STUDY ON PERCEPTIONS OF PRIVATE SECTOR TOWARDS THE POLLUTANT RELEASE AND TRANSFER REGISTER: A CASE STUDY ON PETROCHEMICAL INDUSTRY IN THE MAP TA PHUT INDUSTRIAL ESTATE, RAYONG, THAILAND

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การศึกษาความเข้าใจของภาคเอกชนเรื่องทำเนียบการปล่อยและเคลื่อนย้ายมลพิษ กรณีศึกษาอุตสาหกรรมปิโตรเคมีในนิคมอุตสาหกรรมมาบตาพุด จังหวัดระยอง ประเทศไทย

นางสาวมาริเอะ คอนโด

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรมหาบัณฑิต
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Field of Study	Environment Development and Sustainability
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มาริเอะ คอนโด : การศึกษาความเข้าใจของภาคเอกชนเรื่องทำเนียบการปล่อยและเคลื่อนย้ายมลพิษ กรณีศึกษาอุตสาหกรรมปิโตรเคมีในนิคมอุตสาหกรรมมาบตาพุด จังหวัดระยอง ประเทศไทย. (STUDY ON PERCEPTIONS OF PRIVATE SECTOR TOWARDS THE POLLUTANT RELEASE AND TRANSFER REGISTER: A CASE STUDY ON PETROCHEMICAL INDUSTRY IN THE MAP TA PHUT INDUSTRIAL ESTATE, RAYONG, THAILAND) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: อ. ดร.แสงจันทร์ ลิ้มจิรกาล, 80 หน้า.

ประเทศไทยได้ให้สัตยาบันปฏิญญาริโอและแผนปฏิบัติการ ๒๑ ในการประชุมสหประชาชาติว่าด้วยเรื่องสิ่งแวดล้อมและการพัฒนา และข้อตกลงระหว่างประเทศอื่น ๆ เช่น อนุสัญญาสตอกโฮล์มว่าด้วยสารมลพิษตกค้างยาวนาน และยุทธศาสตร์การดำเนินการระหว่างประเทศว่าด้วยการจัดการสารเคมี และกำลังดำเนินการจัดทำทำเนียบการปล่อยและเคลื่อนย้ายมลพิษ ซึ่งมีโครงการนำร่องในจังหวัดระยอง โดยได้รับความร่วมมือจากหน่วยงานความร่วมมือระหว่างประเทศญี่ปุ่น (JICA) จัดทำโครงการนำร่องในจังหวัดระยอง งานวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาความเข้าใจของภาคเอกชนเรื่องทำเนียบการปล่อยและเคลื่อนย้ายมลพิษ กรณีศึกษาอุตสาหกรรมปิโตรเคมีในนิคมอุตสาหกรรมมาบตาพุดโดยทำการศึกษาทบทวนแนวคิดการพัฒนา และการประยุกต์ใช้ทำเนียบการปล่อย และเคลื่อนย้ายมลพิษ รวมทั้งอุตสาหกรรมปิโตรเคมีและการปล่อยมลพิษในประเทศไทย และดำเนินการเก็บข้อมูลโดยใช้แบบสอบถาม และสัมภาษณ์อุตสาหกรรมปิโตรเคมิคอล ๓๒ แห่ง หน่วยงานที่เกี่ยวข้อง ๔ แห่ง และผู้มีบทบาทสำคัญ ๔ คน

ผลการศึกษาจากแบบสอบถาม และการสัมภาษณ์เชิงลึกผู้มีส่วนได้ส่วนเสียจาก ภาคเอกชน ภาครัฐ และภาคประชาชน พบว่า อุตสาหกรรมปิโตรเคมีเข้าใจถึงประโยชน์ของการจัดทำทำเนียบการปล่อยและเคลื่อนย้ายมลพิษที่มีต่อภาคเอกชนและการบริหารจัดการอย่างยั่งยืนในภาคอุตสาหกรรม รวมทั้งมีประโยชน์อย่างชัดเจนต่อภาครัฐและภาคประชาชน ดังนั้นเพื่อให้การจัดทำทำเนียบการปล่อย และเคลื่อนย้ายมลพิษประสบความสำเร็จในประเทศไทย จึงควรที่จะเพิ่มความรู้ความเข้าใจเกี่ยวกับทำเนียบฯ และอันตรายของสารเคมีต่าง ๆ พร้อมทั้งเพิ่มความเข้าใจซึ่งกันและกันระหว่างผู้มีส่วนได้ส่วนเสียทุก ๆ ฝ่าย และการสร้างขีดความสามารถของภาครัฐและภาคเอกชนในการปรับปรุงกระบวนการจัดทำทำเนียบการปล่อยและเคลื่อนย้ายมลพิษ และควรมีการศึกษาวิจัยในอุตสาหกรรมอื่น ๆ ให้เข้าใจประโยชน์ของการจัดทำทำเนียบการปล่อยและเคลื่อนย้ายมลพิษในสภาพที่เหมาะสมต่อการของการดำเนินการของภาคเอกชน

สาขาวิชา...สิ่งแวดล้อม การพัฒนา และความยั่งยืน....ลายมือชื่อนิสิต.....

ปีการศึกษา..... 2554..... ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก .....

##5387557320: MAJOR ENVIRONMENT DEVELOPMENT AND SUSTAINABILITY
KEYWORDS: PERCEPTION / PRIVATE SECTOR / POLLUTANT RELEASE AND TRANSFER REGISTER [PRTR] / PETROCHEMICAL INDUSTRY / MAP TA PHUT INDUSTRIAL ESTATE

MARIE KONDO: STUDY ON PERCEPTIONS OF PRIVATE SECTOR TOWARDS THE POLLUTANT RELEASE AND TRANSFER REGISTER: A CASE STUDY ON PETROCHEMICAL INDUSTRY IN THE MAP TA PHUT INDUSTRIAL ESTATE, RAYONG, THAILAND. ADVISOR: SANGCHAN LIMJIRAKAN, D.Tech.Sc, 80 pp.

Under the Rio Declaration and Agenda 21 from the United Nations Conference on Environment and Development in 1992 and other international agreements such as the Stockholm Convention on Persistent Organic Pollutants and the Strategic Approach on International Chemical Management, Thailand is currently in the process of adopting the Pollutant Release and Transfer Register [PRTR] through the pilot project in Rayong province with the assistance from the Japan International Cooperation Agency. This research aimed to study perceptions of private sector towards the PRTR through a case study on the petrochemical industry in the Map Ta Phut Industrial Estate. The methodology used comprised reviews concept, development and application of the PRTR, as well as the petrochemical industry in Thailand and its emission. Data collection was conducted by interviewing and questionnaire to thirty-two petrochemical companies, four responsible organizations and four key informants.

Through semi-structured questionnaires and in-depth interviews towards various stakeholders including private sector, public sector and civil society, this study found that petrochemical industry in this study viewed that benefits of the PRTR for the government and civil society is quite clear, while each petrochemical company participated in this study has different understanding on such benefit for private sector to be as sustainable industrial management. Various incentive measures and concerns on the PRTR were also indicated in this study. In order to successfully implement the PRTR in Thailand, the research findings suggest that it would be important to increasing knowledge on the PRTR both public and private sectors and the risk of chemical substances, enhancing mutual understanding among stakeholders, and building the capacity of public sector to improve the PRTR process. Future research may increase the number of participants and focus on different kinds of industries or local communities. The relationships between the scale of company and needs of assistance would be also important to be studied more deeply for an effective implementation of the PRTR.

Field of Study: Environment Development and Sustainability Student's Signature……..….

Academic Year: 2011 Advisor's Signature……...……

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Ms. Sudthida Wongsathapornpat, Deputy Director, and Mr. Sonchai W, Program Officer, also deserve thanks for their tireless support with running the program and liaising with the Graduate School.

The research required input from various stakeholders on the Pollutant Release and Transfer Register [PRTR] including the petrochemical industry in the Map Ta Phut Industrial Estate and responsible organizations such as the Japan International Cooperation Agency, the Pollution Control Department, the Department of Industrial Works, and the Map Ta Phut Industrial Estate. Furthermore, other key informants (an academic, NGOs, a technical expert) gave precious opinions for this study. I do appreciate them.

Ms. Piyawan Suksri was very helpful with understanding the required paperwork and with the translation issues. I would like to thank her continuous assistance from enrolling in Chulalongkorn University to completing my thesis writing.

Lastly, I would like to thank my family, particularly my parents, and friends for their physical and mental supports. Through studying at Chulalongkorn University and writing this thesis, I learnt about not only the importance of sustainability, not only myself, but also my country and others as well.

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LIST OF ABBREVIATIONS

BOI	(Thailand) Board of Investment
DIW	Department of Industrial Works
FTIPC	Federation of Thai Industries, Petrochemical Industry Club
GDP	Gross Domestic Product
GMP	Good Manufacturing Practice
IEAT	Industrial Estate Authority of Thailand
IEC	International Electrotechnical Commission
IFCS	Intergovernmental Forum on Chemical Safety
ISO	International Organization for Standardization
JBICI	Japan Bank for International Cooperation Institute
JICA	Japan International Cooperation Agency
JPCA	Japan Petrochemical Industry Association
LBI	Lewis Bass International
MNRE	Ministry of Natural Resources and Environment
MOE	Ministry of the Environment
MOI	Ministry of Industry
MTPIE	Map Ta Phut Industrial Estate
NGO	Non-Governmental Organization
NRC	National Research Council
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OHSAS	Occupational Health and Safety Advisory Services
PCD	Pollution Control Department

POPs	Persistent Organic Pollutants
PRTR	Pollutant Release and Transfer Register
SAICM	Strategic Approach to International Chemical Management
SIM	Sustainable Industrial Management
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
VOCs	Volatile Organic Compounds
WCED	World Conference on Environment and Development

CHAPTER I

INTRODUCTION

1.1 Background and Importance of the Study

Along the rapid economic development, industrial pollution has caused various negative impacts on the surrounding environment and public health in both developed and developing countries. Pollution issues often create different interests among stakeholders that would make the issues more complicated and taken longer time to be solved. In this regard, the concept of sustainable development has been introduced to the world since 1987 in Our Common Future (the World Conference on Environment and Development [WCED], 1987). Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Humans cannot sustain their lives without considering the balance among the environment, society and economy.

A Pollutant Release and Transfer Register [PRTR] is becoming an important measure to address industrial pollution issues in many countries (Kerret and Gray, 2007). The Organisation for Economic Co-operation and Development [OECD], (2000) defined the PRTR as "an inventory of pollutants released to air, water and soil, and of waste transferred off-site for treatment and/or disposal. Facilities releasing one or more of the chemicals listed report periodically – usually annually – on what was released, how much, and to which environmental media". The PRTR enables interested parties to share information and communicate for solving pollution issues

together. The concept of the PRTR was one of the outcomes of the United Nations Conference on Environment and Development [UNCED] held in Rio de Janeiro in 1992 (Lerche, Mitsuzaki, Sorensen, Carlsen and Nielsen, 2004). Currently, Thailand is in the process of adopting the PRTR for better chemical management, which includes strengthening capacities to report or implement some international agreements such as the Stockholm Convention on Persistent Organic Pollutants [POPs] and the Strategic Approach to International Chemical Management [SAICM] (the Pollution Control Department [PCD], 2009).

The Map Ta Phut Industrial Estate [MTPIE] in Rayong province is one of the five major industrial estates in the Map Ta Phut Industrial Estates. It was established in 1989 (the Industry Estate Authority of Thailand [IEAT], n.d.: Online). The establishment was under the governmental policy (the Eastern Seaboard Development Program) to develop the eastern seaboard of Thailand to be one of the main industrial complexes (Muto, Takeuchi, and Koike, 2007). However, while economic development was growing, industrial pollution has caused the negative impacts on the environment and public health in the area (the Japan International Cooperation Agency [JICA], n.d.: Online). Although regulatory systems have been provided under an improvement including public and private sectors, it seems that pollution issues are still remained at the civil society concerns.

Regarding the problems taken place, the Japan International Cooperation Agency [JICA] has introduced and initiated a pilot project of the PRTR in Rayong province in 2011. In order to promote the using of the PRTR, a private sector would be one of the important stakeholders. This is because the PRTR is mainly relied on the

private sector for data relevant inventories. The petrochemical industry is considered as one of the crucial industries that could be applied the PRTR concept for sustainable industrial management. In this regard, the study on the perceptions of private sector towards the PRTR focusing on the petrochemical industry in the MTPIE is of interest applicable and meaningful for sustainable industrial pollution management.

1.2 Research Objective

- To study the perceptions of private sector towards the PRTR to be applicable for sustainable industrial pollution management focusing on the petrochemical industry in the MTPIE, Thailand.

1.3 Scope of the Study

- The study will focus on the concept, development and application of the PRTR using a pilot project initiated by the JICA in Rayong.
- Perceptions of private sector towards the PRTR will be studied by interviewing and using questionnaire towards stakeholders related on the petrochemical industry in the MTPIE, Rayong.

1.4 Expected Outcomes

- The outcomes of this study would be the potentials of the PRTR applicable for the petrochemical industry, correct information for pursuing an appropriate sustainable industrial management applying for industrial estates, and the usefulness of the PRTR on sustainable industrial pollution management not only for the petrochemical industry but also for other industries.

CHAPTER II

LITERATURE REVIEW

2.1 The Pollutant Release and Transfer Register [PRTR]

2.1.1 The PRTR: Background and Trend

The PRTR has been acknowledged as a way to address industrial pollution management in many countries (Kerret and Gray, 2007). The Organisation for Economic Co-operation and Development [OECD], (2000) defined the PRTR as "an inventory of pollutants released to air, water and soil, and of waste transferred off-site for treatment and/or disposal. Facilities releasing one or more of the chemicals listed report periodically – usually annually – on what was released, how much, and to which environmental media". According to the Ministry of the Environment [MOE] in Japan (n.d.: Online), currently the PRTR has been adopted by various countries such as Netherlands, the United States and Australia, etc.

The PRTR concept was one of the outcomes from the United Nations Conference on Environment and Development [UNCED] in Rio de Janeiro in 1992 (Lerche et al., 2004). The PRTR concept afterwards was introduced to the Chemicals Programme under the Environmental Health and Safety unit of the OECD (OECD, 2000). In 1996, the OECD Council issued a recommendation to start establishing the PRTR in the member states after developing suitable guidelines (OECD, 1996; Lerche et al., 2004).

According to the United Nations Environment Programme [UNEP] (2004), the PRTR has been promoted and encouraged by all major environmental meetings, such as the World Summit on Sustainable Development in Johannesburg in 2002, and the Intergovernmental Forum on Chemical Safety [IFCS] in its Session III in Salvador da Bahia and in Session IV in Bangkok in 2003. In May 2003, a Protocol on the PRTRs to the Aarhus Convention on access to information, public participation in decision-making, and access to justice in environmental matters was adopted by thirty six countries and the European Community in Kiev, Ukraine (UNEP, 2004).

Kerret and Gray (2007) summarized the common stated goals of the PRTR as promoting public right to know, monitoring of environmental policy, and promoting reductions in emissions and risk. Meanwhile, each country has different characteristics in the PRTR application such as kinds of chemical substances, types of industry to be registered, degrees of legal binding, a selection of emission sources and purposes of implementing the PRTR (OECD, 1996; Yoshida, 1999; Fukunaga, 2000). For example, each country may have different definitions of point source and diffuse source (or non-point source) depending on the specific scope of the inventory (OECD, 2003). In general, diffuse sources may include some or all of emissions from area, mobile, biogenic or geogenic sources (OECD, 2003). Kerret and Gray (2007) claimed that the similarities in the North American, the PRTRs created a narrow context for comparing the PRTR processes globally. Lofstedt, Ikeda, and Thompson (2000) also pointed out the importance of considering cultural differences in the PRTR through using the example of the PRTR establishment in Japan. They stated the confusion was occurred among the Japanese regulators because of using the United States model and ignoring cultural differences. Therefore, it is an important consideration on cultural

and situational differences before applying the PRTR in different countries.

2.1.2 The PRTR as a Risk Communication Approach

In Japan, the PRTR was a starting point to discuss the introduction of risk communication (Ishizaka and Tanaka, 2003). Risk communication can be defined differently depending on each organization or field of study. According to the National Research Council [NRC] in the United States, risk communication is defined as "an interactive process of exchange of information and opinion among individual, groups, and institutions" (NRC, 1989). Morgan, Fischhoff, Bostrom, Lave, and Atman (1992) defined risk communication as "any communication that supplies laypeople with information they need to make informed independent judgments about risks to health safety and environment". Referring this definition, Sudatip Yok Chaiwattanaroj, Herrera, Holmberg, Withasinee Oat Rattanabumrung, and Shapiro (2009) summarized risk communication as "an effective practice for communicating health safety and environmental risks".

Similar to risk communication, risk management is also crucial word for explaining the role of the PRTR. The idea of risk management is originated from software development. Boehm (1991) summarized the steps of risk management as assessment, analysis, planning, resolution, monitoring and control. Carr, Konda, Monarch, Ulrich and Walker (1993) developed a model for risk management; it is a continuous process with identify, analyze, plan, track, and control. In this model, communication is located in the center of the circle meaning that risk cannot be addressed adequately without risk communication (Carr et al., 1993).

In a case of Rayong where the Map Ta Phut Industrial Estate [MTPIE] is located, the risk communication of petrochemical pollution could be seen as it still inadequate communicates among stakeholders. Based on the interviews with related stakeholders in Rayong, Sudatip Yok Chaiwattanaroj et al. (2009) pointed that two-way communication had not been fully established yet among stakeholders regarding the risk communication of petrochemical pollution. In order to reduce the environmental risks of chemical substances as a whole, it is necessary for each stakeholder to make their efforts for reducing the emission of chemical substances with mutual cooperation (MOE, n.d.: Online). Stakeholders can share basic information about pollutants, and the emission data will be evaluated constantly in the PRTR; this means that stakeholders can analyze the effectiveness of their activities or policies through the PRTR (MOE, n.d.: Online). It seems that the PRTR could be one of the useful tools to improve risk communication through sharing information and increasing an understanding among stakeholders. .

2.1.3 The PRTR for Sustainable Development

As same as a variety of definitions towards risk communication, there are various definitions of sustainable development in different fields of study. According to the World Conference on Environment and Development [WCED] (1987), sustainable development is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. Although sustainable development literally means maintaining development overtime, as mentioned by Elliot (2006), it also stated the complex interdependencies

among economy, environment and society. This captures development as not contradictory to the environment; rather it could be sustainable through harmonizing the balance among environment, economy and society.

In Agenda 21, conference mission statement of the UNCED in 1992, it suggested governments to implement and improve their databases and inventories on chemical emissions (Lerche et al., 2004). Along with industrial development, chemical substances has been used and emitted increasingly. This may increase the risks on the environment and public health. In this situation, the PRTR could be a starting point to reduce the emission of chemical substances making environmental risks. The PRTR could be a platform to share the information among stakeholders. It would encourage stakeholders including civil society, private sectors, and governments to make their efforts to reduce environmental risks. Therefore, the PRTR would strengthen sustainable development through encouraging stakeholders to participate and cooperate for sustainable industrial pollution management.

2.2 Description of Petrochemical Manufacturing and Industry

2.2.1 Petrochemical Manufacturing: Definition and Practices

Petrochemical industry manufactures a wide variety of products through chemical reaction by using natural gas and crude oil as raw materials. Petrochemical industry creates basic materials such as plastics, synthetic fibers, synthetic rubbers, and synthetic detergents, which in turn are used in the production of consumer goods such as a television, clothes, soaps, paints, tires, shoes, fertilizers, and medicines (the

Japan Petrochemical Industry Association [JPCA], n.d.: Online).

According to the Federation of Thai Industries, Petrochemical Industry Club [FTIPC] (n.d.: Online), the petrochemical process starts after refining crude oil and natural gas. The raw materials (the so called feed-stocks) from the refinery such as naphtha, components of natural gas (such as butane), and some by-products of oil refining process (such as ethane and propane) are processed into cracking and other processes. After those processes, the basic petrochemicals are obtained: olefins (such as ethylene, propylene, butylenes, and butadiene) and aromatics (such as benzene, toluene, and xylenes). These products are processed into more specialized manufacturing, which can be divided into upstream, intermediate, and downstream industries. The processes of petrochemical manufacturing from petroleum to consumer goods are shown in the table 2.1 and 2.2.

Table 2.1 Examples of Petrochemical Manufacturing from Petroleum to Consumer Goods (modified from the FTICP, n.d.: Online)

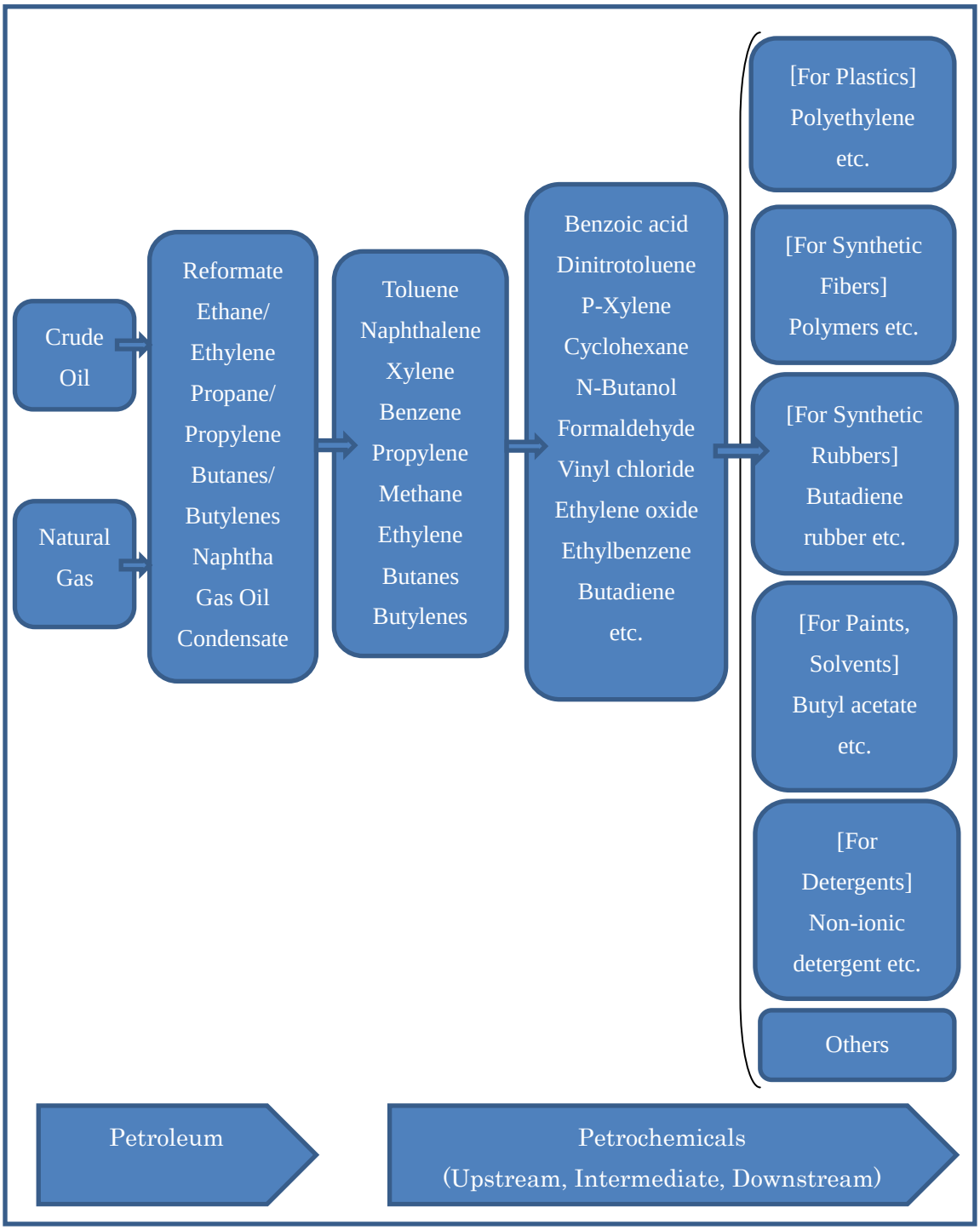


Table 2.2 Exemplified Petrochemical Processes of Toluene and Xylene
(modified from the FTICP, n.d.: Online)

Petroleum		Petrochemical Products			
		Upstream	Intermediate	Downstream	Application
Crude Oil	Reformate	Toluene	Benzyl chloride	Butyl benzyl phthalate	Vinyl resin plasticizer, etc.
			Benzoic acid	Sodium benzoate	Food preservative, Antiseptic, Medicine, Tobacco, Pharmaceuticals, etc.
					Plasticizers, Alkyd resins, etc.
			Dinitrotoluene Toluene diamine Toluene diisocyanate	Polyurethane foams	Furniture Cushioning, Auto seats, Rug underlay, Packaging, Mattresses, etc.
		Xylene	O-Xylene Phthalic anhydride		Alkyd resins, Plasticizers, Dyes, Insecticides, Pharmaceutical intermediates, etc.
			P-Xylene Dimethyl terephthalate Terephthalic acid	Polyester Polymer	Polyester fiber, Film & Resins, etc.

2.2.2 Pollutant Emission in Petrochemical Manufacturing Process

According to the World Bank Group (1998), in the process of petrochemical manufacturing, some of the emissions from pumps, valves, flanges, storage tanks, loading and unloading operations, wastewater treatments and other sources need to be considered and controlled carefully. This is because some of the compounds released to the air could have carcinogenic or toxic impacts. For example, ethylene and propylene emissions can cause the formation of extremely toxic oxides. Other compounds such as benzene, butadiene, 1, 2-dichloroethane, and vinyl chloride would be considered as carcinogenic. In a case of Volatile Organic Compounds [VOCs] (such as acetaldehyde, acetone, benzene, toluene, trichloroethylene, trichlorotoluene, and xylene), the releases depend on the production processes, materials-handling and effluent-treatment procedures, equipment maintenance, and climate conditions.

In addition, the Group (1998) states that accidental discharges especially from the polyethylene and ethylene-oxide-glycol plants in a petrochemical complex could be one of the environmental hazards by releasing the large amounts of pollutants and products into the environment. Therefore, it is well acknowledged as important to consider the matters of safety, health and environment in the petrochemical manufacturing.

On the other hand, the measures for pollution prevention and control in the petrochemical manufacturing could have benefits not only on the environment but also on the economy as well. For example, some of the chemicals lost in the manufacturing process from the storage tanks, product transfer areas and other

process areas can be recovered and reused for the manufacturing (the World Bank Group, 1998). Therefore, implementation of cleaner production processes and pollution prevention measures can be recommended for both environmental and economic benefits.

2.2.3 Petrochemical Industry in Thailand

According to the FTIPC (n.d.: Online), the petrochemical industry started in the early 1950s in Thailand with a slow pace of its growth reflected the small domestic demand for specialized petrochemical products and then began rapid development since large reserves of natural gas were found in the Gulf of Thailand in 1981. Thailand's government launched the Eastern Seaboard Project, and large amounts of public and private investments were flowed into this region. Although the Thailand's petrochemical industry was suffered during the economic crisis beginning in the middle of 1997, this industry is still one of the most important industries supporting the growth of Thailand's economy. Currently, the number of factories is seventy and that of employees is about 20,000 in the overall petrochemical industrial sector.

As noted before, the petrochemical industry is one of the most important industries contributing to the economic growth in Thailand. According to the FTIPC (n.d.: Online), total revenue of the petrochemical industry in Thailand, which includes a domestic downstream production plus upstream and intermediate exports, was 512,774 million Thai Baht in 2008. This amount shares about 5.8% of the Gross Domestic Product [GDP] of Thailand in 2008 (8,867,034 million Thai Baht).

Furthermore, the petrochemical industry is a crucial supplier for other industries such as machineries, manufactured goods, foods and beverages and agricultures. The export of petrochemical industry counts 253,294 million Thai Baht while the total export of Thailand was 5,254,999 million Thai Baht in 2007. This means the total export value of the petrochemical industry was about 4.8% of the total export of Thailand in 2007.

2.3 The JICA's Pilot Project on the PRTR

The PRTR project by the Japan International Cooperation Agency [JICA] is officially called as "the Development of Basic Schemes for PRTR System in Kingdom of Thailand" (JICA, n.d.: Online). R/D (Record of Discussion) of this technical cooperation project was signed by the JICA and the Thai authorities, namely the Department of Industrial Works [DIW] of the Ministry of Industry [MOI] and the Pollution Control Department [PCD] of the Ministry of Natural Resources and Environment [MNRE] in July 2010. In addition to the DIW and the PCD, the Industrial Estate Authority of Thailand [IEAT] also joined this pilot project in Rayong province, Thailand. This technical cooperation project started on 6 March 2011 and is supposed to be finished on 28 February 2015. Rayong province was chosen as a pilot trial because the Map Ta Phut and nearby areas are known as remarkable major places getting serious impacts from industrial pollution sources.

The main objective of this project is to develop a model for the PRTR system in Thailand. The PRTRs, known as a database system, provides public access to information on amounts of pollutants released from different point and/or non point

sources to each environmental medium (air, water, soil) and/or transferred off-site for waste management or wastewater treatment. The PRTR also encourages industry and business to reduce releases and transfers of waste and to adopt cleaner production techniques. In addition, the PRTR provide information for governments to develop plans for pollution prevention and control measurement for chemicals management in a sound manner.

Through the course of industrialization and urbanization, Thailand has experienced environmental issues, especially air pollution issue (JICA, n.d.: Online). Thailand has worked for solving air pollution issues through setting environmental standards and monitoring pollutants by set up nationwide monitoring stations. However, at present, the PCD is unable to identify the amount of chemical substances emitted and transferred inside Thailand whereas developed countries have been working on the establishment of the system in order to understand precisely. Therefore, the establishment of comprehensive system to understand the chemical substances emitted and transferred inside Thailand would be the next step for Thailand.

In the first Progress Report of this project (JICA, 2011), the JICA evaluated the progress of first six months from March to August 2011. The report included six outputs; namely (1) design of the PRTR system, (2) reporting systems from Industry, (3) estimation from point source, (4) estimation from non-point source, (5) utilization of PRTR data, and (6) risk communication. The organizational framework was structured as the first step, and responsible teams were set up so that each team can work for different section through encouraging cooperation among the PCD, the DIW

and the IEAT. In addition, stakeholder's involvement was promoted; for example, the JICA conducted meetings with the Non-Governmental Organization [NGO] and private sectors, respectively. Since this project is on-going at present, there would be continuous efforts with related stakeholders including governments, industries, and civil societies to build up the basic scheme of the PRTR in Thailand such as the guidelines for industry and the list of target substances for the PRTR in Thailand.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Study Area

The Map Ta Phut Industrial Estate [MTPIE], a state-own industrial estate, is located at the Map Ta Phut Industrial Area in Rayong province on the eastern coast of Thailand as shown in Figures 3.1, 3.2 and 3.3. This area is an important region for industrial development, especially for the petrochemical industry due to the Gulf of Thailand contains the petrochemical raw material reserves (Sudatip Yok Chaiwattanaroj et al., 2009). According to the Industry Estate Authority of Thailand [IEAT] (n.d.: Online), the MTPIE occupies an area of 9000 rai (1440 ha) comprising eighty-nine companies which thirty-two of them are petrochemical industrial businesses.

Figure 3.1 Map Ta Phut Area in Rayong Province

Source: National Health Commission Office, 2008

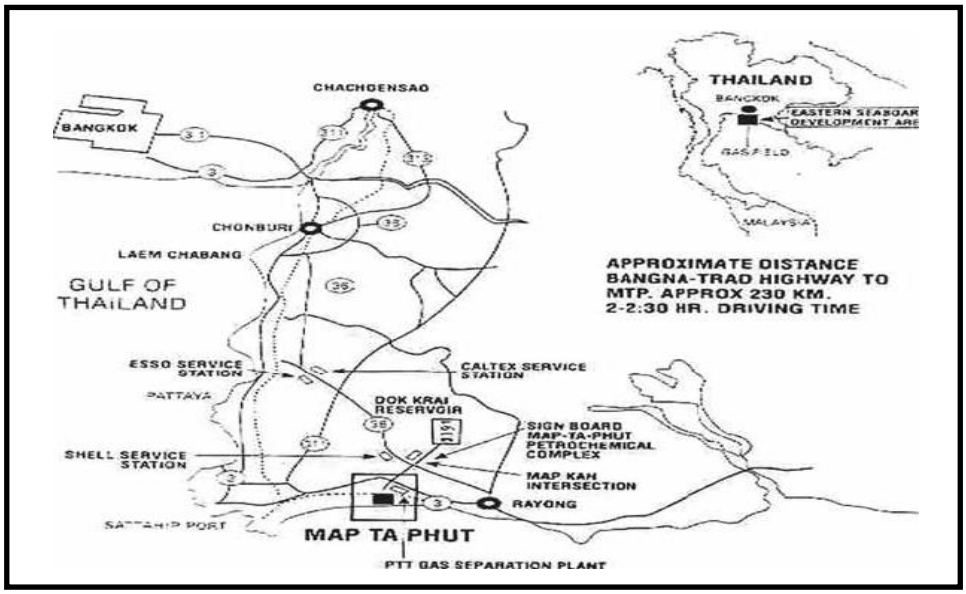
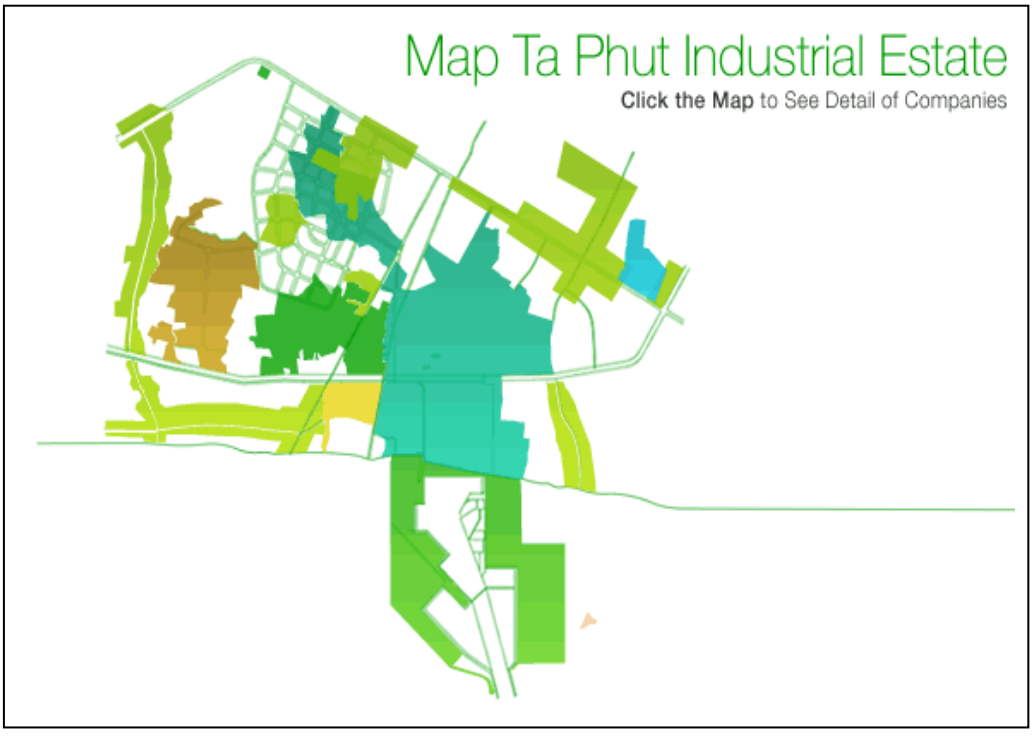


Figure 3.2 Map of the Map Ta Phut Area

Source: The BLCP Power Station, n.d.: Online

Figure 3.3 Map of the Map Ta Phut Industrial Estate

Source: IEAT, n.d.: Online



The MTPIE was established in Rayong province in 1989 under the governmental policy (the Eastern Seaboard Development Program) to develop the eastern seaboard of Thailand to be one of the main industrial complexes. From the beginning period of 1980s to the 1990s, Japan provided the large-scale assistance through the Official Development Assistance [ODA] loans for the comprehensive development of infrastructure towards the program including the Map Ta Phut Industrial Area (Muto, Takeuchi, and Koike, 2007). In the working paper of the Japan Bank for International Cooperation Institute [JBICI], Muto et al. (2007) stated that the development of infrastructure was a major factor to attract direct investment to the area. In addition, Japan has been played an important role not only as a donor but also as major investor for Thailand. The Thailand Board of Investment [BOI] (2011: Online) stated that the number of Japanese investment (applications approved) was 342 among the 856 total foreign investments in Thailand, which was 100,305 million Thai Baht among the total 279,233 million Thai Baht in 2010. This reveals the high investment of the Japanese investors in Thailand.

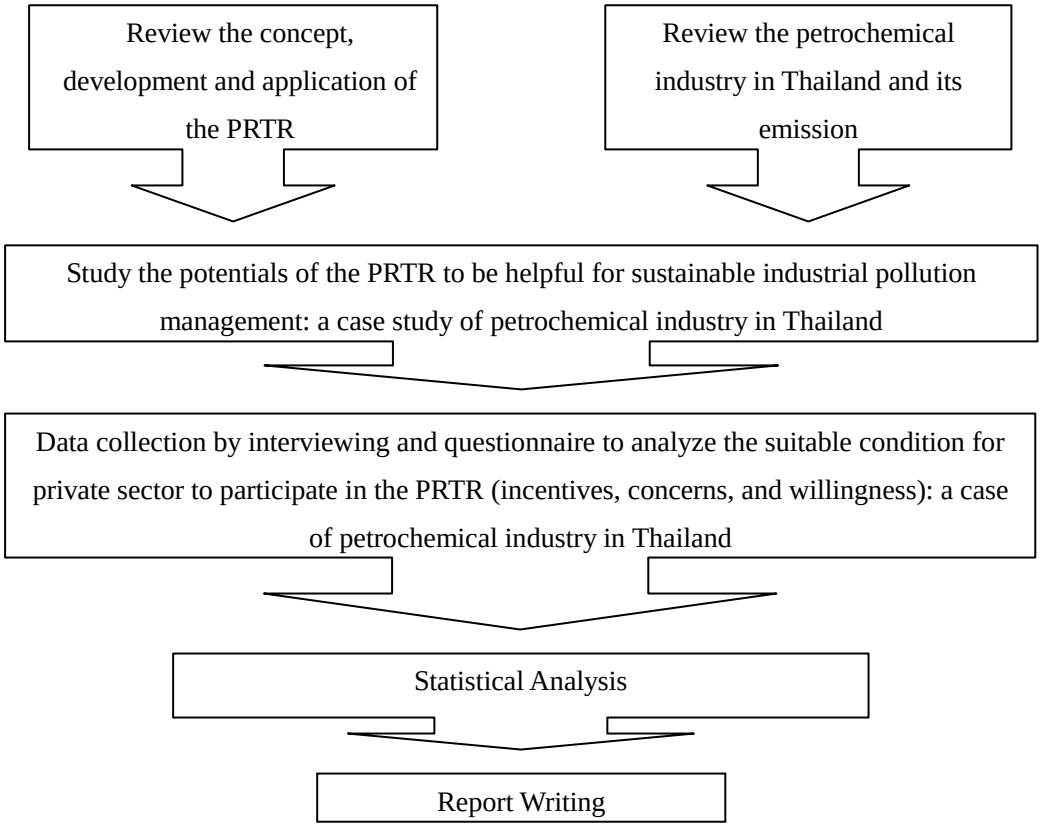
On the other hand, despite the development of export-oriented economy in Thailand, industrial pollution has been addressed and concerned by the civil society in the study area. Therefore, the meaningful system such as the Pollutant Release and Transfer Register [PRTR] for sustainable industrial pollution management needs to be established for the benefits of all stakeholders in this area.

3.2 Methodological Framework

The research is aimed to study the perceptions of private sector towards the

Pollutant Release and Transfer Register [PRTR] focusing on the petrochemical industry in the MTPIE, Thailand. Therefore, a conceptual framework was designed as shown in Figure 3.4.

Figure 3.4 Conceptual Framework



3.3 Data Collection

1) Correspondents

This study focuses mainly on the petrochemical industry at the MTPIE as a case study. Since the target population size is smaller than 200, the entire population could be treated as the sample (Israel, 1992: Online). In

addition, several responsible organizations and other key informants related to this industry are included in the study. Regarding the responsible organizations, the study included the Japan International Cooperation Agency [JICA], the Pollution Control Department [PCD], the Department of Industrial Works [DIW] and the Industry Estate Authority of Thailand [IEAT]. In addition, four key informants from an academic, a technical expert, Non-Governmental Organizations [NGOs] who participated in this pilot project both directly and indirectly were taken in this study in order to understand the usefulness of the PRTR and suitable conditions for private sector comprehensively.

2) Semi-structured Questionnaires

A set of questionnaires for the petrochemical industry in the MTPIE was developed which consisting of five parts, namely a company profile, an environmental reporting, a familiarity with the PRTR, potentials of the PRTR, and suitable conditions for private sector to implement the PRTR. The questionnaire was applied including open-ended and closed-ended questions with categorical or nominal response choices (Fink, 2003). Questionnaires for responsible organizations are similar to the questionnaire for the petrochemical industry, excluding a part of environmental reporting. Both questionnaires aimed to understand the usefulness of the PRTR for sustainable industrial management and suitable conditions for private sector to implement the PRTR process.

3) In-depth interviews

In-depth interviews to the petrochemical industry and responsible

organizations have contents of questions relating to the PRTR similar to the questionnaire applied to other correspondents. However, the in-depth interview was conducted as an open-ended question in order to obtain more details and reasons for how much of understanding on the usefulness of the PRTR for sustainable industrial management and the suitable condition for private sector to implement the PRTR process. Furthermore, other key informants (an academic, a PRTR expert, two NGOs) were interviewed to gain comprehensive understanding of persons relevant on this issue.

3.4 Data Analysis

Data analysis was conducted separately between semi-structured questionnaires and in-depth interviews. The questionnaires of both petrochemical industry and responsible organizations were analyzed by descriptive statistics, which describe "what is or what the data shows" (Trochim, 2006: Online). While in-depth interviews toward petrochemical industry were analyzed using the content analysis (Gillham, 2000). Some findings from the questionnaire analysis and the interview analysis–were integrated into other findings from the interviews to responsible organizations and other related informants so that this study can understand the relation among correspondents' perception in order to provide recommendation for the future practices.

CHAPTER IV

RESULTS AND DISCUSSION

As mentioned in Chapter 3, data related in this study were collected using the semi-structured questionnaire and the in-depth interview to thirty-two petrochemical companies, four responsible organizations and four key informants. But the responses were a low number from the petrochemical industry (six responses). Therefore, the findings based on data obtained from responses on such questionnaire and interview were analyzed and discussed. Table 4.1 is a list of participants relevant in the petrochemical industry in the Map Ta Phut Industrial Estate [MTPIE], responsible organizations, and other informants related to this pilot project on the Pollutant Release and Transfer Register [PRTR] in Rayong, Thailand. The ID for the petrochemical industry is “I” and the ID for responsible organization is “O” in the table.

Table 4.1: List of Participants (✓: Conducted, ×: Not conducted)

ID	Semi-structured Questionnaire	In-depth Interview
Petrochemical Industry		
I1	✓	✓
I2	✓	✓
I3	✓	×
I4	✓	×
I5	✓	✓
I6	×	✓
Responsible Organizations		
O1	✓	✓
O2	✓	×
O3	✓	✓
O4	✓	✓
Other Related Key Informants		
Academic	×	✓
PRTR Expert	×	✓ (through e-mails)
NGO 1	×	✓
NGO 2	×	✓

4.1 Semi-structured Questionnaires

The study using semi-structured questionnaires was conducted between January and April 2011. Five petrochemical companies agreed to answer the questionnaire. This means that the response rate of petrochemical industry for questionnaire was about 15.6% of the total thirty-two companies. While all of the four responsible organizations answered for the questionnaire.

Questionnaires were mainly written in English and translated into participant's native language if participants felt difficulties to answer in English. The questionnaire for the petrochemical industry is presented in Appendix A, while the one for the responsible organization is in Appendix B. The full set of questionnaire responses to all questions is included in Appendix C. Important findings from the questionnaire are discussed under nine categories as follows:

- Demographic of Participants
- Management Standards
- Environmental Reporting
- Familiarity with the PRTR
- Usefulness of the PRTR
- Incentive / Merit of the PRTR
- Needs of Assistance
- Importance of Non-point Source
- Benefits or Barriers of the PRTR

4.1.1 Demographic of Participants

Questions #2, #4, and #5 relate to the demographic of participants. Among five petrochemical companies which answered for the questionnaire, one was a president, one was a manager and three were engineers. On the other hand, among four responsible organizations, two were directors, one was an engineer, and one was an official representative.

On the scope of company operation, they were diverse among them that one was at a national level, two were at a regional level and other two were at an international / a global level. In terms of the number of employees, one company employs between 11-100 people, two companies employ between 101-500 people, and the other two companies employ between 501-1000 people.

4.1.2 Management Standards

All of the five participating companies indicated using the ISO 14001 (environmental management standards by the International Organization for Standardization [ISO]). Four companies (80% of the five participating companies) indicated ISO 9001 (quality management systems). Three companies (60% of the five participating companies) were engaged with Responsible Care (initiative for health, safety and environmental performance). Additionally, there are other standards and certification schemes mentioned by the participated petrochemical industry, namely OHSAS 18001 (occupational health and safety management system by the Occupational Health and Safety Advisory Services [OHSAS]), ISO/IEC 17025

(general requirements for the competence of testing and calibration laboratories by the ISO and the International Electrotechnical Commission [IEC]), GMP [Good Manufacturing Practice] (production and testing practice to ensure a quality product), and Safety Standard by Lewis Bass International group [LBI] (safety engineering firm).

4.1.3 Environmental Reporting

Questions #7, #8, and #9 were designed to understand the environmental reporting and risk communication practices by the petrochemical industry in the MTPIE. All of the five petrochemical companies have monitored the emission to the air, water, and hazardous waste, and reported those data to several responsible agencies. In addition, they released or provided the environmental information through various medias. All of the five participating companies indicated "Environmental Report" for providing the environmental information. Three companies (60% of the five participating companies) made the information available through "Own Webpage". Two companies (40% of the five participating companies) reported through "Responsible Care Report". Also, two companies (40% of the five participating companies) indicated "Event on the subject of the environment and safety" in order to provide and release the environmental information. "Corporate Brochures", "Asset Securities Report/Business Report", "Periodic Explanation or Contact with Civil Organization", "Observation tour or exhibition at the company place", "Disaster drills participated by the civil society", "Participation in the explanatory meeting or dialogue organized by the local governments as an elucidator", "Participation in the explanatory meeting or dialogue organized by the civil society as

an elucidator", "Participation in the committee organized by local governments" and "Respond only when there is a request of information" were indicated by one company (20% of the five participating companies) respectively. No participating companies were using "Environmental Accounting Reporting", "Catalog/Pamphlet", "Public Relations Magazine", "Advertising", "Sending workers as a lecturer for seminar or assembly", "Participation in the explanatory meeting or dialogue organized by the business organization as an elucidator", "Submitting/offering documents for the media" and "Submitting to an academic journal".

4.1.4 Familiarity with the PRTR

Question #11 asked the familiarity with the term "PRTR" by using the scale from number 1 (Not familiar) to 10 (Most familiar / Expert). Two petrochemical companies ranked "3" while other three petrochemical companies ranked "4", "5" and "8", respectively. Rating average for the familiarity of the petrochemical industry in this study was about "4.6". On the other hand, responsible organizations ranked the familiarity of private sector in Thailand based on their assumptions. The rating average was about "4.5". This is quite similar to the rating average of the petrochemical industry itself. However, there was a range among responsible organizations' answers for their assumptions on the familiarity of the petrochemical industry with the term "PRTR" because one organization indicated "2" (the lowest point) and another organization indicated "6" (the highest point). Additionally, the rating average of the four responsible organizations on their own familiarity with the PRTR was "7.5".

4.1.5 Usefulness of the PRTR

Questions #12 to #15 tried to understand the participants' viewpoints on the usefulness of the PRTR for Sustainable Industrial Management [SIM]. Two petrochemical companies answered "Yes" while other two answered "More or less" and another one indicated "Not sure". The last one indicated "Not sure" because of many kinds of reports on pollution release presently. While, all of the four responsible organizations indicated "Yes" for the question #12.

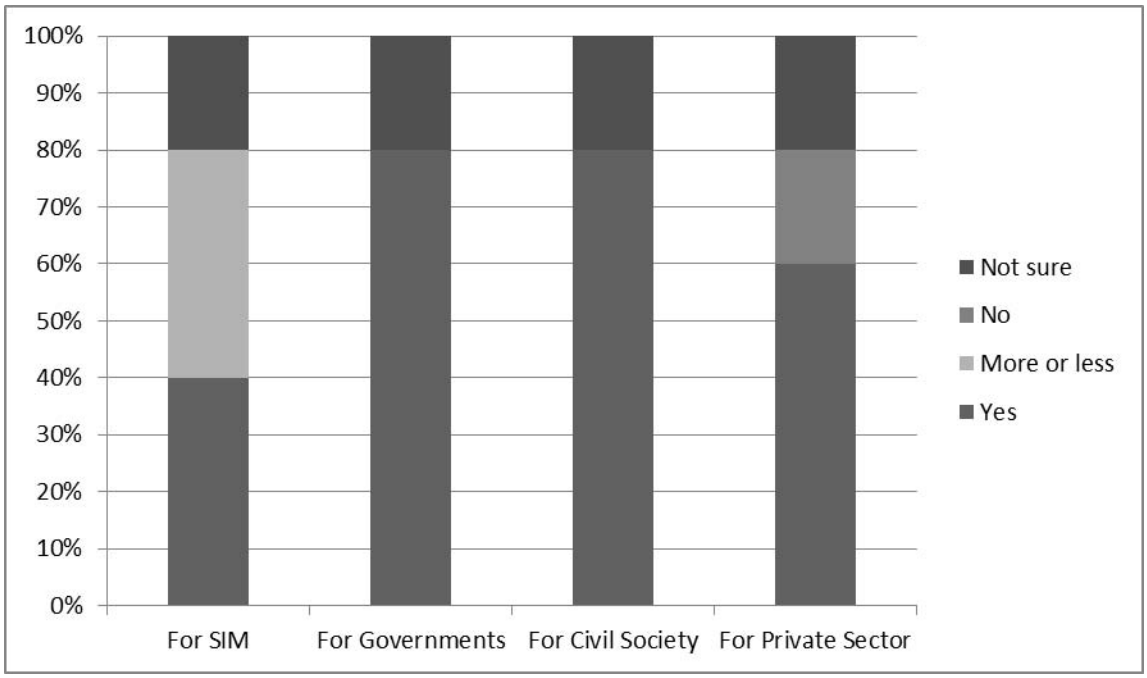
For the question on the usefulness of the PRTR for the Thai governments was well-understood among them. Four petrochemical companies and four responsible organizations indicated "Yes". While one petrochemical company indicated "Not sure" because of the obscurity in the governmental policy.

For the question on the usefulness of the PRTR for civil society was also well-understood among the petrochemical industry and responsible organizations while one petrochemical company indicated "Not sure". On the other hand, for the question on the usefulness for private sector, one petrochemical company indicated "No" and another petrochemical company indicated "Not sure". Despite these two companies, other three petrochemical companies and all of the four responsible organizations indicated "Yes".

It seems that the understanding of the petrochemical industry on the usefulness of the PRTR is different depending on each stakeholder, namely governments, civil society, and private sector. On the other hand, the responsible

organizations see the usefulness of the PRTR similarly for all of the stakeholders. Figure 4.1 shows the petrochemical industry's perceptions on the usefulness of the PRTR.

Figure 4.1 Chart of Private Sector's Perceptions on the Usefulness of the PRTR



4.1.6 Incentive / Merit of the PRTR

The question #16 asked about incentives or merits of the PRTR for private sector. This question was an open-ended question. Only one petrochemical company mentioned economic incentives such as tax reduction and tax refund while most of the participated companies indicated other incentives such as benchmarking, technology transfers, and an improvement of environmental management. However, there was one petrochemical company mentioned some difficulties to find incentives of the PRTR due to the increase of costs.

On the other hand, responsible organizations pointed out other incentives such as enhancing communication with other stakeholders and reducing costs through improving the management. While only one organization recommended to use rewards in order to create incentives for private sector.

4.1.7 Needs of Assistance

Question #17 tried to understand what kinds of assistance would be necessary for private sector to implement the PRTR. Six kinds of assistance were listed, namely “financial assistance / funding”, “technology transfer / material support”, “management consulting / advisory services”, “training of staff / personal”, “research collaboration”, and “cooperation with other stakeholders”. This question asked about the levels of necessity on each assistance, namely “Absolutely necessary”, “Highly important”, “Preferable but not necessary” and “Not a factor / Irrelevant”.

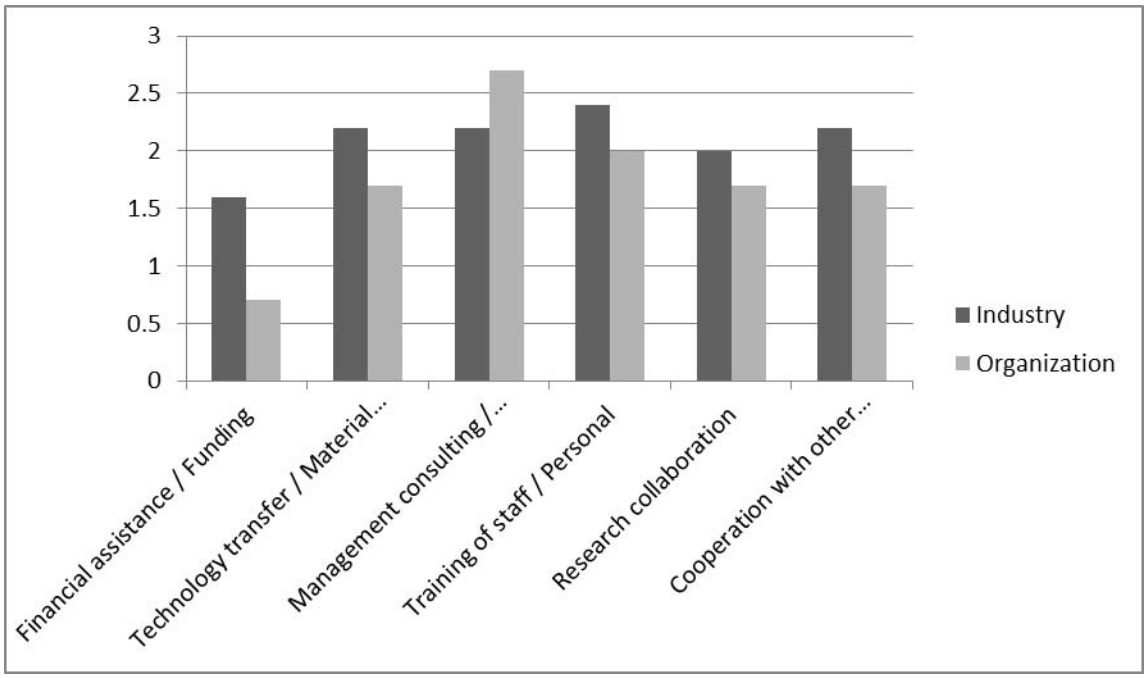
Five companies and three responsible organizations answered for question #17. There was one responsible organization indicated “Not sure” for question #17 because they are still in the process of designing the basic PRTR scheme.

For the levels of necessity, this designed into the scale of 3, 2, 1, and 0. “Absolutely necessary” is equal to 3, “Highly important” is equal to 2, “Preferable but not necessary” is equal to 1, and “Not a factor / Irrelevant” is equal to 0. For the petrochemical industry, financial assistance / funding was indicated at average of 1.6, technology transfer / material support was 2.3, management consulting / advisory

services was 2.2, training of staff / personal was 2.4, research collaboration was 2.0, and cooperation with other stakeholders was 2.2.

For the responsible organizations, the financial assistance / funding was indicated at average of 0.7, technology transfer / material support was 1.7, management consulting / advisory services was 2.7, training of staff / personal was 2.0, research collaboration was 1.7, and cooperation with other stakeholders was 1.7. Figure 4.2 shows the comparison of perceptions on needs of assistance between petrochemical industry and responsible organizations.

Figure 4.2 Comparison of Perceptions on the Needs of Assistance



Among six categories needed to assist, the petrochemical industry mentioned that “Training of staff / Personal” was highly in need of assistance, while “Financial assistance / Funding” was less need than other assistance. On the other hand, responsible organizations ranked “Management consulting / Advisory services” as the

highest level of necessity to be assisted and “Financial assistance / Funding” was in the lowest need of necessity for private sector that confirm with the views of the petrochemical industry. Based on these answers, it can be suggested that “Training of staff / Personal” is one of one of the most important assistance for the petrochemical industry.

4.1.8 Importance of Non-point Source

Question #18 asked the perceptions towards the importance of including the emission from non-point sources such as mobile, agricultural, and household sources. All of the four responsible organizations and three petrochemical companies stated that the PRTR should include non-point sources while other two petrochemical companies answered that the PRTR in Thailand did not need to include non-point sources.

4.1.9 Benefits or Barriers of the PRTR

Question #19 was an open-ended question to understand benefits or barriers of the PRTR. There are only two petrochemical companies that indicated some benefits of the PRTR. These petrochemical companies indicated that the government would benefit on the environmental management, one company indicated that there would be no benefit in the PRTR.

The three responsible organizations indicated the benefits of the PRTR not only for the governments but also for other stakeholders. For example, constructive

discussions about the chemical substances and its risks, supporting the sustainable development, reductions of damage costs, and increases of production were pointed out as benefits of the PRTR.

When it comes to barriers of the PRTR, one petrochemical company mentioned the complexity of data and the clarity of its definitions. This company also stated some burdens due to some overlaps in the reporting systems. Another petrochemical company declared the necessity of guideline and/or assistance on how to do the PRTR for the first period of implementing the PRTR. On the other hand, one responsible organization indicated no data input / wrong information, insufficient training program, and lack of sustainable management, while another one indicated how to calculate the emission factor correctly and the lack of awareness and capacity in the governmental sector.

4.2 In-depth Interviews

The study using in-depth interviews was conducted between January and April 2011. Four petrochemical companies agreed to answer the interview. This means that the response rate of petrochemical industry for interview was about 12.5% of the total thirty-two companies. The interviews were conducted mainly in English, but also in Japanese or Thai language if participants felt difficulties to answer in English.

Since the population size is quite small and also each person is a key informant for this study, therefore the interview could be seen as an appropriate

method (Gillham, 2000). Furthermore, Gillham (2000) mentioned that in case of a sensitive topic, face-to-face interview would be useful to build trust with informants and to obtain information that is not disclosed in the anonymous questionnaire.

Important findings from the interview towards petrochemical industry are analyzed by content analysis under these five categories as follows:

- Communication with People
- Merit of the PRTR
- Importance of Non-point Source
- Concerns towards the PRTR
- How to Implement the PRTR

Table 4.2 Analysis Grid for Content Analysis

Categories					
ID	1 Communication with people	2 Merit of the PRTR	3 Importance of non-point source	4 Concerns towards the PRTR	5 How to implement the PRTR
I1					
I2					
I5					
I6					

In addition to the four petrochemical companies, three responsible organizations and other three key informants (two NGOs and one academic) were interviewed. One technical expert on the PRTR answered questions via e-mail. Those answers were integrated, analyzed, and discussed.

4.2.1 Communication with People

During the interview, several companies mentioned about periodical meetings organized by the Industrial Estate once in every three months in the MTPIE. In the periodical meeting, officers from the Industrial Estate and representatives from the surrounding communities in the study area visited factories and shared opinions and/or questions with the petrochemical companies. Some petrochemical companies mentioned that what they were trying to do was not only to explain about their industrial operation but also to listen to the people's opinions and questions.

In addition to the meetings mentioned above, one company explained his efforts to communicate to people. The company visited the surrounding communities and organized a meeting with the people twice a month. This was because the company would like to inform their processes on protecting the safety and environment for local communities. Another company explained their initiatives to improve communication with people. For example, the company invites people to their plants in order to understand petrochemical processes and environmental measures. In addition, the company prepared mobile clinic for people, organized seminars for knowledge sharing, and created emergency manuals for the community. The company also mentioned their efforts for planting trees and providing scholarships for nursing course.

All of the four petrochemical companies participated in the interview seem to understand the importance of the communication with the people and put them into

practice. It seems that the petrochemical industry in this study is trying to make their efforts to enhance two-way communication with the people in their community.

4.2.2 Merit of the PRTR

Most of the petrochemical companies indicated some merits in the PRTR, excluding one company stated that there would be no merits for private sector to implement the PRTR. Two petrochemical companies mentioned in the interview that the PRTR can contribute to an improvement in the whole production processes and a recovery of the loss from the emission. One of the two companies explained that if the emission of the Volatile Organic Compounds [VOCs] in the process could be monitored, the VOCs can be recovered and reused as a raw material for polyethylene. The company also mentioned that reporting more detailed emission data for the PRTR can lead to build positive corporate images.

In addition to these merits of a recovery and an image building, another petrochemical company mentioned a merit of collecting the emission data of various pollutants based on the same standard within the PRTR flame-work. This company thinks that the standard should not be mixed with other standards because each standard has different logics. The company explained that if we use the mixed standards, it might lead to arguments and misunderstanding among stakeholders.

On the other hand, one petrochemical company indicated that there would be no merit directly contributed to business because of additional costs and manpower. However, this company also mentioned that it could be mandatory for private sector

to implement the PRTR from the perspectives of the civil society. The company also considered that it might be more important to investigate the causes of public health problem in that area and to increase an accurate knowledge about the risk of chemical substances among stakeholders, rather than to implement the PRTR.

It seems that the petrochemical industry in this study perceives the merits of the PRTR differently. An improvement in the whole production processes, a recovery of the loss from the emission, building positive corporate images, and collecting the emission data of various pollutants based on the same standard within the PRTR flame-work were indicated by three petrochemical companies in the interview, while another petrochemical company mentioned that there would be no merit directly contributed to business because of additional costs and manpower issues.

4.2.3 Importance of Non-point Source

All of the four petrochemical companies agreed that it was important to include the emission from non-point sources. Two petrochemical companies mentioned that chemical emissions from non-point sources such as mobile sources and households could have harmful impacts on the environment and society.

On the other hand, another petrochemical company mentioned that the priority should be the emission from factories in the beginning of this pilot project because it might be difficult to calculate the emission from non-point sources. This company agreed to include the emission from non-point sources if there is sufficient manpower to calculate the emissions. However, this company sees the lack of

capacity in the responsible organizations to calculate the emissions at present. Therefore, the company suggested focusing on point sources in the beginning of the pilot project, and then expanding to other sources in the process of implementing the PRTR.

It seems that all of the four petrochemical companies in the interview think that it is better to see the overall emissions of chemical substances not only from factories but also from other sources such as mobile and household sources. However, as one petrochemical company mentioned, it might be difficult to calculate emissions from those non-point sources precisely in the beginning of this pilot project in Thailand.

4.2.4 Concerns towards the PRTR

All of the four petrochemical companies in the interview expressed several concerns on the PRTR implemented in Thailand. One petrochemical industry pointed out the increase of costs and manpower issues. Meanwhile, another petrochemical company mainly concerned the manpower issue to implement the PRTR, rather than the cost issue.

Furthermore, other petrochemical company showed its concerns on the overlaps of reporting systems and a lack of governmental feedback for those collected data such as an analysis for improving their industrial managements.

The three petrochemical companies indicated their concerns on the ability of

stakeholders to understand the scientific data published in the PRTR accurately. This is because data could be too technical for the people to understand sufficiently.

It seems that each petrochemical industry has different concerns on the PRTR. This included costs, manpower, overlaps of reporting systems, and a lack of governmental feedback. Among the petrochemical industry in this study, the ability of stakeholders to understand the scientific PRTR data accurately seems to be one of the most important concerns to implement the PRTR effectively.

4.2.5 How to Implement the PRTR

Through the interview, petrochemical industry suggested several recommendations for implementing the PRTR successfully in Thailand. First of all, as mentioned in the previous section, stakeholders' understanding on the chemical substances seems to be crucial to implement the PRTR effectively. One petrochemical company indicated the importance of increasing the level of understanding among the civil society towards chemical substances before initiating the PRTR process.

Another petrochemical company suggested that the team for constructing the PRTR consisted of well understanding people on scientific aspects of the PRTR. This company also recommended preparing a neutral party for risk communication.

Furthermore, one suggestion was to ensure that the reporting system for the PRTR is neither overlapped with other existing reporting systems, nor too detailed in the beginning period of this pilot project so that this company is willing to voluntarily

participate in the PRTR.

Additionally, one petrochemical company mentioned that the private sector needs a clear plan and a guideline to implement the PRTR for the preparation of the report.

Through the interview, the petrochemical industry expressed their suggestions and/or requests for implementing the PRTR in Thailand such as an education towards stakeholders about chemical substances, ensuring the level of understanding on scientific aspects of the PRTR among team members for this PRTR pilot project, avoiding the overlapped or too detailed forms for the PRTR reporting, and informing private sector of a time line and guidelines for the PRTR project. These opinions would be important for responsible organizations to implement the PRTR effectively and efficiently in Thailand.

4.3 Discussion

4.3.1 Importance of Non-point Source

Importance of including emissions from non-point sources was widely agreed not only by the petrochemical industry, but also by the responsible organizations and other key informants. This is because emissions from non-point sources such as mobile and agricultural sources would have significant impacts on the environment and society as well as the emission from point source such as factories.

However, as several petrochemical companies, some responsible organizations, NGOs and an academic pointed out, it would be difficult for the governments to collect detailed data from non-point sources in the beginning period of this pilot project due to the lack of capacity in the governmental sector. One NGO mentioned that not only the industry but also the governments should be given supports such as funding and capacity building to manage the PRTR in Thailand. As suggested by some petrochemical companies, responsible organizations, NGOs, and an academic, it seems important to use simple method for estimating the emission from non-point sources in the beginning of the PRTR pilot project and gradually improve the precise level of estimation in the process of implementing the PRTR.

4.3.2 Scale of Company and Needs of Assistance

Regarding the needs of assistance for private sector to implement the PRTR, an academic and two petrochemical companies mentioned in the interview that large companies would be able to implement the PRTR more actively and easily than smaller companies. This is because large companies have more sufficient resources including technical, financial and knowledgeable human resources. One petrochemical company mentioned in the interview that it would be effective for the petrochemical industry to share the successful experiences of the large companies with other medium or small companies in Thailand.

However, in the questionnaire, the smallest petrochemical company in this study (11-100 employees) evaluated all of the six kinds of assistance as either “Preferable but not necessary” or “Not a factor / Irrelevant”. On the other hand, other

petrochemical companies, which are bigger than the smallest one, indicated their needs of assistance more highly than the smallest company indicated. These responses cannot be generalized as all of the small and medium sized companies in Thailand. However, the results from the questionnaire and the interview in this study might suggest that it would be necessary for responsible organizations to understand deeply what the small and medium companies need in deed to implement the PRTR.

4.3.3 Misunderstanding towards Private Sector

In-depth interviews of stakeholders found that there might be several misunderstanding towards private sector. It would be inappropriate to generalize the misunderstanding from the collected data in this study because only six petrochemical companies in the MTPIE participated and only eight informants from related organizations were included in this study. Under the consideration on this constraint, this section will try to increase better understanding towards private sector and enhance mutual understanding among stakeholders.

First of all, one of the key informants stated in the interview that the industry should not refuse to report for the PRTR. The key informant concerned that the industry might refuse to implement the PRTR because of the cost increases, difficulties to measure the emission, or the confidentiality of those data. This opinion could be regarded as misunderstanding to some extent because several petrochemical companies were willing to implement the PRTR. There was only one company reluctant to implement the PRTR, not only due to the cost and technical barriers, but also due to the stakeholders' ability to understand the scientific PRTR data correctly.

As mentioned by most of the companies in this study, what they concern is more than the cost and technological barriers. Rather, the overlaps in the reporting systems and the stakeholders' ability to understand the scientific PRTR data correctly seems to be their concerns to implement the PRTR.

Secondly, another key informant mentioned that the industry think only about the profit but not about the public. However, questionnaires and interviews to the petrochemical industry indicated their continuous efforts to communicate with the public and to improve their processes and measures for the environment and society.

Thirdly, there was another misunderstanding towards private sector by the responsible organizations. One of the responsible organizations mentioned that the industry will not join this project if the PRTR does not include non-point sources. However, some petrochemical companies mentioned that whether it includes the non-point sources or not, they were willing to implement the PRTR. Other petrochemical companies also indicated that what they concerned was not the non-point sources but rather the lack of scientific knowledge among stakeholders and the overlaps in the reporting systems.

Furthermore, one of the responsible organizations mentioned that the industry would implement the PRTR if the required data is not that different from the previous reporting or not harder than the previous one. On the other hand, two petrochemical companies mentioned their concerns on the overlaps of reporting systems. It is true that the technical issue is one of the industrial concerns. However, if the required data is not that different from the previous reporting, the industry might

be reluctant to report for the PRTR because of the overlaps in the reporting schemes. Therefore, responsible agencies might need to make sure that there is no overlap in the PRTR and other reporting schemes.

Based on the collected data from the questionnaires and interviews, this section tried to find out some misunderstanding towards the private sector among other stakeholders. Better understanding towards the private sector might be important to support the private sector's engagement in the PRTR and improve the risk communication among the stakeholders.

CHAPTER V

CONCLUSION

This research was carried out in order to study the perceptions of private sector towards the Pollutant Release and Transfer Register [PRTR] to be applicable for sustainable industrial pollution management focusing on the petrochemical industry in the Map Ta Phut Industrial Estate [MTPIE], Thailand. The research findings and results as mentioned in Chapter 4 can be concluded and recommended as follows.

5.1 Conclusion of Research Findings

5.1.1 Usefulness of the PRTR

As of Kerret and Gray (2007), the PRTR has three main objectives, namely promoting public right to know, monitoring of environmental policy, and promoting reductions in emissions and risk This means that the PRTR could be beneficial for each stakeholder including public sector, private sector and civil society.

In the questionnaire, the usefulness of the PRTR for the government and civil society was highly supported by the petrochemical industry more than the one for sustainable industrial development and private sector. Meanwhile, in the questionnaires and interviews, the petrochemical companies also indicated some positive aspects of the PRTR for private sector such as an improvement of environmental management, a recovery of the loss from the emission in the

production process and collecting the emission data using the same standard so that stakeholders can share information. In addition, one company reluctant to implement the PRTR, which indicated no benefit of the PRTR for private sector, mentioned that it could be mandatory for private sector to implement the PRTR from the wider viewpoints of the civil society.

In conclusion, the petrochemical industry in this study viewed that benefits of the PRTR for the government and civil society is quite clear, while each petrochemical company participated in this study has different understanding on such benefit for private sector to be as sustainable industrial management.

5.1.2 Suitable Conditions for Private Sector

In order to implement the PRTR effectively, private sector is one of the important stakeholders due to data relevant inventories. The study found that suitable conditions for the private sector to engage in the PRTR process composed of incentives, concerns, and needs of assistance.

Various measures to build up any incentive for private sector to implement the PRTR such as tax reductions, benchmarking, technology transfers, and improvements of environmental management were mentioned by the petrochemical industry participated in this study. Various positive aspects of the PRTR for private sector were also indicated such as a recovery of the loss in the process, building good corporate images, and collecting emission data comprehensively using the same standard. These positive aspects could be counted as good incentives. Promoting these

various aspects of the PRTR would help to increase the comprehensive understanding on the benefits of the PRTR among private sector and promote the participation of private sector in the PRTR process.

Furthermore, the petrochemical industry in this study expressed their concerns on the PRTR such as cost increases, overlaps in reporting systems, manpower needs, the lack of governmental feedback, and the lack of knowledge on chemical substances among stakeholders. These would be important concerns to be solved before and through the process of the PRTR's implementation.

The study also found that training of staff is more important than funding for the industry. Therefore, capacity building of human resources is more helpful than financial assistance. However, there are differences among the petrochemical companies referring the kinds of assistance and levels of needs to effectively implement the PRTR.

5.2 Recommendation

5.2.1 Implementation of the PRTR

In order to implement the PRTR in Thailand, this study suggests three recommendations based on research findings from questionnaires and interviews as follows.

1. Various participants who participate in this project need to carefully

understand the technical aspects of the PRTR. It is important to increase the understanding on both the PRTR and the risk of chemical substances among stakeholders.

2. It would be helpful if the PRTR project could create a neutral party in order to make the scientific PRTR data understandable to general public. The neutral party can be useful to improve risk communication among stakeholders so that the PRTR process could increase mutual understanding among stakeholders.

3. Capacity building, cooperation, and education among governmental and public sectors, would be crucial in order to implement the PRTR effectively in Thailand as mentioned by various participants from public sector, private sector, and civil society. The reason is that the government should firstly initiate the PRTR process and estimate emissions from non-point sources by using the simple methods for such emissions in the beginning of the PRTR implementation.

Another important suggestion agreed by various participants is the collaboration among stakeholders to effectively implement the PRTR towards sustainable development of Thailand.

5.2.2 Recommendation for Future Research

Due to various constraints such as language barriers, time constraints, and the sensitivity of the issue in the study area, this study was engaged by six petrochemical

companies. Therefore, it would be more significant if the future research can increase the number of participants in order to understand the perceptions of private sector towards the PRTR more comprehensively. Additionally, researching different kinds of industries or local communities would increase the understanding on the PRTR in Thailand.

Furthermore, as mentioned in Chapter 4, the relationships between the scale of company and needs of assistance would be important to be studied more deeply for an effective implementation of the PRTR. Moreover, this PRTR project in Thailand initiated by the Japan International Cooperation Agency [JICA] is currently in the step of constructing the basic scheme. In order to compare the results during the time period, pre-post monitoring and evaluation need to be followed up the private sector's perceptions towards the PRTR.

REFERENCES

BLCP Power Station. (n.d.). Contact Us: BLCP Power Station [Online]. Available from: http://www.blcp.co.th/2011/images/contact/map_blcp.gif [2012, April].

Boehm, B. W. (1991). Software Risk Management: Principles and Practices. Arlington, VA: Defence Advanced Research Project Agency.

Carr, M. J., Konda, S. L., Monarch, I., Ulrich, F. C., and Walker, C. F. (1993). Taxonomy-Based Risk Identification (Technical Report). Pennsylvania: Software Engineering Institute, Carnegie Mellon University.

Elliot, J. A. (2006). An Introduction to Sustainable Development. 3rd ed. Oxon: Routledge.

Federation of Thai Industries, Petrochemical Industry Club [FTIPC]. (n.d.). What is petrochemistry [Online]. Available from: http://www.ftipc.or.th/SHOWSHARE/WHATISPETROCHEMISTRY/tabid/90/language/en-US/Default.aspx [2012, January].

Fink, A. (2003). How to Ask Survey Questions. 2nd ed. Thousand Oaks, CA: Sage Publications, Inc.

Fukunaga, T. (2000). PRTR System in Japan Chemical Industry. Sumitomo Chemical Journal of Technology 2000 II, Feature Report on the Environment and Safety, pp. 35-39. Japan: Sumitomo Chemical Co., Ltd.

Gillham, B. (2000). Case Study Research Methods. London: Continuum.

Industrial Estate Authority of Thailand [IEAT]. (n.d.). Development of Eco-Industrial Estate and Networks Project: Progress [Online]. Available from: http://www.mtpie.com/dnt/mn_dnt.htm [2012, January].

Industrial Estate Authority of Thailand [IEAT]. (n.d.). Industrial Area in MTPIE [Online]. Available from: http://www.mtpie.com/indr/mn_indr.htm [2012,

April].

Ishizaka, K., and Tanaka, M. (2003). Resolving public conflict in site selection process – a risk communication approach. Waste Management. 23: 385-396.

Israel, G. D. (1992). Determining Sample Size [Online]. One of the series of the Agricultural Education and Communication Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, 7 pp. Institute of Food and Agricultural Sciences, University of Florida. Available from: http://edis.ifas.ufl.edu/pdffiles/PD/PD00600.pdf [2011, November].

Japan International Cooperation Agency [JICA]. (n.d.). Project for the Development of Basic Schemes for PRTR System in Kingdom of Thailand: Outline of the Project [Online]. Available from: http://www.jica.go.jp/project/english/thailand/013/index.html [2011, December].

Japan International Cooperation Agency [JICA]. (2011). Progress Report No.1 [Online]. Available from: http://www.jica.go.jp/project/english/thailand/013/news/general/pdf/110921_01_01.pdf [2012, January].

Japan Petrochemical Industry Association [JPCA]. (n.d.).What is Petrochemical? (assumed translation) [Online]. Available from: http://www.jpca.or.jp/junior/00what/sekiyukagaku.htm [2012, January].

Kerret, D., and Gray, G. M. (2007). What Do We Learn from Emissions Reporting? Analytical Considerations and Comparison of Pollutant Release and Transfer Registers in the United States, Canada, England, and Australia. Risk Analysis. 27 (1): 203-223.

Lerche, D., Mitsuzaki, S. Y., Sorensen, P. B., Carlsen, L., and Nielsen, O. J. (2004). Ranking of chemical substances based on the Japanese Pollutant Release and Transfer Register using partial order theory and random linear extensions. Chemosphere. 55: 1005-1025.

Lofstedt, E. R., Ikeda, S., and Thompson, K. M. (2000). Risk Management across the Globe: Insights from a Comparative Look at Sweden, Japan, and the United States. Risk Analysis. 20 (2): 157-161.

Ministry of the Environment [MOE]. (n.d.). PRTR Information Plaza: Why do we need the PRTR system? (assumed translation) [Online]. Available from: http://www.env.go.jp/chemi/prtr/about/about-2.html [2011, December].

Morgan, M. G., Fischhoff, B., Bostrom, A., Lave, L., and Atman, C. J. (1992). Communicating risk to the public. Journal of Environmental Science and Technology. 26: 2048-2056.

Muto, M., Takeuchi, T., and Koike, N. (2007). Policy Coherence in Development: Case Study of East Asia. JBICI Working Paper No. 24, 68 pp. Japan Bank for International Cooperation Institute [JBICI].

National Health Commission Office. (2008). HIA for HPP towards Healthy Nation: Thailand's Recent Experiences. Chiangmai: Wanida Press.

National Research Council [NRC]. (1989). Improving Risk Communication. Washington, DC: National Academy Press.

Organisation for Economic and Co-operation and Development [OECD]. (1996). Pollutant Release and Transfer Registers (PRTRs): A Tool for environmental Policy and Sustainable Development - Guidance Manual for Governments.141 pp., Paris: OECD.

Organisation for Economic and Co-operation and Development [OECD]. (2000). PRTR Implementation: Member Country Progress. 104 pp., Paris: OECD.

Organisation for Economic and Co-operation and Development [OECD]. (2003). Resource Compendium of PRTR Release Estimation Techniques, Part 2: Summary of Diffuse Source Techniques. 107 pp., Paris: OECD.

Pollution Control Department [PCD]. (2009). Let's understand PRTR (assumed translation), 15 pp. Bangkok: Ministry of Natural Resources and Environment [MNRE]. (Pamphlet)

Sudatip Yok Chaiwattanaroj., Herrera, M., Holmberg, R., Withasinee Oat Rattanabumrung., and Shapiro, H. (2009). Risk Communication in Thailand: A Case Study in Rayong Province. Bachelor's Thesis, Faculty of Worcester Polytechnic Institute, Chulalongkorn University.

Thailand Board Of Investment. [BOI]. (2011). Foreign Direct Investment from Major Countries [Online]. Available from: http://www.boi.go.th/english/download/statistics_foreign_investment/261/FINV117.pdf [2011, July].

Trochim, W. M. K. (2006). Descriptive Statistics [Online]. Available from: http://www.socialresearchmethods.net/kb/statdesc.php [2012, January].

United Nations Environment Programme [UNEP]. (2004). Report on the Regional Workshop on Pollutant Release and Transfer Registers (PRTRs) for ASEAN Countries. 23 pp., Geneva: UNEP.

World Bank Group. (1998). Petrochemicals Manufacturing. Pollution Prevention and Abatement Handbook, pp. 371-376.

World Conference on Environment and Development [WCED]. (1987). Our Common Future. Oxford: Oxford University Press.

Yoshida, F. (1999). Environmental Information Disclosure System: Process of Implementing the PRTR in Japan (assumed translation). Journal of Economics & Business Administration. 179 (1): 19-34.

APPENDICES

APPENDIX A

QUESTIONNAIRE FOR PETROCHEMICAL INDUSTRY

The following is the copy of the questionnaire prepared for petrochemical industry. It contains an introduction of this study (one page) and twenty questions (five pages).

Thank you very much for your interest and cooperation in this research.

My name is Marie Kondo and my Master's degree thesis at Chulalongkorn University is titled "Study on Perceptions of Private Sector towards the Pollutant Release and Transfer Register: A Case Study on Petrochemical Industry in the Map Ta Phut Industrial Estate, Rayong, Thailand".

This research aims to study the perceptions of private sector towards the Pollutant Release and Transfer Register [PRTR] through a case study on petrochemical industry in the Map Ta Phut Industrial Estate. In this regard, I would like to study your perceptions on the PRTR in this questionnaire.

The PRTR is a new way of comprehensive chemical management defined as "an inventory of pollutants released to air, water and soil, and of waste transferred off-site for treatment and/or disposal. Facilities releasing one or more of the chemicals listed report periodically – usually annually – on what was released, how much, and to which environmental media". Cooperating with the Pollution Control Department [PCD], Department of Industrial Works [DIW] and Industry Estate Authority of Thailand [IEAT], Japan International Cooperation Agency [JICA] has initiated one pilot project for constructing basic scheme of the PRTR in Rayong province in 2011.

By completing this survey, your response and collaboration would make the PRTR process and its level of engagement by private sector to be conducted successfully in Thailand. Currently, the concept of PRTR can be regarded as new for Thailand. It is my hope that my research will share information on the PRTR as it is demonstrated in Thailand, and shed new light on the relationship of the private sector and other stakeholders.

Thank you so much for your interest and cooperation. Please fill in the following questionnaire. It may take about 30 minutes to answer all of the questions. Information that you offer here will be used exclusively for research objectives. If you have any questions or concerns about participating in this survey, please contact me at kondomarie627@gmail.com.

I. Contact Person

1. Name: (Mr. / Ms.) _____

2. Position: _____

II. Company Profile

3. Company: _____

4. What is the scope of your company?
   - ☐ Local or community
   - ☐ Regional
   - ☐ National
   - ☐ International / Global

5. How many employees does your company have?
   - ☐ 1 – 10
   - ☐ 11 – 100
   - ☐ 101 – 500
   - ☐ 501 – 1000
   - ☐ 1001 – 5000
   - ☐ More than 5000
   - ☐ Not sure

6. Please specify which of the following standards and reporting mechanisms your company has adopted. (Select all that apply.)
   - ☐ ISO 14001
   - ☐ Responsible Care
   - ☐ ISO 9001
   - ☐ Other (Please specify: _____)
   - ☐ Not sure (because :_____)

III. Environmental Reporting

7. Does your company monitor…
   - emissions to air? ☐ Yes ☐ No ☐ Not sure
   - emissions to water? ☐ Yes ☐ No ☐ Not sure
   - hazardous waste? ☐ Yes ☐ No ☐ Not sure

8. Does your company report those emission data?
   - ☐ Yes, to whom: _____
   - ☐ No ☐ Not sure (because:_____)

9. Does your company release or provide environmental information?
   - ☐ No ☐ Not sure (because:_____)
   - ☐ Yes (How? Check all that apply.)
     - ☐ Corporate Brochures
     - ☐ Asset Securities Report / Business Report
     - ☐ Environmental Accounting Reporting
     - ☐ Environmental Report
     - ☐ Responsible Care Report
     - ☐ Catalog / Pamphlet
     - ☐ Public Relations Magazine
     - ☐ Advertising
     - ☐ Own Webpage
     - ☐ Periodic Explanation or Contact with Civil Organization
     - ☐ Sending workers as a lecturer for seminar or assembly
     - ☐ Observation tour or exhibition at the company place
     - ☐ Event on the subject of the environment and safety
     - ☐ Disaster drills participated by the civil society
     - ☐ Participation in the explanatory meeting or dialogue organized by the **business organization** as an elucidator
     - ☐ Participation in the explanatory meeting or dialogue organized by the **local governments** as an elucidator
     - ☐ Participation in the explanatory meeting or dialogue organized by the **civil society** as an elucidator
     - ☐ Participation in the committee organized by local governments
     - ☐ Submitting / offering documents for the media
     - ☐ Submitting to an academic journal
     - ☐ Respond only when there is a request of information etc.
     - ☐ Others:_____

IV. Familiarity with the PRTR

10. Have you ever heard of the PRTR?

☐ Yes ☐ No

11. At this moment, how is your familiarity with the PRTR? On a scale from 1 to 10, please rank your level of familiarity with the term "PRTR". (Select one number from 1 to 10.)

☐ 1 (Not familiar)
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7
☐ 8
☐ 9
☐ 10 (Most familiar / Expert)

V. Potentials of the PRTR

12. Do you think the PRTR could be useful for sustainable industrial management in Thailand?

☐ Yes ☐ No
☐ More or less ☐ Not sure (because: _____)

13. Do you think the PRTR could be useful for governments in Thailand?

☐ Yes ☐ No
☐ More or less ☐ Not sure (because: _____)

14. Do you think the PRTR could be useful for civil society in Thailand?

☐ Yes ☐ No
☐ More or less ☐ Not sure (because: _____)

15. Do you think the PRTR could be useful for private sector in Thailand?

☐ Yes ☐ No
☐ More or less ☐ Not sure (because: _____)

VI. Suitable Condition for Private Sector

16. What would be incentives / merits for your company to participate in the PRTR in Thailand?

_____

_____

_____

_____

17. What would be necessary for your company to participate in the PRTR in Thailand?

- Financial assistance / Funding

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Technology transfer / Material support

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Management consulting / Advisory services

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Training of staff / Personal

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Research collaboration

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Cooperation with other stakeholders

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Other (Please specify: _____)

18. The PRTR has different systems in each country. For example, in Japan, the PRTR database includes not only the emission from the point sources (factories, etc.) but also the emission from other non-point sources (mobile objects, agriculture, construction, households, etc.). On the other hand, in the United States, the database covers mainly the emission from the point sources. In this regard, how do you think whether the PRTR in Thailand should include the non-point sources or not?

    ☐ The PRTR in Thailand should include the non-point sources.
    ☐ The PRTR in Thailand does not need to include the non-point sources.
    ☐ It would not be different whether including the non-point sources or not.
    ☐ Not sure (because: _____)

19. How do you analyze benefits or barriers of the PRTR in Thailand?

    _____
    _____
    _____
    _____

20. Do you have any suggestion or recommendation?

    _____
    _____
    _____

Thank you for your cooperation.

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APPENDIX B

QUESTIONNAIRE FOR RESPONSIBLE ORGANIZATION

The following is the copy of the questionnaire prepared for responsible organizations. It contains an introduction of this study (one page) and sixteen questions (four pages).

Thank you very much for your interest and cooperation in this research.

My name is Marie Kondo and my Master's degree thesis at Chulalongkorn University is titled "Study on Perceptions of Private Sector towards the Pollutant Release and Transfer Register: A Case Study on Petrochemical Industry in the Map Ta Phut Industrial Estate, Rayong, Thailand".

This research aims to study the perceptions of private sector towards the Pollutant Release and Transfer Register [PRTR] through a case study on petrochemical industry in the Map Ta Phut Industrial Estate. In this regard, I would like to study your assumptions of the private sector's perceptions on the PRTR in this questionnaire.

The PRTR is a new way of comprehensive chemical management defined as "an inventory of pollutants released to air, water and soil, and of waste transferred off-site for treatment and/or disposal. Facilities releasing one or more of the chemicals listed report periodically – usually annually – on what was released, how much, and to which environmental media". Cooperating with the Pollution Control Department [PCD], Department of Industrial Works [DIW] and Industry Estate Authority of Thailand [IEAT], Japan International Cooperation Agency [JICA] has initiated one pilot project for constructing basic scheme of the PRTR in Rayong province in 2011.

By completing this survey, your response and collaboration would make the PRTR process and its level of engagement by private sector to be conducted successfully in Thailand. Currently, the concept of PRTR can be regarded as new for Thailand. It is my hope that my research will share information on the PRTR as it is demonstrated in Thailand, and shed new light on the relationship of the private sector and the PRTR.

Thank you so much for your interest and cooperation. Please fill in the following questionnaire. It may take about 30 minutes to answer all of the questions. Information that you offer here will be used exclusively for research objectives. If you have any questions or concerns about participating in this survey, please contact me at kondomarie627@gmail.com.

I. Contact Person and Organization

1. Name: (Mr. / Ms.) _____

2. Organization: _____

3. Position: _____

II. Familiarity with the PRTR

4. Have you ever heard of the PRTR before?

☐ Yes ☐ No

5. What is the reason for your organization to participate in this PRTR project?

_____

_____

_____

_____

6. On a scale from 1 to 10, please rank **your organization**'s level of familiarity with the term "PRTR". (Select one number from 1 to 10.)

☐ 1 (Not familiar)
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7
☐ 8
☐ 9
☐ 10 (Most familiar / Expert)

7. On a scale from 1 to 10, please rank the **private sector**'s level of familiarity with the term "PRTR" in Thailand. (Select one number from 1 to 10.)

☐ 1 (Not familiar)
☐ 2
☐ 3
☐ 4
☐ 5
☐ 6
☐ 7
☐ 8
☐ 9
☐ 10 (Most familiar / Expert)

III. Potentials of the PRTR

8. Do you think the PRTR could be useful for sustainable industrial management in Thailand?

☐ Yes ☐ No
☐ More or less ☐ Not sure (because: _____)

9. Do you think the PRTR could be useful for governments in Thailand?

☐ Yes ☐ No
☐ More or less ☐ Not sure (because: _____)

10. Do you think the PRTR could be useful for civil society in Thailand?

☐ Yes ☐ No
☐ More or less ☐ Not sure (because: _____)

11. Do you think the PRTR could be useful for private sector in Thailand?

☐ Yes ☐ No
☐ More or less ☐ Not sure (because: _____)

IV. Suitable Condition for Private Sector

12. What do you think what would be incentives / merits for private sector to participate in the PRTR in Thailand?

_____

_____

_____

_____

13. What do you think what would be necessary for private sector to participate in the PRTR in Thailand?

- Financial assistance / Funding

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Technology transfer / Material support

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Management consulting / Advisory services

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Training of staff / Personal

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Research collaboration

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Cooperation with other stakeholders

☐ Absolutely necessary ☐ Preferable but not necessary

☐ Highly important ☐ Not a factor / Irrelevant

- Other (Please specify: _____)

14. The PRTR has different systems in each country. For example, in Japan, the PRTR database includes not only the emission from the point sources (factories, etc.) but also the emission from other non-point sources (mobile objects, agriculture, construction, households, etc.). On the other hand, in the United States, the database covers mainly the emission from the point sources. In this regard, how do you think whether the PRTR in Thailand should include the non-point sources or not?

☐ The PRTR in Thailand should include the non-point sources.
☐ The PRTR in Thailand does not need to include the non-point sources.
☐ It would not be different whether including the non-point sources or not.
☐ Not sure (because: _____)

15. How do you analyze benefits or barriers of the PRTR in Thailand?

_____
_____
_____
_____

16. Do you have any suggestion or recommendation?

_____
_____
_____

Thank you for your cooperation.

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APPENDIX C
QUESTIONNAIRE RESPONSES

The following is a compilation of all received questionnaire responses. The responses are listed in the order of the questions for petrochemical industry (ID: "I") and are aggregated to show other answers from responsible organizations (ID: "O").

Question1: **Name of Informant** *(Confidential)*

Question 2: **Position**

Written Responses	Response Percent	Eligible Response Count	Response from Responsible Organizations
Owner / President	20%	1	0
Director	0%	0	2
Manager	20%	1	0
Engineer	60%	3	1
Other	0%	0	1
	answered question	**5**	**4**
	skipped question	**0**	**0**

Question 3: **Name of Company** *(Confidential)*

Question 4:

What is the scope of your company?

Answer Options	Response Percent	Eligible Response Count
Local or community	0%	0
National	20%	1
Regional	40%	2
International / Global	40%	2
	answered question	**5**
	skipped question	**0**

Question 5:

How many employees does your company have?

Answer Options	Response Percent	Response Count

1 – 10	0%	0
11 – 100	20%	1
101 – 500	40%	2
501 – 1000	40%	2
1001 – 5000	0%	0
More than 5000	0%	0
Not sure	0%	0
	answered question	**5**
	skipped question	**0**

Question 6:

Please specify which of the following standards and reporting mechanisms your company has adopted (Select all that apply).

Answer Options	Response Percent	Response Count
ISO 14001	100%	5
Responsible Care	60%	3
ISO 9001	80%	4
Other (please specify)	60%	3
Not sure	0%	0
	answered question	**5**
	skipped question	**0**

[Written responses for Question 6]:

ID: Other (please specify)

I3: OHSAS 18001, ISO/IEC 17025, GMP

I4: OHSAS 18001

I5: Safety std. by LBI group

Question 7a:

Does your company monitor emissions to air?

Answer Options	Response Percent	Response Count
Yes	100%	5
No	0%	0
Not sure	0%	0
	answered question	**5**
	skipped question	**0**

Question 7b:

Does your company monitor emissions to water?

Answer Options	Response Percent	Response Count
Yes	100%	5
No	0%	0
Not sure	0%	0
answered question		**5**
skipped question		**0**

Question 7c:

Does your company monitor hazardous waste?

Answer Options	Response Percent	Response Count
Yes	100%	5
No	0%	0
Not sure	0%	0
answered question		**5**
skipped question		**0**

Question 8:

Does your company report those emission data?

Answer Options	Response Percent	Response Count
Yes	100%	5
No	0%	0
Not sure	0%	0
answered question		**5**
skipped question		**0**

[Written responses for Question 8]:

ID: Yes, to whom

I1: IEAT, Municipality

I2: DIW, IEAT

I3: DIW, ONEP, IEAT

I4: DIW, EIAT *(IEAT)*

I5: DIW, ONEP, IEAT

Question 9a:

Does your company release or provide environmental information?

Answer Options	Response Percent	Response Count
Yes	100%	5
No	0%	0
Not sure	0%	0
	answered question	**5**
	skipped question	**0**

Question 9b:

How? Check all that apply.

Answer Options	Response Percent	Response Count
Corporate Brochures	20%	1
Asset Securities Report / Business Report	20%	1
Environmental Accounting Reporting	0%	0
Environmental Report	100%	5
Responsible Care Report	40%	2
Catalog / Pamphlet	0%	0
Public Relations Magazine	0%	0
Advertising	0%	0
Own Webpage	60%	3
Periodic Explanation or Contact with Civil Organization	20%	1
Sending workers as a lecturer for seminar or assembly	0%	0
Observation tour or exhibition at the company place	20%	1
Event on the subject of the environment and safety	40%	2
Disaster drills participated by the civil society	20%	1
Participation in the explanatory meeting or dialogue organized by the business organization as an elucidator	0%	0
Participation in the explanatory meeting or dialogue organized by the local governments as an elucidator	20%	1
Participation in the explanatory meeting or dialogue organized by the civil society as an elucidator	20%	1
Participation in the committee organized by local governments	20%	1
Submitting / offering documents for the media	0%	0

Submitting to an academic journal	0%	0
Respond only when there is a request of information etc.	20%	1
Others	0%	0
answered question		**5**
skipped question		**0**

Question 10:

Have you ever heard of the PRTR?

Answer Options	Response Percent	Response Count
Yes	100%	5
No	0%	0
answered question		**5**
skipped question		**0**

Question 11:

At this moment, how is your familiarity with the PRTR? On a scale from 1 to 10, please rank your level of familiarity with the term "PRTR" (Select one number from 1 to 10)

Answer Options	Response Percent	Eligible Response Count	Response from Organizations (familiarity of organizations)	Response from Organizations (Assumption on the familiarity of private sector)
1 (Not familiar)	0%	0	0	0
2	0%	0	0	1
3	40%	2	0	0
4	20%	1	1	1
5	20%	1	0	0
6	0%	0	0	2
7	0%	0	0	0
8	20%	1	2	0
9	0%	0	0	0
10 (Most familiar/Expert)	0%	0	1	0
answered question		**5**	**4**	**4**
skipped question		**0**	**0**	**0**

rating average	**4.6**	**7.5**	**4.5**

Question 12:

Do you think the PRTR could be useful for sustainable industrial management?

Answer Options	Response Percent	Eligible Response Count	Response from Responsible Organizations
Yes	40%	2	4
More or less	40%	2	0
No	0%	0	0
Not sure	20%	1	0
answered question		**5**	**4**
skipped question		**0**	**0**

[Written responses for Question 12]:

ID: Not sure (because….)

I2: Currently, we have many reports about pollution release such as waste disposal report, wastewater discharge report that must send to regulators (DIW, IEAT) / some factories has.

Question 13:

Do you think the PRTR could be useful for governments in Thailand?

Answer Options	Response Percent	Eligible Response Count	Response from Responsible Organizations
Yes	80%	4	4
More or less	0%	0	0
No	0%	0	0
Not sure	20%	1	0
answered question		**5**	**4**
skipped question		**0**	**0**

[Written responses for Question 13]

ID: Not sure (because….)

I1: Governmental policy is not clear.

Question 14:

Do you think the PRTR could be useful for civil society in Thailand?

Answer Options	Response Percent	Eligible Response Count	Response from Responsible Organizations
Yes	80%	4	4
More or less	0%	0	0
No	0%	0	0
Not sure	20%	1	0
answered question		**5**	**4**
skipped question		**0**	**0**

Question 15:

Do you think the PRTR could be useful for private sector in Thailand?

Answer Options	Response Percent	Eligible Response Count	Response from Responsible Organizations
Yes	60%	3	4
More or less	0%	0	0
No	20%	1	0
Not sure	20%	1	0
answered question		**5**	**4**
skipped question		**0**	**0**

Question 16:

What would be incentives / merits for your company to participate in the PRTR in Thailand?

ID	Written Response
I1	It is impossible to find incentives because there is no impact compared to ISO. Due to the increase of costs, demerit would be bigger than merit.
I2	1. We can benchmark the specific emission data with others in the same industrial. 2. It’s a chance of technology or best practice transfer from the low emission factory to other factories.
I3	To encourage Thailand Environmental Management System for support the petrochemical industrial development.
I4	1. Tax Reduction, Tax Refund 2. BOI

I5	1. If PRTR will be regulated in further, company can learn this project (how to do) while participate in pilot project. 2. PRTR will make benefit for company an overall environmental management.
O1	PRTR is a tool to enhance the communication on chemical substance between the stakeholders. If Thailand can establish the PRTR system that functions properly, private sector such as those with factories to operate will be able to communicate with citizens based on the scientific data therefore avoiding misunderstanding and misinterpretation of its operations
O2	PRTR will let private sector know how to manage production and waste management. Private can reduce cost of chemical release to environment. Private can reduce waste management cost and damage cost from improper waste management.
O3	1. Industry can save money through improving the management for the lost in the process. 2. Industry can use the PRTR to negotiate with the public and with the stakeholders.
O4	In my opinion that you must to give rewards to private sector to participate in the PRTR and should announce private sector to the public specially.

Question 17a:

What would be necessary for your company to participate in the PRTR in Thailand? (17a: Financial assistance / Funding)

Answer Options	Response Percent	Eligible Response Count	Response from Responsible Organizations
Absolutely necessary	20%	1	0
Highly important	20%	1	0
Preferable but not necessary	60%	3	2
Not a factor / Irrelevant	0%	0	1
answered question		**5**	**3**
skipped question		**0**	**1 (Not sure)**
rating average		**1.6**	**0.7**

Question 17b:

What would be necessary for your company to participate in the PRTR in Thailand? (17b: Technology transfer / Material support)

Answer Options	Response	Eligible	Response from

	Percent	Response Count	Responsible Organizations
Absolutely necessary	60%	3	0
Highly important	0%	0	2
Preferable but not necessary	40%	2	1
Not a factor / Irrelevant	0%	0	0
answered question		**5**	**3**
skipped question		**0**	**1 (Not sure)**
rating average		**2.2**	**1.7**

Question 17c:

What would be necessary for your company to participate in the PRTR in Thailand? (17c: Management consulting / Advisory services)

Answer Options	Response Percent	Eligible Responses Count	Response from Responsible Organizations
Absolutely necessary	60%	3	2
Highly important	20%	1	1
Preferable but not necessary	0%	0	0
Not a factor / Irrelevant	20%	1	0
answered question		**5**	**3**
skipped question		**0**	**1 (Not sure)**
rating average		**2.2**	**2.7**

Question 17d:

What would be necessary for your company to participate in the PRTR in Thailand? (17d: Training of staff / Personal)

Answer Options	Response Percent	Eligible Response Count	Response from Responsible Organizations
Absolutely necessary	60%	3	1
Highly important	20%	1	1
Preferable but not necessary	20%	1	1
Not a factor / Irrelevant	0%	0	0
answered question		**5**	**3**
skipped question		**0**	**1 (Not sure)**

rating average	**2.4**	**2**

Question 17e:

What would be necessary for your company to participate in the PRTR in Thailand? (17e: Research collaboration)

Answer Options	Response Percent	Eligible Response Count	Response from Responsible Organizations
Absolutely necessary	60%	3	0
Highly important	0%	0	2
Preferable but not necessary	20%	1	1
Not a factor / Irrelevant	20%	1	0
answered question		**5**	**3**
skipped question		**0**	**1 (Not sure)**
rating average		**2**	**1.7**

Question 17f:

What would be necessary for your company to participate in the PRTR in Thailand? (17f: Cooperation with other stakeholders)

Answer Options	Response Percent	Eligible Response Count	Response from Responsible Organizations
Absolutely necessary	60%	3	0
Highly important	20%	1	2
Preferable but not necessary	0%	0	1
Not a factor / Irrelevant	20%	1	0
answered question		**5**	**3**
skipped question		**0**	**1 (Not sure)**
rating average		**2.2**	**1.7**

Question 18:

The PRTR has different systems in each country. For example, in Japan, the PRTR database includes not only the emission from the point sources (factories, etc.) but also the emission from other non-point sources (mobile objects, agriculture, construction, households, etc.). On the other hand, in the United States, the database covers mainly the emission from the point sources. In this regard, how do you think whether the PRTR in Thailand should include the

non-point sources or not?

Answer Options	Response Percent	Eligible Response Count	Response from Responsible Organizations
The PRTR in Thailand should include the non-point sources.	60%	3	4
The PRTR in Thailand does not need to include the non-point sources.	40%	2	0
It would not be different whether including the non-point sources or not.	0%	0	0
Not sure	0%	0	0
answered question		**5**	**4**
skipped question		**0**	**0**

Question 19:

How do you analyze benefits or barriers of the PRTR in Thailand?

ID	Written Response
I1	I do not think that there would be benefits.
I2	Benefits: 1. The government can use this data to set up the measure to incentive or manage the major source sector. Barriers: 1. The complexity of data and the clarity of definitions. 2. There are many emission reports to each regulators (DIW, IEAT).
I3	n.a.
I4	n.a.
I5	Benefit: Government can manage environmental for overall sector better. Barrier: In the first period for implementation, need guidelines, assistance on how we can do PRTR.
O1	The PRTR system can help stakeholders to discuss about existing chemical substances and its risks by using the data it has collected. Through constructive discussion about the existing chemical substance in the environment and its potential risk, people will have better understanding of what they should be aware of and what they do not have to worry too much. Therefore, if this PRTR project with PCD, DIW and IEAT is successful it could be one of the tools to help balance the economic development and sustainable society and environment thus contributing to further sustainable development of Thailand.

O2	benefits: good environment, reduce damage cost, increase production barriers: no data input / wrong information, insufficient training program, lack of sustainable management
O3	Barriers: 1. how to do correct emission factor 2. lack of awareness and capacity in the governmental sector
O4	It is great thing that will be benefits for many communities which established around the factories or industrial estate.

Question 20:

Do you have any suggestion or recommendation?

ID	Written Response
I1	n.a.
I2	n.a.
I3	n.a.
I4	n.a.
I5	n.a.
O1	n.a
O2	1. more chemicals and wastes should be developed in PRTR 2. develop law and regulation to comply with PRTR 3. continuous dissemination program
O3	The PRTR in Thailand should be set up so that we can see the whole picture of chemicals in the environment. However, there are some barriers such as the availability of the information and lack of capacity in the government. In order to set up the PRTR in Thailand, we will need the capacity building and cooperation among the governmental sector not only the PCD and DIW but also other related governmental organizations.
O4	It is good opportunity for Thailand to collaborate with Japan to find out the right sources which could be manage by government or private sector.

BIOGRAPHY

Marie Kondo was born in Fukuoka on 27 June 1987 and grew up in Hiroshima, Japan. After the completion of high school in Hiroshima, she enrolled in Aoyama Gakuin University in Tokyo and studied at North Central College in the United States for one year as an exchange student. In 2010, she completed a Bachelor of Arts, majoring International Communication at Aoyama Gakuin University, and enrolled in the Environment, Development and Sustainability (EDS) Program at Graduate School of Chulalongkorn University in Bangkok, Thailand.