 0.61 million tons (18.5%) of household waste. The former was sold to recycling shops, which might improperly dispose of them while the latter was disposed along with general waste. Since 2006, Local Administrative Organizations have been encouraged to continuously separate hazardous wastes from the community and collect them for recycling or for disposal at proper hazardous waste treatment sites. However, there is still no explicit hazardous waste management system.

For infectious waste --there was approximately 50,481 tons of infectious waste produced in the country per year. Of the total waste, 28,668 tons (57%) came from public hospitals, 8,606 tons

(17%) from private hospitals and 9,698 tons (19%) from clinics. Most of this (75%) was properly managed by large medical facilities. However, small medical facilities such as clinics, health-promoting hospitals, community health centres or veterinary clinics (25%) were limited in their waste collection, transportation and disposal management. At present, there are at least 142 infectious waste incinerators in the country. Most of which were not properly equipped to treat air pollution in accordance with regulations or treat infectious waste in order to reduce health and environmental risks. This could expose incinerator workers to potential health risks and affect the environment as well. Therefore, it is necessary to assess the capacity of every hazardous waste incinerator in the country in order to gather useful information and plan a management system.

In 2014, only the volume of industrial hazard waste is decreased but municipal hazardous waste and infectious waste are still increasing. The summary of volume of hazardous waste categorized by source during 2012-2014 is shown in Table D-3.

Table D-3 The volume of hazardous waste categorized by source during 2012-2013

Indicators	Data	Unit	Year	Reference
Amount of Industrial Hazardous Waste	2,810,000	Tonne/year	2012	Pollution Control Department (PCD), 2013
	2,690,000		2013	
	2,065,000		2014	
Amount of Municipal Hazardous Waste	710,000	Tonne/year	2012	Pollution Control Department (PCD), 2013
	560,000		2013	
	567,000		2014	
Amount of Infectious Waste	40,000	Tonne/year	2012	Pollution Control Department (PCD), 2013
	50,000		2013	
	52,000		2014	

In December 2014, the Pollution Control Department, Waste and Hazardous Waste Management Office, released some principles and related technical documents to solid waste and hazardous waste management as a guideline to pertaining agencies especially local administrations. Key features are Particular Municipal Waste Management Principle, Municipal Waste Management Scheme and some name lists of private companies involving solid waste disposal.

Such documents state the laws pertaining to local administration's municipal hazardous waste management i.e. Public Health Act B.E. 1992, and Public Health Act (2) B.E. 2007. However, the laws focus on downstream management i.e. collection, transportation, and disposal. There was no statement about the separation of hazardous waste from solid waste, and no details in terms of municipal hazardous waste management. Hence, local administrations do not have a clear direction of municipal hazardous waste management. It is then a priority for Thailand to improve the existing constitution to clearly guide the local administrations for municipal hazardous waste management, or billing a specific law for municipal hazardous waste management, which could be product fee principle, or Extended Producer Responsibility (EPR).

There are several programs related to EPR development being implemented in Thailand. They include two phases:

Phase I: Voluntary and CSR Programs:

At the beginning, corporate social responsibility (CSR) was the main focus to promote cooperation among stakeholders. Voluntary waste management programs were then introduced including:

- *Packaging wastes take-back program*: A program aims to promote packaging waste recovery and recycling. Through the cooperation of local governments, manufactures, distributers and recycling businesses, over one ton of packaging wastes such as glasses, paper, cans and plastic bottles was recovered per day from department stores and nearby communities.
- *WEEE Can Do*: The program aims to take back WEEE and E-wastes for recycling and disposal. Through the cooperation of governments, producer, distributers and consumers, over one million pieces of WEEE and E-waste have been recovered and managed properly.
- *Green label*: Green label is a program to promote environmental friendly products. It is a voluntary program that many manufactures participate in as their corporate social responsibility. At present, they are over 60 guidelines and criteria for packaging and products.

Phase II: Law and regulation development

Currently, specific laws for waste management are being developed for effective waste management.

As an important principle, EPR has been addressed in these new laws:

- *Solid Waste Management Act*: Drafted new Solid Waste Management Act contains many chapters of waste management from cradle to grave approach. The act also mentions EPR principle to promote producers to respond their product life cycle from production, distribution and waste management.
- *WEEE Regulation*: Drafted WEEE Regulation intends to apply product charge to major home appliances such as televisions, air conditions, computers, washing machines, and refrigerators. Producers must take back their products for recycling and disposal, while local governments have to set up network to buy back WEEE from household
- *Drafted Economic Instrument for Environment Act*: This act aims to apply various economic instruments such as tax, fee, charge, subsidy and incentives to promote sustainable production and consumption, resource efficiency as well as EPR model.

IV. Indicators Based on Macro-level Material Flows (Secondary Indicator)

Table D-4 Thailand material flows in 4 categories of material resources in 2008

Indicators	Data	Unit	Year	Reference
Biomass	289,768,359	DMC tonne	2008	http://www.cse.csiro.au/forms/form-material-flows.aspx, UNEP 2013
Construction minerals	140,927,149			
Fossil fuels	103,371,279			
Metal ores and industrial minerals	20,035,302			

Thailand has been attempting to shift the development paradigm and redirect the country to a low-carbon and environmentally friendly economy. The country's production and consumption behaviour has been restructured to prepare for a transition toward a low-carbon and environmentally healthy economy. To this end, energy efficiency in the transportation and logistic sectors will be enhanced in order to reduce greenhouse gas emissions. Eco-cities will also be developed that emphasize urban planning and integration of cultural, social and ecological factors.

V. Amount of Agricultural Biomass Waste Used (Primary Indicator)

The Ministry of Energy (MOE) has defined the definition of 'biomass' in the report on "Biomass Database Potential in Thailand" as the production of industrial-agricultural waste such as rice husk, bagasse fiber and palm shell. This study was conducted in 2012 by Department of Alternative Energy Development and Efficiency (DEDE) in order to determine the amount of biomass available in different areas as well as to see the use of biomass for energy production.

The study gathered data on biomass and spatial (area base) of the agricultural area from the past five years as well as analyzed and evaluated the potential of biomass which can be used to produce energy in 3 regions; northeast, north, and south of Thailand covering 51 provinces. It is found that the maximum potential of the biomass consists of 9 types of plants, 19 types of biomass as in the following table:

Table D-5 Total amount of 19 biomass waste generation and utilization in 51 provinces of Thailand in 2009-2010

Indicators	Data	Unit	Year	Reference
Amount of agricultural biomass waste generation	60,192,778.41	Tonne/year	2009-2010	DEDE, MOE, August 2012
Rice Straw	10,127,682.14			
Rice Husk	4,597,578.06			
Sugar cane leaves and tops	7,810,953.43			
Bagasse	7,644,639.00			
Stems and leaves of corn	3,269,327.48			
Corn cobs	956,876.34			
Cassava roots	4,171,526.33			
Palm trunk	1,441,884.50			
Palm leaves and branches	10,529,274.34			
Palm empty branches	2,389,622.55			
Palm fiber	1,418,838.39			
Palm shell	298,702.82			
The roots and leaves of rubber tree branches	808,025.00			
Swarf rubber wood	1,939,260.00			
Slab rubber wood	1,939,260.00			

Indicators	Data	Unit	Year	Reference
Rubber wood chips and sawdust	484,815.00			
Soybean leaves and stems	205,600.03			
Leaves and stems of mung bean	110,838.59			
Leaves and stem of peanuts	48,074.41			
Amount of agricultural biomass waste utilization	16,192,778.41	Tonne/year	2009-2010	DEDE, MOE, August 2012
1) Rice Straw	1,086,774.12			
2) Rice Husk	3,680,679.20			
3) Sugar cane leaves and tops	815,995.82			
4) Bagasse	7,644,639.00			
5) Stems and leaves of corn	163,466.37			
6) Corn cobs	788,822.04			
7) Cassava roots	0.00			
8) Palm trunk	0.00			
9) Palm leaves and branches	326,451.31			
10) Palm empty branches	1,417,539.37			
11) Palm fiber	0.00			
12) Palm shell	0.00			
13) The roots and leaves of rubber tree branches	70,383.50			
14) Swarf rubber wood	0.00			
15) Slab rubber wood	0.00			
16) Rubber wood chips and sawdust	0.00			
17) Soybean leaves and stems	10,280.00			
18) Leaves and stems of mung bean	5,541.93			
19) Leaves and stem of peanuts	2,403.72			

The data of this study has shown that only 26.6% of biomass in the country has been utilized. Therefore, it is obvious that the recovery of agricultural biomass waste should focus on the use for alternative energy or fuel, rather than the use in agriculture system (e.g. feed, fertilizer). Considering the energy crisis, where energy source is declining, and the energy cost is rising, the recovery of agricultural biomass waste for alternative energy or fuel can reduce the use of fossil fuel. It seems to be an interesting option in the time of energy crisis.

VI. Marine & Coastal Plastic Waste Quantity (Primary)

According to Central Database System and Data Standard for Marine and Coastal Resource, Department of Marine and Coastal Resource, MONRE, the accumulative amount of marine and

coastal trash collected in Thailand from 2009 to 2012 was 216,691 pieces, weighing 20,947.16 kilograms. There were 29,994 pieces of plastic (13.84%), secondly 24,416 pieces of rope (11.27%), and thirdly covers and lids (10.15%). Please refer to Table D-6.

Table D-6 Marine & Coastal Plastic Waste generation and collection in 2009

Indicators	Data	Unit	Year	Reference
Collected marine & Coastal Plastic Waste	20,947.16	Kilogram	2009-2012	Central Database System and Data Standard for Marine and Coastal Resource, Department of Marine and Coastal Resource, MONRE (http://www.dmcr.go.th/Thailandcoastalcleanup/)
	216,691.00	Pieces		

The Department of Marine and Coastal Resources realizes the increasing impacts of marine debris on marine organisms, marine ecosystem, and people's quality of life. Marine and Coastal Resources Conservation Extension, Department of Marine and Coastal Resources initiated a concept to systemically clean the beaches. With the collaboration of Green Fins Association and Ocean Conservancy, International Coastal Cleanup was firstly launched in 2008 with the practices and implementation based on the suggested principles of international beach cleaning. The goals of this project are to effectively gather relevant data, to build up network among agencies and local organizations in order to operate campaigns and learning activities regarding marine, and to increase the number of volunteers and cleaning areas.

In addition to the international beach cleanup, all sectors should cooperate with each other in order to collect, reduce, and manage marine debris on the beaches, in appropriate ways such as reduction of resource utilization, effective use of resources, enhancing efficiency of waste collection, providing knowledge of appropriate waste management to tourists and fishermen and raising awareness on the issue.

VII. Amount of E-waste Generation, Disposal and Recycling. Existence of Policies and Guidelines for E-waste Management (Primary)

The estimation of hazardous household waste in 2014 by Pollution Control Department (PCD), Ministry of Natural Resources and Environment (MONRE) is 576,316 tonnes, increased 13,482 tonnes more than 2013 or 2.40%. The major part of that waste is from electrical and electronic equipment, which makes up 65.4%, with the other 34.6% being other types of hazardous waste including batteries, light bulbs and chemical containers. None of this waste was properly managed.

Table D-7 Amount of E-Waste generation in 2013-2014

Indicators	Data	Unit	Year	Reference
Amount of E-Waste generation	562,834	tonne	2013	PCD, MONRE,2014
	576,316		2014	

However, PCD has estimated E-Waste Inventory and provided a forecast for 2014-2018 as shown in Table D-8.

Table D-8 E-Waste Inventory and forecast 2014-2018

Product type	E-Waste generation 1,000 units in year				
	2014	2015	2016	2017	2018
TV	1,835	2,034	2,218	2,375	2,499
Digital camera	616	788	979	1,183	1,393
VDO camcorder	120	131	144	158	172
Media player	583	668	749	825	891
Printer	1,365	1,504	1,633	1,748	1,849
Mobile phone	8,405	9,237	10,005	10,697	11,305
PC	1,538	1,737	1,944	2,157	2,374

Source: PCD, 2013

According to the growing trend of WEEE, PCD established the National Integrated WEEE Management Strategy (Phase II: 2012-2016). The formulation of this Strategic Plan on E-wastes - Ministry of Natural Resources and Environment in cooperation with Ministry of Industry and supported by other relevant government and private agencies have developed the national strategic plan for the environmentally sound management of E-wastes and it was approved by the cabinet on July 24th, 2007.

The main objective of the plan is to improve the existing segregation and collection system of E-wastes and to manage them properly. The plan has introduced the concept of Polluter Pay Principle (PPP) by taking into account the responsibility of producer, importer and consumer and the promotion of 3Rs as vital tools for the environmentally sound management of E-wastes, including 6 strategies as follows:

Strategy 1: Strengthening of import/export control
Key measures:
- Registration of e-product importer
- Promote import of standard-complied product
- Monitor impacts from FTA /AEC/MEA

Strategy 2: Promotion of eco-friendly e-products with the focus on public procurement
Key measures:
- Promote testing and certification of eco-product
- Propose a policy on e-product rental

Strategy 3: Development of E-waste database
Key measure:
- Develop data collection and reporting system

Strategy 4: Development of e-waste segregation, collection, storage and transport for local government
Key measures:
- Capacity building for local government
- Formulate laws on product fee and/or EPR

Strategy 5: Upgrade of dismantling and recycling facility
Key measures:
- Support R&D in recycling technology
- Support investment in environmentally sound recycling

Strategy 6: Promotion of public awareness on e-waste
Key measure:
- Disseminate e-waste knowledge through formal and informal education

1. Past Efforts in Drafting the Thai WEEE laws

Recognizing the gaps in the existing laws for a comprehensive management system of WEEE and other household hazardous wastes, the Pollution Control Department (PCD) formulated a policy and has commissioned several WEEE law development projects. The first effort started in 2004 with the development of the Draft Act on Promoting the Management of Hazardous Waste from Used Products, B.E. …. This draft Act proposed the determination of product fees to be collected from producers and importers and the establishment of a government fund to promote the management of hazardous waste from used products. It also prescribed penalties for non-compliance, the WEEE management system and the opportunity for the private sector to operate WEEE buy-back centres as well as hazardous waste treatment facilities. However, it was not clear whether a new fund should be established or whether it would be part of the existing Environmental Fund. During the same period, PCD in collaboration with 16 agencies drafted the National Integrated Strategy for the Management of Waste Electrical and Electronic Equipment (henceforth the Thai WEEE Strategy). The strategy was approved by the Cabinet on 24th July, 1997. The Cabinet assigned the Ministry of Natural Resources and Environment to coordinate among concerning agencies and monitor the implementation of the strategy. A national sub-committee was appointed under the National Environment Board (NEB) to steer and keep track on the progress of the task under the Thai WEEE Strategy. It should be pointed out that work plans on the legal development and the financial and fiscal mechanisms were clearly mentioned in the said strategy.

Between 2007 and 2011, the Fiscal Policy Office under the Ministry of Finance drafted an Act on Fiscal Measures for Environment B.E. (formerly known as “an Act on Economic Instruments for Environmental Management B.E. ...”). This draft Act would provide a framework for the use of 6

economic instruments for environmental management; (1) environmental taxes; (2) pollution management fees; (3) product tax and surcharge and buy-back system; (4) insurance for environmental risk and damage; (5) tradable permits for the rights to use natural resource or pollution emission rights; and (6) subsidies and other supporting measures.

The draft Act would allow concerning government agencies to use the economic instruments by enacting Royal Decrees and Ministerial Regulations. For the management of hazardous waste from used products, policymakers can use the product fee instrument which enables authorities to charge the fees from producers and importers who cause environmental impacts. Revenues from the product fees under this Act would be delivered to a new "Environmental Tax and Charge Fund". This new Fund was proposed to be established under the Ministry of Finance to execute the revenues from product fees and other economic instruments tax, pursuant to the objectives of using those economic instruments proposed by the concerning agencies. Given the size of the Ministry of Finance's draft law project, PCD cancelled its own draft act and instead began to develop subordinate laws which were to be enacted under the draft Act of Fiscal Measures for Environment B.E. (Thailand year))Pollution Control Department, 2011). Three subordinate laws were tabled:

1) Draft Royal Decree on Criteria, Methods, Conditions and Management of Revenue from Product Fees,
2) Draft Ministerial Regulation on Product Fees for Electrical and Electronic Products B.E. …., and
3) Draft Notification of the Ministry of Natural Resources and Environment on the List of Electrical and Electronic Products under Product Fee.

However, during the promulgation of the draft Act on Fiscal Measures for Environment B.E., the Fiscal Policy Office under the Ministry of Finance encountered critical problems and decided to terminate the project. While the Fiscal Policy Office salvaged part of the project and worked on draft Acts on Water Pollution Taxes and on Air Pollution Taxes, it did not follow up on the product fees. PCD, therefore, has to work on a legal framework for the WEEE management again at an Act level, which led to this study project. Although this delayed the WEEE law enactment process, the research team considered this as an opportunity for policy makers to review and find a WEEE management scheme which mostly suits the current context of Thailand.

2. Proposed Draft Act on the Management of WEEE and Other Household Hazardous Wastes

In 2014, Pollution Control Department (PCD) and Environmental Research Institute, Chulalongkorn University developed a legal framework and the draft Act which were subsequently revised after conducting a series of public consultation meetings between June and September 2014 and having close consultation with PCD and stakeholders throughout the study period. The draft Act was also developed based on the review findings on international experience, the consideration of the organizational preparedness in Thailand and the results of interview with private sector (producers, retailers and recyclers).

After conducting a legal review and analysis, the research team proposed that the WEEE

management system should be based on full EPR scheme. This is because the full EPR scheme involves fewer agencies that need organizational preparedness compared to the product fees scheme. In general, the key players of the full Extended Producer Responsibility (EPR) scheme are producers and importers that have international experiences in dealing with EPR laws elsewhere. The product fee scheme, meanwhile, involves several players, especially fee collecting agencies, the Environmental Fund Office, and the Local Administrative Organizations who would take an important role in establishing take-back centers and collecting WEEE from consumers but have little experience on the issue (while retailer take-back is regarded as an important mechanism for both schemes). Therefore, the proposed draft Act emphasizes the WEEE management scheme in which the producers will be the main responsible players in collaboration with other stakeholders. Nonetheless, the draft Act offers a policy option for the government (a national multi-stakeholder committee) to impose the product fee scheme for some certain product types or product groups deemed appropriate or to switch the management scheme for better implementation. To enable the product fee scheme, the government can issue a Ministerial Regulation on the determination of the criteria, methods, and conditions of product fee collection, and revenue management.

3. Draft Act on the Management of WEEE and Other End-of-Life Products

The research team proposed that the name of the draft Act be changed from "the Draft Act on the Management of Waste Electrical and Electronic Equipment and Household Hazardous Wastes" to "the Draft Act on the Management of WEEE and Other End-of-Life Products" since WEEE can be considered as a subset of "household hazardous wastes". However, if the scope of the law is limited to WEEE, we will lose the opportunity to control other non-WEEE items or "other end-of-life products", e.g. used dry-cell batteries, used chemicals containers, used tires, end-of-life vehicles (motorcycles and cars). These other end-of-life products have components of hazardous substances that may impact the environment and human health as well. Besides, the EPR scheme in other countries has been used to regulate these end-of-life products. The research team, therefore, proposed a change to the name of the Act. Nevertheless, WEEE should be priority products during the initial stage of the law implementation since WEEE has been studied for some time by the PCD and sufficient databases are now in place, especially on the estimation of WEEE, hazards, standards and technologies for proper management which can be used to support the law implementation.

The Draft Act on the Management of WEEE and Other End-of-Life Products consists of key topics as follows:

- Principle and Rationale
- Keyword Definition
- Chapter 1: The End-of-Life Product Management Board
- Chapter 2: Product Control
    - Part 1: Defining Regulated Products
    - Part 2: Control of Producers and Distributors
- Chapter 3: End-of-Life Product Management
    - Part 1: Discarding, Taking Back, Collection and Transportation
    - Part 2: Recycling, Treatment and Disposal
- Chapter 4: Target Setting

- Chapter 5: Revenue Management and Fund Subsidies
- Chapter 6: Monitoring and Controlling
- Chapter 7: Transitory Provisions

VIII. Existence of Policies, Guidelines, and Regulations Based on the Principle of Extended Producer Responsibility (EPR)

Status of implementation	Name of policies (year)	Product items covered by the policy
Fully implemented		
Postponement period before full implementation		
Under preparation of specific legislations	The Draft Act on the Management of WEEE and Other End-of-Life Products	1) televisions, both CRT and LCD/Plasma types, 2) Cameras/VDO recorders, 3) portable audio visual equipment, 4) printers and facsimiles, 5) telephones, 6) personal computers, 7) air conditioners, 8) refrigerators; 9) fluorescent lamps, and 10) dry-cell batteries
Existence of provisions supporting EPR principle		
Based on voluntary approach/agreement	WEEE Can Do campaign (2011-2012) by PCD	・ Used Fluorescence (Toshiba Lighting and Phillip Electronics Co.,Ltd) ・ Battery of mobile phone (DTAC Co., Ltd.) ・ Used mobile phone and accessories (Nokia Co., Ltd.)

Source: developed by author

There are several policies, guidelines, and regulations based on or related on the principle of extended producer responsibility (EPR) as follows.

- On 23rd March 2005, the Prime Minister presented the policies delivered to the National Assembly. As to the Natural Resources and Environmental Policy regarding the waste aspect, the Government will implement an environment-friendly waste disposal system and enhance waste disposal capacity of local administrative authorities. The Government will also promote the private sector's role in research and development for recycling of raw material and clean technology. In addition, *the Government will not allow Thailand to become an end receiver of waste, which has to bear the costs of waste and pollution.*
- National integrated waste management plan: The plan focused on the sustainable consumption

of the natural resources and the application of the 'cradle to grave concept, including control of waste generation at sources, increase on waste segregation and enhancement of waste utilization efficiency prior to the final disposal. The targets of waste minimization in this plan are to have the waste reduction scheme, to have the waste segregation system for reuse and recycling in every community over the country, and to minimize 30% of total waste generated within 2009.

- National master plan on the cleaner production and cleaner technology: As a baseline for industrial waste management, the plan promoted the cleaner production and cleaner technology in order to minimize pollutions from the production line and other industrial activities as well as the pollutions or hazardous substances in the product itself. In this regard, projects on waste reduction in pulp and paper industry and in the plastic industry have been initiated.
- Strategic Plan on Packaging and Packaging Waste Management (Draft): In an attempt to minimize the large volume of packaging waste each year, the Government has drafted the National Strategic Plan on Packaging and Packaging Waste Management, based on the integrated waste management approach and life cycle approach. It laid down measures for all relevant parties concerned to handle wastes generated from each stage of packaging life cycle, including design process, production, consumption, treatment and disposal. Thus, the strategies are divided into four target groups, including (1) designer, producer, importer and packer, (2) product transporter and distributor, (3) user and consumer, and (4) waste collector, transporter and processor.
- Government Green Procurement Policy Project: Thailand Environment Institute has initiated the Government Green Procurement Policy Project in order to solve Thailand environmental problems. Toward prevent pollution through government green procurement policy; green criteria would be included into procurement procedure, in addition to quality and price. The producer practice would also be changed to include life-cycle consideration to improve environmental impacts of their products and services.
- Thailand State Pollution Report 2013: indicated in policy proposal in its last chapter that regarding the pollution situation and future trends in Thailand, the implementation of pollution management in various aspects, analysis had been conducted on problems, difficulties, impacts on environment quality and people's health, pollution complaints and conditions affecting the development of the country. The analysis led to the proposal of a policy for pollution management that should promote "Solid Waste Management as a National Agenda". One of proposed actions is *organizing packaging or product take-back programs in accordance with Extended Producer Responsibility (EPR) principle by encouraging producers to be responsible for their products once they expire. This included collection, transportation and disposal of the products to ensure environmental safety*.
- The Promotion Plans for Environmentally Friendly Products and Services B.E. 2556 – 2559 (2013-2016): The cabinet agreed upon The Promotion Plans for Environmentally Friendly Products and Services B.E. 2556 – 2559 on August 29, 2013. This was to push the promotion plans for procuring products and services that were friendly to the environment of the governmental Sectors to be active and continuous, following the plan of the cabinet on January 22, 2008. The Promotion Plans for Environmentally Friendly Products and Services B.E. 2551 - 2554 (2008-2011) have been extended to the target groups such as the Local Administration Organization, state enterprises, universities, sectors under governmental control, and public

organizations. The governmental sectors have already participated in this project and have set up additional standards of products and services that were friendly to the environment such as gas stations. Furthermore, they also pushed this through the Comptroller General's Department (CGD) to adjust the Regulations of the Office of the Prime Minister on Procurement B.E. 2535 (1992) for the central and local governmental sectors to be able to procure the products and services that were friendly to the environment. The essence of the plans B.E. 2556 - 2559 showed its vision that Thailand will have sustainable development and would be friendly to the environment, with the sustainable mechanism of the production and consumption for maximizing the ability of the resources and for reducing pollution. This consisted of 4 strategies: *(1) the propulsion of the quantity of the procurement in the governmental sectors; (2) stimulating the production of the products and services which were friendly to the environment; (3) building a sustainable consumption of public and organizational sectors; and (4) the management and control of the promotion plan.*

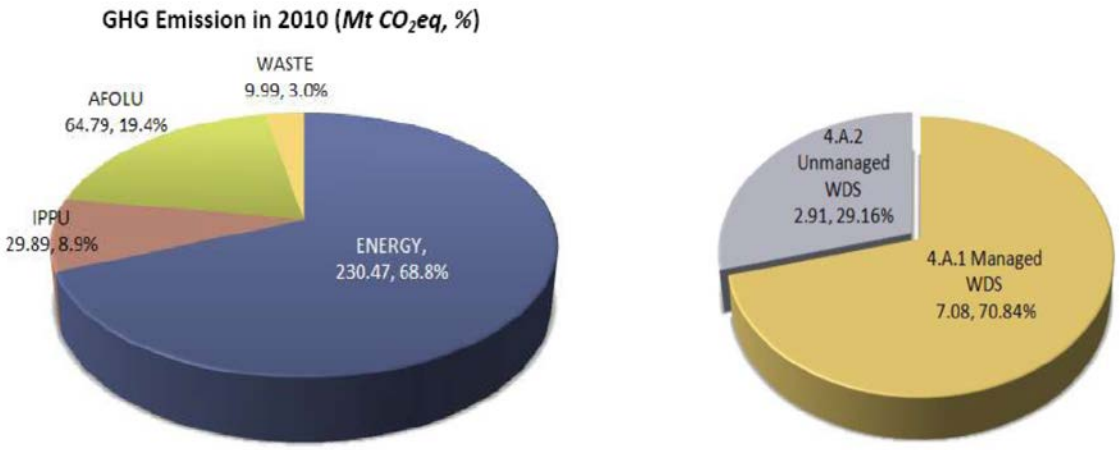
IX: GHG Emissions from Waste Sector

Thailand Greenhouse Gas Management Organization (Public organization) released a report on greenhouse gas emissions, calculating emissions and absorption between 2000 – 2010 according to the means and principle stated in the IPCC Guidelines for National Greenhouse Gas Inventories, Intergovernmental Panel on Climate Change: IPCC, Revised version of 2006 to meet the standard accordingly.

The calculation of emissions used activity data from the public sector, state enterprises, the private sector, and related agencies. The level for calculation was in Tier 1, with Default Value of Emission Factor from 2006 IPCC Guidelines. Besides, the Emission Factor in Tier 2 was also used in some activities where Thailand can refer to particular reference countries. For example, some sub-branch in industrial process and product use (IPPU), and agriculture, forestry, and land use sector (AFOLU). The report of calculation is divided into 4 sectors: Energy, Industrial and product use, Agriculture and Land use, and Waste. The six greenhouse gases were calculated, in accordance with United Nation, namely; Carbon Dioxide: CO_2, Methane: CH_4 Nitrous Oxide: N_2O, Hydrofluorocarbon: HFC, Perfluorocarbon: PFC, and Sulfur Hexafluoride: SF6. The national total emissions were reported as kgCO_2-equivalent.

The Waste sector emission report was divided into 4 categories as follows (4A) Solid Waste Disposal Site; (4B) Biological method management; (4C) Incineration in burner and open field; and (4D) Wastewater management. The Activity Data used was collected from PCD, Department of Industry, and Regional Environmental Office. The complete calculation in Waste sector was complete in one group i.e..4 A Solid Waste Disposal Site, where it was calculated in Tier 2 using First Order Decay Model (FOD) and national waste database in 2003-2005, according to Regional Environmental Office annual report for extrapolation of greenhouse gas emission between 2000 and 2010.

For reporting system, Greenhouse Gas Information Center established a database to file activity data collection, collected from different agencies, Emission Factor, and the greenhouse gas calculation results in order to record, edit, improve, calculate, and report in a systematic and continuous way, in templates on IPCC Worksheet Software in order for standard, reference, and comparison.



Source: TGO, 2011

Figure D-1 Volume and ratio of greenhouse gas emissions by Waste sector in 2010

*Remarks * Total emission 9.99 Mt CO_2eq*

According to the Greenhouse gas emissions report in 2010, (see Figure D-5 above) Thailand emitted 335.14 Mt CO_2 eq. The energy sector was the top emitter; 230.47 Mt CO_2 eq, or 68.8% of total greenhouse gas emissions. The first runner-up was agriculture, forestry, and land use (AFOLU) with 64.79 Mt CO_2 eq or 19.4%. The second runner-up was the Industrial sector and product use with 29.89 Mt CO_2 eq or 8.9% of total greenhouse gas emissions. The Waste sector emitted 10 Mt CO_2 eq, which was the lowest emitter, emitting only 3%.

From the calculation, in 2010, the Waste sector emitted 10 Mt CO_2 eq or 2.6% of total greenhouse gas emissions in the country, categorized into (1) Managed Waste Disposal Site: SWDs and (2) Unmanaged Waste Disposal Site: SWDs, emitting 7.08 and 2.91 Mt CO_2 eq, or 70.84% and 29.16% respectively, as shown in Figure D-5. The trend analysis for between 2000 and 2010 found the increase of greenhouse gas emissions to 8.6% per year by the Waste Sector, as shown in Table D-9.

Table D-9 GHG emissions from waste sector in 2010

Indicators	Data	Unit	Year	Reference
Total GHG Emissions from Waste Sector	9.32	Mt CO_2 eq	2000	Thailand Greenhouse Gas Management Organization (TGO), 2011
	9.99		2010	
Total GHG Emissions from Managed Solid Waste Disposal on Land	7.08	Mt CO_2 eq	2010	
Total GHG Emissions from Un-managed Solid Waste Disposal on Land	2.91	Mt CO_2 eq	2010	

Thailand has been dealing with climate change by setting up the National Committee on Climate Change and approved Thailand's Climate Change Master Plan 2015 – 2050 as proposed by the Office of Natural Resources and Environmental Policy and Planning (ONEP). The Master Plan has objectives to guide actions to mitigate and tackle problems arising from climate change, promote the conduct of appropriate and effective action plans in all sectors and levels, and encourage Thailand to move towards Low Carbon Society in accordance with the concept of "sufficient economy", by identifying the following 3 strategies:

1. Adaptation in order to respond to the impacts of climate change
2. Mitigation through greenhouse gas reduction and increase of sinks and reservoirs
3. Improvement in Thailand's capacity in managing risks associated with climate change

At present, the Ministry of Natural Resources and Environment is in the process of proposing the Master Plan for approval by the Cabinet.

E: EXPERT ASSESSMENT ON WASTE MANAGEMENT AND 3R POLICY

His Majesty the King Bhumibol Adulyadej of Thailand graciously conferred the philosophy of sufficiency economy based on Buddhist principles of self-reliance, self-satisfaction and the middle path on the entire nation in 1997. The philosophy as it is trusted to lead the nation to balanced development in a more secure way and it will lead to a more resilient and sustainable economy. The characteristics of sufficiency included moderation, reasonableness and effective self-immunity as risk management related to 3R conditions for decisions and activities based on knowledge and virtue (awareness, honesty, heart). The middle path is the best consideration for action such as moderation linking with reduce plus reuse and choose the right resources to reduce waste, reasonableness linking with reduce plus recycle besides consideration of factors involved rationally and careful anticipation of the outcomes or consequences, while effective self-immunity as risk management linking with well preparation to cope with impact and change.

The National Economic and Social Development Plan has been followed the path of sufficiency economy. The national policy and plan regarding the waste aspect line in implementation an environmental-friendly waste disposal system. The Environmental Management Plan 2012-2016 is a specific plan for management of natural resources and environment focused on strategies about (1) minimize waste generations by apply 3Rs (Reduce Reuse Recycle) principle (2) integrated waste management technologies for promoting waste utilization and reducing landfill spaces (3) clustering solid waste management among municipalities (4) Public Private Partnership for solid waste management (5) economic instrument (6) incentives for pollution prevention such as promotion for cleaner technology and production (CT/CP), zero waste technology, green product. E-waste policy as a part of National Integrated WEEE Management Strategy was approved by the cabinet on 24 July 2007. Draft act on the management of WEEE and other end of life products was approved by cabinet on 19 May 2015. Road map on waste and hazardous waste management approved by the National Council for Peace and Order on the 26th August 2014. The action plan “Thailand Zero Waste 2016” as national agenda including unlock, promote, and support waste utilization based on 3Rs waste segregation at sources under Maintenance of Public Sanitary and Order Act (no.2) B.E. 2560 (2017) are crucial fundamental for Thailand in waste management lead to practical achievement. Besides the principle “One stop service” by decentralized role of operator waste management to local organization under Ministry of Interior while Pollution Control Department (PCD), Office of Natural Resources and Environmental Policy and Planning (ONEP), and Department of Environmental Quality Promotion (DEQP) under ministry of Natural Resources and Environment involved in waste management as regulator and technical advisor. Capacity building for choosing technology proper to Thai society is prerequisite. In addition, simple activities e.g. use recycle materials collected and segregated from home or public place as goods and service either donation to temple for activity loving kindness and compassion of Buddhism manner or exchanged with other goods at Zero Baht Shop which can be realized that goods can be purchase without money. This activity provides sustainable consumption to community waste management “at-source segregation”.

REFERENCES

AIT/UNEP Regional Resource Center for Asia and the Pacific (RRC.AP).2010. Municipal Waste Management Report: Status-Quo and Issues in Southeast and East Asian Countries. (in English) (ISBN: 978-974-8257-73-0)

Bank of Thailand, "Statistical data EC_EI_027 Thailand's macro economic indicators," Last Updated: 31 September 2012, http://www2.bot.or.th/statistics /BOTWEBSTAT.aspx?reportID=409&language =ENG [retrieved 12 August 2012].

Bangkok Post, "Thailand: Government urged to tackle dioxin levels," as of 29 February 2008, http://www.asiapacificforum.net/news/thailand-government-urged-to-tackle-dioxin-level.html [retrieved 15 September 2009].

Central Database System and Data Standard for Marine and Coastal Resource, Department of Marine and Coastal Resource, MoNRE. 2015. Thailand coastal cleanup. (online). Available : http://www.dmcr.go.th/Thailandcoastalcleanup/ (Access March 2015).

Constitution of the Kingdom of Thailand, B.E. 2550, (2007) Bureau of Parliamentary Committee 3, The Secretariat of the House of Representatives, English translation by Pinai Nanakorn, 185 pp.

Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy. 2016. Biomass Database Potential in Thailand. (online). Available: http://weben.dede.go.th/webmax/content/biomass-database-potential-thailand (Access 6 Feb 2016).

Department of Environment, (2005) Solid waste management in Bangkok 2005, Bangkok Metropolitan Administration, 51 pp. (ISBN: 974-9565-82-7)

Department of Environment, (2008) Bangkok state of the environment 2006-2007, Bangkok Metropolitan Administration, pp.66-93.

Hoornweg, D., and Thomas, L., (1999) What a waste: Solid waste management in Asia. Working paper 1999/05/31, Report Number 19328, Urban Development Division, Transportation, Water and Urban Development Department, The WORLD BANK, Washington, DC. USA. 52 pp.

International POPs Elimination Network (IPEN), "Dioxin hotspot report-case study of municipal waste incinerators in Phuket and Samui," Campaign for Alternative Industry Network (CAIN), Greenpeace Southeast Asia (GPSEA), Alternative Agriculture Network (AAN). International POPs Elimination Project, March 2006, pp 3-9, http://www.ipen.org/ipenweb1/ library/iped_pdf_repo [retrieved 3 May 2009].

Ministry of Natural Resources and Environment. 2014. Country Report on Progress/ achievements/ initiatives towards implementation of the Ha Noi 3R Declaration – Sustainable 3R Goals for Asia and the Pacific (2013-2023). Available: Fifth Regional 3R Forum in Asia and the Pacific 25-27 February 2014, Surabaya, Indonesia

NESDB Economic Outlook. 2012. Thailand's Economic Fact Sheet. Bank of Thailand's Monthly Report 31 May 2012, http://www.mfa.go.th/business/ contents/files/eco-factsheet-20120630-201407-113428.pdf [retrieved 3 July 2012].

Nicro. S., and Vassanadumrongdee. S., (2007) State of Environmental Governance, Thailand Environment Institute, 73 pp. (in Thai) (ISBN: 978-974-8479-22-4)

Office of the National Economic and Social Development Board (NESDB), (2012) State of 3Rs in Thailand: draft as of 31 January 2016

Office of national resources and environmental policy and planning (ONEP), "Executive Summary: Preparation of Environmental Management Plan 2007-2011," http://www.onpe.go.th/eng/download/PEMP_2007_11_Summary.pdf [retrieved 15 June 2009].

Pollution Control Department, (2008) Integrated Management Strategy on Waste from Electrical and Electronic Equipment: WEEE, Ministry of Natural Resources and Environment. (in Thai) (ISBN: 978-974-286-377-7)

Pollution Control Department, (2012) Main Report on Drafting Law to Promote 3R, Ministry of Natural Resources and Environment. (in Thai)

Pollution Control Department, (2012) Pollution Management Plan 2012-2016, Ministry of Natural Resources and Environment. (in Thai) (ISBN: 978-974-286-955-7)

Pollution Control Department, (2014) Criteria and Technical Document related to Solid Waste and Hazardous Waste Management, Ministry of Natural Resources and Environment. (in Thai)

Pollution Control Department, (2014) Roadmap: Solid Waste and Hazardous Waste, Ministry of Natural Resources and Environment. (in Thai)

Pollution Control Department,)2014) Thailand State of Pollution Report 2013, Ministry of Natural Resources and Environment. (in English) (ISBN: 978-616-316-205-2)

Pollution Control Department, (2015) Thailand State of Pollution Report 2014 (draft), Ministry of Natural Resources and Environment, pp3-1-3-11.)in Thai)

Pollution Control Department, "State of solid waste 2004," http://infofile.pcd.go.th/mgt/pollution2547_4waste_en.pdf?CFID=4338698CFTOKEN=50698938 [retrieved 13 June 2009].

Pollution Control Department, "State of solid waste 2014," http://infofile.pcd.go.th/mgt/pollution2547_4waste_en.pdf?CFID=4338698CFTOKEN=50698938 [retrieved 18 Jan 2014].

Pollution Control Department, (2007) State of the pollution in Thailand B.E. 2549, Ministry of Natural Resources and Environment, pp 46-54. (in Thai) (ISBN: 978-974-286-345-6)

Pollution Control Department, (2008) Summary state of the pollution in Thailand B.E. 2550, Ministry of Natural Resources and Environment, pp 15-17. (in Thai) (ISBN: 978-974-286-516-0)

Pollution Control Department, (2009) Summary state of the pollution in Thailand B.E. 2551, Ministry of Natural Resources and Environment, pp 18-22. (in Thai) (ISBN: 978-974-286-638-9)

Pollution Control Department, "Project of drafted master law for the promotion of waste reduction reuse and recycling," Main Repert, PCD 04-106 volume 2/5, http://infofile.pcd.go.th/waste/drafted law3Rs-Eng [retrieved 13 June 2009].

Pollution Control Department, "Pollution Prevention and Mitigation Policy 1997-2016," Pollution from Solid Waste, Thai Environmental Regulation, http://www.pcd.go.th/info_serv/en_regulation.html [retrieved 20 August 2009].

Siriratpiriya, O., "Limitation or opportunity to utilize waste in Thailand," Proceeding, the Expert Meeting on Waste Management in Asia-Pacific Islands, 27-29 October 2005, Tokyo, Japan.

Siriratpiriya, O., "Needs of research and development for sustainable Thai society by 3 Rs of solid waste management," Proceeding, the 3rd Expert Meeting on Solid Waste Management in Asia-

Pacific Islands -Networking of Experts for Environmentally-sound Solid Waste Management and the 3Rs-, 7-9 November 2007, Okayama, Japan.

Strategy and Evaluation Department, (2012) Statistical profile of Bangkok Metropolitan Administration 2011, Bangkok Metropolitan Administration, Cabinet Publishing and Gazette Office, Samsaeng road, Dusit, Bangkok 10330, pp 4, 16-17, 140-152. (in Thai)

Thongkaimook, A., "3R portfolio- good practices to promote the 3Rs in Thailand," The Asia 3Rs Conference, October 30-November 1, 2006, Tokyo, Japan. http ://infofile.pcd.go.th/waste/waste_ 3Rs Port folio.pdf? [retrieved 13 June 2009].

Vanapruk. P, Khumpuak. S, and Tariya. A, (2007) Feasibility study of municipal solid wastes for electricity generation, Development of Environment and Energy Foundation, pp 17-36. (ISBN 978-974-8038-75-9)