博士論文

Doctoral Thesis

A comparative analysis of Oil and Gas corporate strategies to climate change mitigation in Southeast Asia

（東南アジア諸国の石油・天然ガス企業における気候変動対策戦略の比較研究）

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Abstract

The Oil and Gas (O&G) industry, which is part of the energy supply sector, can pursue a wide range of climate change mitigation activities, which are defined by the Fifth Assessment Report of International Panel on Climate Change (IPCC 5AR) (2014) as "a human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs)". However, considering the severe impacts of global climate change and the Paris climate agreement, which put forward a strong global commitment in preventing a 2-degree Celsius increase in global temperature above pre-industrial levels, the long term phase-out of fossil fuels and the substitution by low-GHG alternative energy resources appears imperative. This will contribute to the transformation and greening of the energy sector and, more importantly, pave a path to achieve goals 7 (Affordable and Clean Energy) and 11 (Climate Action) of the Sustainable Development Goals (SDGs).

The study of the investments in renewable energy that are made by O&G companies is vital to the sustainable development of human society as a whole. Nevertheless, it is certainly challenging to convince the O&G industry -whose very products result in GHG emissions (in the form of either carbon dioxide or other gases such as methane) - to take part in efforts to mitigate climate change. Thus, it is critical to comprehensively understand what can influence change in corporate strategies, in order for the right policies or incentives to be implemented in the industry. The present research embarks on an academic journey to examine corporate strategies of O&G companies to climate change mitigation, placing a special focus on business diversification from fossil fuels to renewable energy. Three National Oil Companies (NOCs) from emerging economies in Southeast Asia- PTT from Thailand, PERTAMINA from Indonesia and PETRONAS from Malaysia, were selected as case studies and serve as a starting point for the study of the wider picture on NOCs. The study also included two associates of PTT- Bangchak Petroleum and Thai Oil-, in order to provide a more in-depth picture of the specific case of Thailand.

This research conducted three studies to achieve its objectives. Firstly, a thorough review on actual renewable energy investment projects of the five companies during the first 15 years of 21st century was carried out. The results showed that all five companies have invested in renewable energy, but to various degrees and on a range of different technologies. All of them have produced and commercialized biofuels, mostly due to existence of government mandates in each of the three countries. However, the study also found that such investments appeared to be correlated with the oscillations in global crude oil prices. Solar PV only became the focus of the attention of PTT,

Bangchak and PETRONAS in recent years, when the cost of solar cells dramatically dropped and their respective governments initiated attractive Feed-in-Tariff policies. Lastly, PERTAMINA is the only one company involved in the development and exploitation of geothermal energy, although it aims to invest more in tidal, ocean, wind and solar PV in the coming years.

Following the development in the renewable energy projects of each company, the study then examined the discourses which the companies applied to justify their green investments. Annual reports available in the company websites were collected and a discourse analysis was run through the MAXQDA software. The main focus was to determine which were the most repeated discourses that each company used to explain their investment in particular renewable energy sources. Moreover, the discourses found were categorized into four different types, based on an analytical framework on discursive legitimacy strategies, namely authorization, rationalization, moral evaluation and mythopoesis. The result showed that companies manipulated various discourses to legitimate their low-carbon energy projects and that those discourses reflected the specific socio-cultural context in the home country.

Lastly, as the results pointed out that some companies, in particular those in Thailand, have been relatively more active in investing in renewable energy, the study investigated the factors that influence companies to invest in or divest from low-carbon energy. A novel analytical framework was applied to comparatively analyze all five companies from the three countries studied. The framework comprised three sets of factors; 1) company's specific features i.e. ownership structure and role of the CEOs and shareholders, expectation on short-term and long-term economic advantages, view on climate change, 2) national factors i.e. government's renewable energy and climate change policy, country's resources, social movement on environmental issues, and 3) global factors i.e. world crude oil prices, discovery of shale oil and gas, cost of technology, and peer influences. Secondary data as well as primary data from semi-structured interviews in three countries were used in this analysis. Country specific context and company features were highlighted as important factors for all companies that were analyzed, and which appear to have more influences than global factors.

Acknowledgement

Being a PhD student is one thing I had never thought I would be doing. However, at the time of writing this acknowledgement, I am now in the final step toward my PhD graduation. All of academic pressure and psychological challenges such as perpetual stress, fear of failure and constant feeling of being not good enough are not far from what many former PhDs experienced. Despite that, I have obtained great supports from all the people without whom I would not have achieve another important success in my life.

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Dedication

To my Alexander, I hope that this PhD research will be your inspiration to stay strong and positive in order to overcome whatever you are facing now. If I can do, you can do it too. You are the most talented and kindest person for me.

To the future me, please remember all hardship you had and be proud of yourself as you pass another big test which make you be humbler but stronger and wiser at the same time. Thank you for being so perseverant.

To my future children, I wish in the future I could show this thesis to you. I wish to make you proud and inspire you to realize and fulfil your potentials. I am look forward to welcoming you to this world.

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List of abbreviations

ABBREVIATIONS	EXPLANATION
AEC	ASEAN Economic Community
AGM	Annual General Meeting
API	American Petroleum Institute
APERC	Asia Pacific Energy Research Centre
APROBI	Asosiasi Produsen Biofuel Indonesia
ASEAN	Association of Southeast Asian Nations
Bangchak	Bangchak Petroleum Public Co.,Ltd.
bcm	Billion cubic meters
BCPG	BCPG Public Co.,Ltd.
BP	British Petroleum
BSE	Bangchak Solar Energy Co.,Ltd.
CBM	Coal Bed Methane
CCS	Carbon capture and storage
CEOs	Chief Executive Officers
CETDEM	Centre for Environment, Technology&Development Malaysia
CNPC	China National Petroleum Corporation
CPO	Crude palm oil
CSR	Corporate Social Responsibility
DEDE	Department of Alternative Energy Development and Efficiency, Ministry of Energy of Thailand
DGNREEC	Directorate General of Gas and Directorate General of New, Renewable Energy and Energy Conservation (Indonesia)

E for E	Energy for Environment Foundation
EGAT	Electricity Generating Authority of Thailand
EGCO	Electricity Generating Co.,Ltd.
EURUS	Eurus Energy Japan Corporation
FiT	Feed-in-Tariff
GCC	Global Climate Coalition
GHGs	Greenhouse gases
GPSC	Global Power Synergy Public Co., Ltd.
GWh	Gigawatt hours
IEEJ	The Institute of Energy Economics, Japan
INDCs	Intended Nationally Determined Contributions
IOCs	International Oil Companies
IPCC 5AR	Fifth Assessment Report of International Panel on Climate Change
IPP	Independent Power Producer
JOCs	Joint Operating Contracts
Kb/d	Kilo barrel of oil per day
kWh	Kilowatt hour
KWp	Kilowatt peak
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MBA	Malaysian Biodiesel Association
MNCs	Multinational Corporations
MOU	Memorandum of understanding
MPOB	Malaysian Palm Oil Board

MSOE	Ministry of State Owned Enterprises (Indonesia)
MW	Megawatt
NIOC	National Iranian Oil Company
NOCs	National Oil Companies
NGOs	Non-Governmental Organizations
NGV	Natural gas vehicle
OECD	Organization for Economic Co-operation and Development
OGCI	The Oil and Gas Climate Initiative
OPEC	Organization of the Petroleum Exporting Countries
O&G	Oil and Gas
PEA	Provincial Electricity Authority
PETRONAS	Petroliam Nasional Berhad (Malaysian national oil company)
PDB	PETRONAS Dagangan Berhad
PDVSA	Petróleos de Venezuela, S.A. (Venezuelan state-owned oil and natural gas company)
PGE	PERTAMINA Geothermal Energy
PLN	Perusahaan Listrik Negara (Indonesia State Electricity Corporation)
PPA	Power Purchase Agreement
PPSB	PETRONAS Power Sdn Bhd
PSO	Public Service Obligation
PTPN	PT Perkebunan Nusantara (Indonesian state-owned plantation company)
PTTI	PTT International Co.,Ltd.
PTIT	Petroleum Institute of Thailand
PTT	PTT Public

PTTEP	PTT Exploration and Production Co.,Ltd
PTTGE	PTT Green Energy Co.,Ltd.
RE	Renewable energy
R&D	Research and Development
SDGs	Sustainable Development Goals
SEDA	Sustainable Energy Development Authority Malaysia
SET	Stock Exchange of Thailand
SKK Migas	The Special Taskforce for Upstream Oil and Gas Business Activities (Indonesia)
S&P	Standard & Poor
Suria KLCC	Suria Kuala Lumpur City Centre
tcm	Trillion cubic meters
Thai Oil	Thai Oil Public Co., Ltd.
TNB	Tenaga Nasional Berhad (Malaysian state-owned electric utility company)
TSE	Thai Solar Energy Co., Ltd.
TSR	Thai Solar Renewable Co.,Ltd.
FTSE	Financial Times Stock Exchange
UAC	Universal Absorbent and Chemical Co., Ltd.
UBE	Ubon Bio Ethanol Co., Ltd.
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WEGCO	Wind Energy Generating Co., Ltd.

Chapter 1 Introduction

1.1 Background and problem statement

The present research embarks on an academic journey to examine the corporate responses of the Oil and Gas (O&G) industry to climate change mitigation, placing a special focus on business diversification from fossil fuels to renewable energy. The O&G industry, which is part of the energy supply sector, can provide a major contribution to global climate mitigation efforts, which are defined by the Fifth Assessment Report of International Panel on Climate Change (IPCC 5AR) (2014) as "a human intervention to reduce the sources or enhance the sinks of greenhouse gases (GHGs)". Some potential mitigating options include energy efficiency improvements, fugitive emission reduction in fuel extraction as well as in energy conversion, transmission and distribution systems, fossil fuel switching, carbon capture and storage (CCS) technology installation, alternative and renewable energy development as well as planting of forest to increase carbon sinks. However, although the aforementioned approaches could potentially reduce GHG emissions, some of them may have side effects, in term of encouraging a lock-in to fossil fuel products. Considering the severe impacts of global climate change and the Paris climate agreement, which put forward a strong global commitment in preventing a 2-degree Celsius increase in global temperature above pre-industrial levels and to limit the temperature rise even further to 1.5 degrees Celsius, the long term phase-out of fossil fuels and the substitution by low-GHG alternative energy resources appears imperative.

The study of the investments in renewable energy that are made by O&G companies is vital to the sustainable development of human society as a whole, as they could contribute to the transformation and greening of the energy sector and more importantly pave a path to achieve goals 7 (Affordable and Clean Energy) and 11 (Climate Action) of the Sustainable Development Goals (SDGs). From a brief look, it seems that renewable energy would be disruptive and even radical technology for the business as usual of O&G companies. However, in fact some major the US and EU-based O&G companies have

invested in low-carbon energy, which could be traced back since the first oil shock in 1970s. T^2 and Associates (2013) recorded investment volume in climate change mitigation technology by energy sector, other industries and the federal government from 2000-2012 and found that the US-based O&G companies had invested the highest up to an amount of US$165.4 billion or around 49 percent of the total investment of US$ 336.3 billion in the North American market. 7 percent of US$ 165.4 billion or US$ 11.4 billion was allocated for non-hydrocarbon technology i.e. wind, biofuels, solar PV, geothermal, as well as landfill digester gas. Considering huge financial capacity, O&G companies appear to be one of key players in promoting renewable energy technologies.

While being criticized as an exploiter, a polluter and a lobbyist, the industry also is perceived to hold positive roles as an economic developer, an innovator and a self-regulator in private governance. As a result, some scholars have advocated for a constructive approach when dealing with these corporations. Such authors include, for example, Levy and Jones (2007) who suggested that policy makers should harness and steer these corporations' resources toward sustainable development. Nevertheless, it is certainly challenging to convince the O&G industry -whose very products result in GHG emissions (in the form of either carbon dioxide or other gases such as methane)- to take part in efforts to mitigate climate change. Thus, it is critical to comprehensively understand what can influence change in corporate strategies, in order for the right policies or incentives to be implemented in the industry.

However, academic literature appears to have limitations in capturing the rapid changes that are taking place in the 21st century. Volatility of crude oil prices, the discovery of shale oil and gas, new global climate change agreements, not to mention the global movement to divest from fossil fuels, are a few examples of changing worldwide phenomena that are affecting corporate strategies in the development of renewable energy. This represents a substantial gap in the literature, and highlights the need for academia to catch up with the rapid changes taking place in industry.

On top of that, majority of the existing literature investigated the green business of US and EU-based multinational O&G companies; namely ExxonMobil, Chevron, BP, Shell,

Statoil, and Total (Levy and Kolk, 2002; Ceres, 2004; Davis, 2006; Pinkse and Buuse, 2012; Miller,2013; Csomos, 2014; Johnson, 2015) with a few exceptions from Penha (2011) and Puliver (2007). Moreover, news articles from well-known and respected newspapers and weekly magazines like the Economist, the Guardian and Bloomberg have scrutinized the same group of major O&G companies. Our knowledge on green investments done by O&G companies was thus built upon a small group of cases and was limited to the contexts of the abovementioned regions.

The present research thus aims to expand the horizon of this subject matter through enlarging case studies to cover a greater number of National Oil Companies (NOCs). NOCs, as Victor (2007) pointed out, represent around 80% of world oil reserves and account for 73% of production, while the reserves of International Oil Companies (IOCs) have been declining and have thus have to move to areas where exploration and production are challenging. As Penha (2011) pointed out, O&G reserves are an important factor that determines whether they would invest in renewable energy or not. Saudi Aramco, NIOC, PDVSA and CNPC had bigger O&G reserves than some IOCs but did not invest or had little investment volume in renewable energy whereas Shell, BP and Total have put efforts into multiple green technologies such as solar PV, wind and biofuels. Nevertheless, special attention should be paid to NOCs in developing countries, where the dilemma between improving energy security to maintain economic growth and alleviate poverty and investing in sustainable energy to reduce GHG emissions is acute. To what extent NOCs in emerging economies welcome the development of disruptive renewable energy technologies appears to be under-examined in literature. The present research proposes that behaviours, business strategies of NOCs as well as factors influencing their behaviours are different from those of IOCs because of specific characteristics as shown in Table 1. As will demonstrate later, it is crucial that we are aware of the heterogeneity of this incumbent industry.

Table 1 Main differences between NOCs and IOCs

Issues	IOCs	NOCs
Ownership structure	Private investors (shareholders)	Government owns between 51% and 100% of shares
O&G reserves	Earn license to do business in oil wells in various countries	National law of some countries give authority for NOCs to manage all O&G reserves in the countries
Legal authority	No	Some NOCs are regulators for all O&G exploration and production activities i.e. PETRONAS (Malaysia)
Mission	Obtain maximum profits and return them to shareholders	- Profit making - Comply with government policy - Secure energy supply for the country
Relations with government	Private sector VS government	- Government officials are appointed to be part of board of executives - CEOs report directly to Prime Minister
Examples of companies	ExxonMobil, BP, Shell, Total, Chevron	Saudi Aramco, GasProm (Russia), PetroChina, PTT (Thailand), PERTAMINA (Indonesia), PETRONAS (Malaysia)

Another important gap in literatures is that little analysis was carried out on the discourses that O&G companies have used to legitimize their business diversification from fossil fuels to renewable energy sources, given the fact that such renewable energy technology is not their core business (Livesey, 2002; Livesey and Kearins, 2002; Breeze, 2012). Understanding how the O&G companies justify their renewable energy investment through discourses will not only expand knowledge on the communication strategies that the companies apply to gain legitimacy from their audiences but also on discursive factors for diffusing renewable energy in societies.

To fill in these research gaps, the present study chose to target three NOCs from emerging economies in Southeast Asia- PTT group from Thailand, PERTAMINA from Indonesia and PETRONAS from Malaysia. These three NOCs are selected as a starting point for the study of NOCs in the bigger picture. The study also included two associates of PTT- Bangchak Petroleum and Thai Oil- for an in-depth investigation of the case of Thailand. The three NOCs are a major actor in the economies of their respective countries.

Besides, they were only three companies from Thailand, Indonesia and Malaysia which were ranked by Fortune Global 500, a list of top 500 companies in the world in term of business profits, as 125th, 146th and 230th respectively (Fortune Global500, 2016). Once convinced to have a goal in low-carbon energy investment, these three NOCs as well as their associates will help their home countries untapped renewable energy potential. Not to mention that doing so will create new job employment and increase accessibility to electricity of people in remote areas.

Thailand, Indonesia and Malaysia have recently submitted their Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) declaring their GHG reduction targets and already existing policies to promote clean and renewable energy in their energy mix[1]. It is therefore important to examine how these three NOCs and their associates have positioned themselves amid the strong urge for national energy security and climate change mitigation efforts of their respective national governments. The findings from the three NOCs and associates will certainly enhance understanding of corporate strategies of O&G companies operating in developing countries. More importantly, as one of five underlying principles of ASEAN Economic Community (AEC) Blueprint 2025 is to enhance connectivity and sectoral cooperation, lessons learned from the cases of PTT, PERTAMINA and PETRONAS will provide a model for other NOCs in the rest seven Southeast Asian countries. Last but not least, by attempting to close the gaps in literature that have been highlighted earlier, the author hopes that this thesis will help the sustainable development of human society, and further the field of Sustainability Science.

[1]Thailand intends to reduce greenhouse gas emissions by 20% from the projected business-as-usual (BAU) level by 2030 (INDC, 2015), Indonesia will reduce 26% of its GHG emissions against BAU scenario by 2020 (INDC, 2015) and Malaysia aims to cut down its greenhouse gas (GHG) emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005 (INDC, 2016).

1.2 Research objectives

Considering the severe impacts of global climate change and the Paris climate agreement, which put forward a strong global commitment in preventing a 2-degree Celsius increase in global temperature above pre-industrial levels, the long-term phase-out of fossil fuels and the substitution by low-GHG alternative energy resources appears imperative. As a result, the present study aims to examine exclusively the role of O&G companies in contributing to mitigate climate change through renewable energy investment. Three National Oil Companies (NOCs) from Thailand, Malaysia and Indonesia and their associates are chosen as case studies to fill in the gap in literature which studied mostly on western International Oil Companies(IOCs) and major NOCs from Middle East and major countries like China and Russia. Through these novel case studies, the present study expects to enhance understanding on the way of thinking and corporate strategies of O&G companies, which operate under specific socio-political and economic contexts of developing countries. The following part presents the main research objectives and three sub-objectives.

Main objective: To examine corporate strategies to climate change mitigation of oil and gas companies in Southeast Asia, with special focus on business diversification from fossil fuels to renewable energy

From this goal, three sub-objectives were defined:

Sub-objective 1: To examine renewable energy development projects of state-owned oil and gas companies and associates in Thailand, Indonesia and Malaysia in the first 15 years of 21st century

This sub-objective aims to add knowledge on the renewable energy investment of O&G industry. The existing literature suggested that world major O&G companies have an on-off relation with renewable energy. Some major IOCs (such as ExxonMobil) are even opposing renewable energy developments, by stating that they are not profitable and outside the role of O&G companies. Understanding the renewable energy investment activities and changes throughout years of five O&G companies from Thailand, Malaysia

and Indonesia is thus important in order to compare investing behaviors of major world O&G companies.

Sub-objective 2: To examine discourses or language-in-use of state-owned oil and gas companies and associates in justifying renewable energy investment

The sub-objective 2 addresses the gap in existing literature which has not yet studied the discourses that O&G companies used to legitimizing their renewable energy investment. The findings of discourse study are important because it provides a potential solution to address 'behavioral challenges', one of three sets of socio-technical barriers for renewable energy diffusion or penetration (Dulal et al., 2013; Jacobsson and Lauber, 2006; Painuly, 2001; Reddy and Painuly, 2004; Sovacool, 2009; Sovacool et al., 2011). Discourse study reveals how the O&G companies promoted and justified new renewable energy sources to the public given the fact that they are not conventional energy like fossil fuels.

Sub-objective 3: To investigate factors that influence state-owned oil and gas companies and associates to invest in or divest from renewable energy

The third sub-objective pushes forward the knowledge on factors which influence O&G corporate behaviors and decision-making on global climate change mitigation in particular renewable energy investment. The present study aims to test if factors found in the existing literature can be applied with NOCs and their associates from developing countries given the fact that most of them were usually used to study firm behaviors from western and developed countries. Moreover, the study aims to fill in the gap in existing literature which has limitations in capturing rapid changes that are taking place in the 21st century in particular global phenomena such as very low crude oil prices, discovery of shale oil and gas, new global climate change agreements and global movement to divest from fossil fuel companies.

1.3 Research questions

Sub-objective 1: To examine renewable energy development projects of oil and gas companies in Thailand, Indonesia and Malaysia in the first 15 years of the 21st century

Specific research questions:

1.1 Do O&G companies in Thailand, Indonesia and Malaysia invest in renewable energy?

1.2 What sources of renewable energy have been prioritized by each O&G company?

Sub-objective 2: To examine discourses or language-in-use of oil and gas companies in justifying renewable energy investment

Specific research questions:

2.1 What are discourses each O&G company applies to justify a given source of renewable energy?

2.2 What sort of discursive legitimation strategies are used to justify a given renewable energy by O&G companies in Thailand, Indonesia and Malaysia?

2.3 What are the implications of discourse study for renewable energy diffusion?

Sub-objective 3: To determine the factors that influence state-owned O&G companies to invest in or divest from renewable energy at both the domestic and international level

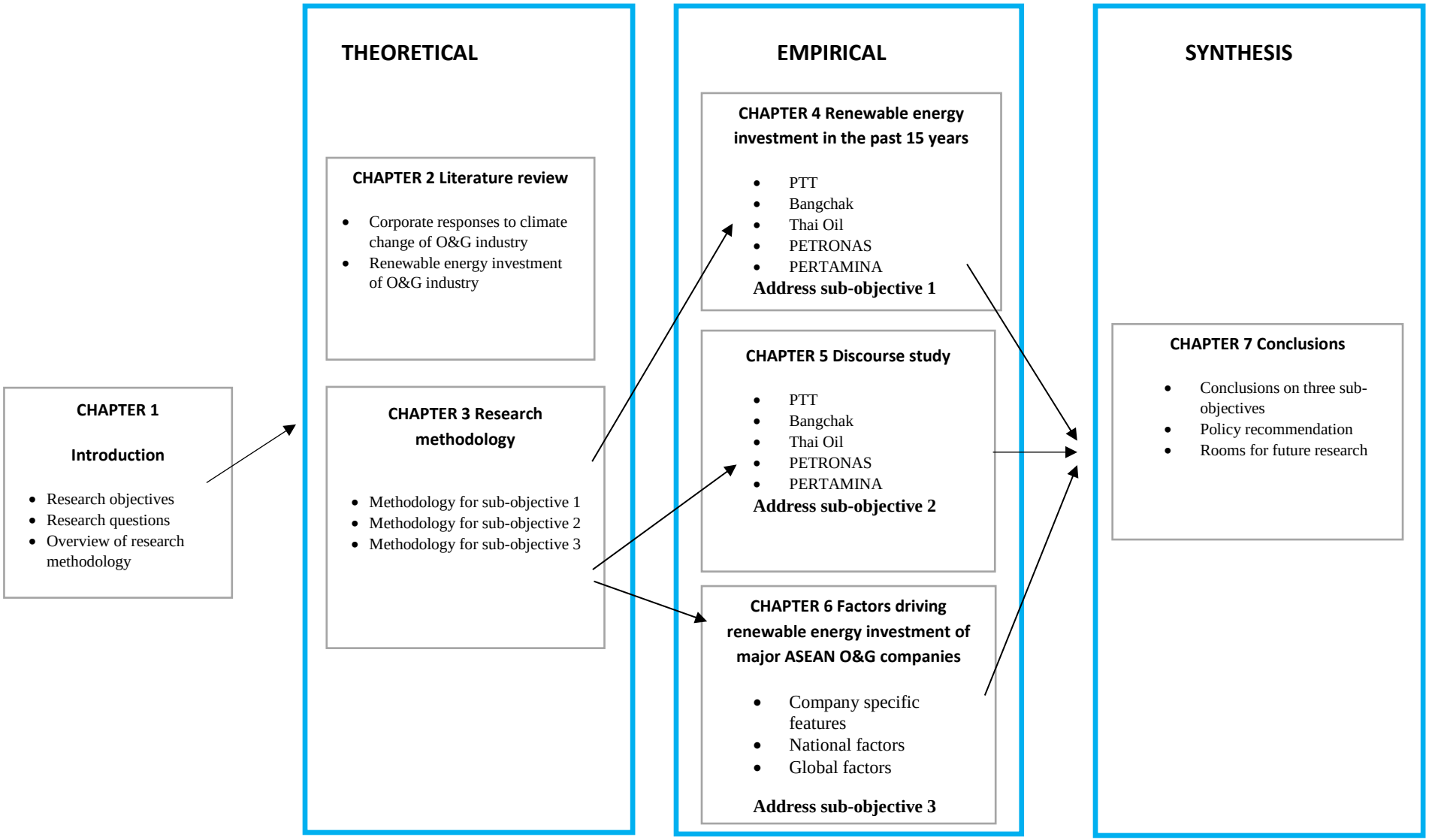
Specific research questions:

3.1 What are factors which influence O&G companies in Thailand, Malaysia and Indonesia to invest in renewable energy?

3.2 How are factors influencing National Oil Companies (NOCs) to invest in renewable energy different from those influencing O&G companies studied in existing literature (western International oil companies (IOCs) and major NOCs)

3.3 What are characteristics of O&G companies which are the most and the least likely to conduct renewable energy investment?

1.4 Structure of dissertation



Chapter 2 Literature review on O&G companies and climate change mitigation

2.1 Introduction

Climate change mitigation, which is the sum of humanity's efforts to curtail greenhouse gases (GHG) emissions, has caused controversy in the industries that rely heavily on fossil fuels. Among them is the O&G industry, which is allegedly "one of the most powerful and global business sectors today and its activities and products are directly linked with rising greenhouse gas emission" (Hove et al., 2002, p.3). Since the beginning of the GHG abatement effort it has been widely considered that climate change was a threat to the O&G industry, and thus a hostile response from this industry is not unexexpected.

Anti-climate change corporate responses can be traced back to the period of time leading to Kyoto Protocol. In 1989 major O&G companies in the USA formed the 'Global Climate Coalition' (GCC), an organiation aimed at lobbying US Congress not to pass regulation on the reduction of greenhouse gas emissions (Kolk and Levy, 2001). The GCC together with the American Petroleum Institute (API) acted against mandatory climate change policy by the US and international community by employing two different sets of strategies: "raising questions about and undercutting the prevailing scientific wisdom on climate change in order to cast doubts in the mind of the public and policy-makers on the existence of a problem, and attacking the policy proposals on economic grounds" (Hove et al., 2002, p.5). These two lobbying groups were part of what McCright and Dunlap called the 'American conservative movement', which was a major reason why the USA did not ratify Kyoto Protocol (McCright and Dunlap, 2003).

The GCC started to lose part of its lobbying power when some of its members decided to leave the group. British Petroleum (BP) was the first company to withdraw from the GCC in 1996, followed by Royal Dutch Shell in 1998; while US-based major O&G companies such as ExxonMobil still participated until the end of the GCC in 2002 (Kolk and Levy, 2001). After the adoption of the Kyoto Protocol in 1997 the world witnessed a

clear divergence of corporate responses to climate change between European and American Multinational O&G corporations, resulting in a 'Trans-Atlantic divide', as Rowlands pointed out in his article "Beauty and the Beast? BP' and Exxon's position on global climate change" (Rowlands, 2000). In addition, in the middle of these two extremes some other major companies have chosen 'wait-and-see' stance on global climate change (Hove et al., 2002). However, as issues related to climate change have matured, recent trends in literature have started to reflect an increasing convergence of corporate responses regarding the positive manner in which they respond to climate change mitigation (Kolk and Levy, 2004).

The O&G industry is one of central players regarding many environmental issues, not only those directly related to global climate change. While being criticized as an exploiter, a polluter and a lobbyist, the industry also is perceived to hold positive roles as an economic developer, an innovator and a self-regulator in private governance. Thanks to their enormous economical, organizational and technological capacity, some scholars have advocated for a constructive approach when dealing with these corporations. Such authors include, for example, Levy and Jones (2007) who suggested that policy makers should harness and steer these corporations' resources toward sustainable development. Nevertheless, it is certainly challenging to convince the O&G industry -whose very products result in GHG emissions (in the form of either carbon dioxide or other gases such as methane)- to take part in efforts to mitigate climate change. Thus, it is critical to comprehensively understand what can influence change in corporate strategies, in order for the right policies or incentives to be implemented in the industry. In this chapter, two different groups of literature are reviewed. The first group includes authors that have examined factors that can influence the corporate responses of O&G companies to climate change mitigation. The second group includes those who investigate exclusively issues of renewable energy investment or divestment in renewable energy by O&G companies.

2.2 Literature on factors that can influence O&G corporate responses to climate change

As O&G companies are major players whose operations directly affect and get affected by climate change mitigation efforts, a sizeable number of authors have attempted to expand knowledge on the subject matter. In order to conduct a comprehensive literature survey on the matter, the author first targeted literature that exclusively examined climate change strategies in the O&G industry, by using specific key words such as "O&G industry", "O&G MNCs (Multinational Corporations)", "global climate change", "corporate responses to climate change" and "GHG emissions reduction". Then, more general key words were applied to expand the scope of literature from articles merely concerning O&G industry and climate change strategies to the O&G industry and environmental strategies, to firms and the corporate responses to global climate change, to firms and the environmental responsibility, and finally, at the broadest scope, to firms and corporate strategies. In addition, from the references in the articles found through the E-journal database, further material was obtained. The literature reviewed covered a wide range of publications, including the European Management Journal, Global Strategic Management, Climate Policy, Business and Politics, Global society, Global Environmental Politics, Strategic Management Journal, European Accounting Review, Academy of Management Journal, Journal of International Management and Business Strategy and Environment. No limitation was set on the date of publication of the journal papers, in order to find as many journals as possible. The literature survey phase of the research was considered to be concluded when no further determinants could be found and the repetition of the majority of the determinants took place.

The present research categorized literature into five groups, based on the different key words that were used while searching. They were 1) O&G and climate change strategies, 2) O&G and CSR and environmental strategies, 3) Firms and corporate responses to climate change and global warming, 4) Firms and CSR and environmental responsibility and 5) Firms and Corporate strategies. The articles that fell into each group, and the name of journal in which they were published is shown in Figure 1.

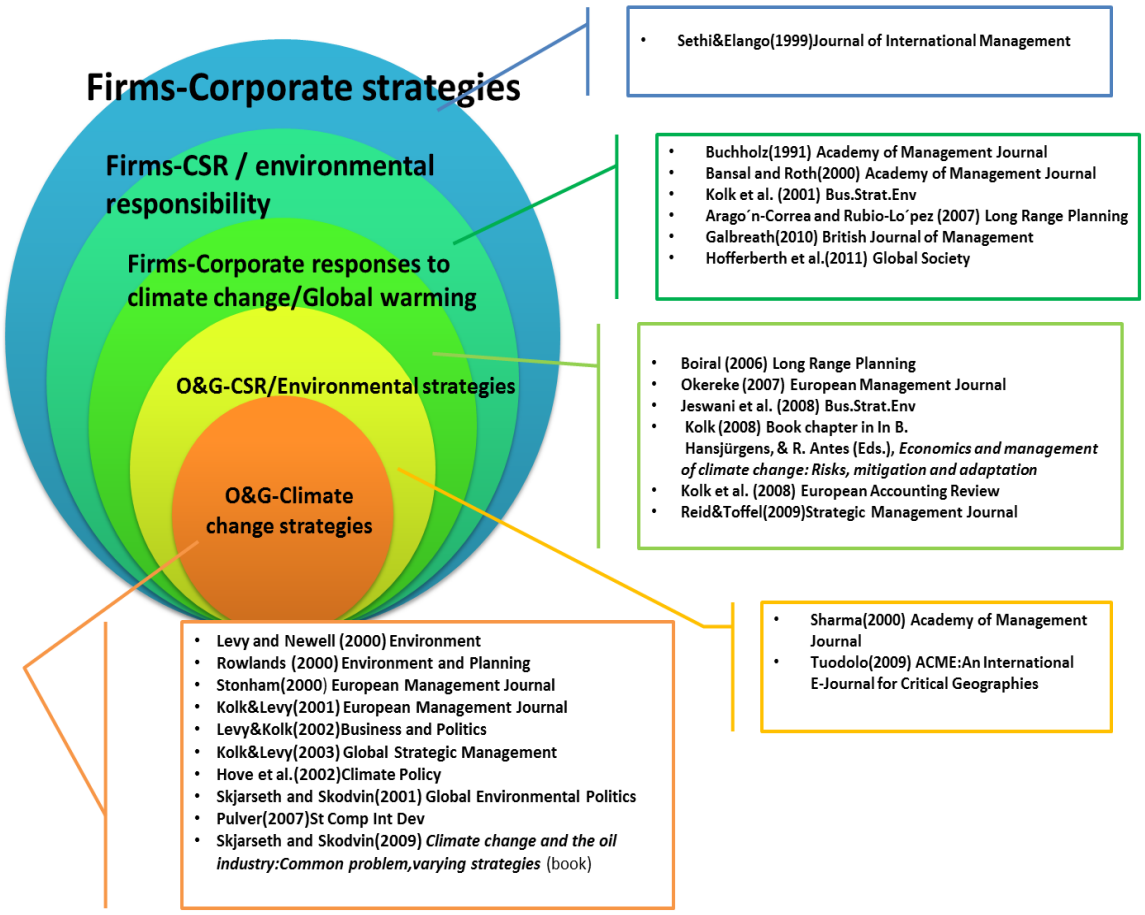


Figure 1 Literature examining factors that can influence corporate responses to climate change

2.2.1 Results and discussion on the reviewed literature

2.2.1.1 Literature in the first group examining O&G industry and their climate change strategies

The authors in the first group shared a common interest in finding what caused divergent corporate climate strategies between major US-based and EU-based O&G corporations. All of the reviewed literature in this group first attempted to explain the hostile perception of the O&G industry towards global climate change prior to the adoption of the Kyoto Protocol; then raised the case of BP and Shell (major EU-based companies) which took the first moves to adopt more proactive climate strategies, while their American counterpart, ExxonMobil, still pursued an antagonistic approach. A number of determinants were debated to shed light on the puzzle of the different climate policies pursued by US-based and EU-based companies, which get referred to as the 'Oceans Apart' (Levy and Newell, 2007) or 'Trans-Atlantic divide' (Rowlands, 2000). The main factors discussed in the literature included 1) company-specific features, such as CEO's policy or CEO's speech, which suggested supporting standpoint to climate change, organizational structure (degree of decentralization), main products (whether the company relied more on oil or natural gas), R&D research team, economic situation and market position, experience in renewable energy (RE) investment (US-based company experienced negatively in RE), 2) institutional environment of the home country, such as government climate policy or incentives on RE investment, societal concerns about climate change/environmental issues, relationships between business and government, 3) international issues such as the global climate regime (complexity and uncertainty of climate change issues), global oligopolistic structure of O&G industry, and an intense interaction of CEOs of O&G companies in the international arena (a process of osmosis).

Although all determinants in the three sets were seen to be interrelated and distributing to the corporate climate strategy, the home country factors were given special importance in explaining why EU-based companies pursued proactive strategies while US-based counterparts took adversarial approaches. Company specific features were considered less influence since major O&G corporations generally possessed similar organizational

features. Lastly, international issues have become increasingly predominant, as the climate strategies of O&G companies appear to have started to converge after Kyoto Protocol was implemented.

Two critical gaps were found when reviewing the literature in this group. Firstly, home country factors were exclusively analyzed, while host country's institutional environment was overlooked. Most of the literature examined corporate climate strategies at the headquarters of major American and European O&G companies i.e. ExxonMobil, BP (BP Amoco), Shell, Texaco, TotalFinaElf, and Statoil, and argued that "a multinational company (unlike states) can require its branch offices in various countries to comply with corporate policy-which is likely to reflect the policy of its home country" (Skjærseth and Skodvin, 2001, p.61). From this logic, it was assumed that O&G companies would take proactive approaches to climate change mitigation if their home country's government or civil society was very concerned about global climate change, and would have reactive responses if the home country factors were not strong on the issue. However, there was rarely a study of the climate change mitigation strategy of the branches of major O&G companies in other countries; especially developing countries, to test such assumptions. Also, the majority of the literature also neglected to analyze host country factors.

Nevertheless, a study by Tuodolo (2009) investigated whether NGOs' collaborative strategy with O&G companies can shape corporate social responsibility (CSR). Shell was chosen as a case study given the fact that many NGOs have established a collaborative relationship with this company through projects such as biodiversity conservation or HIV/AIDS prevention. Examining the operation of Shell in Nigeria, Tuodolo (2009) concluded that NGOs' collaboration with the company appeared to benefit Shell's image more than society, as the local communities in the Niger Delta area have severely suffered from the activities of Shell; namely 3,213 oil spills incidents, discharged drilling waste, gas flaring, and intra- and inter-communal conflicts (p.537-538). Although his study did not specially focus on corporate climate strategy, it offered an empirical case showing how branches of O&G corporations in developing countries may not necessarily have the same policy as their headquarters in developed countries.

Secondly, companies from developed countries, either in the US or Europe, were the sole targets of studies. Thus, little is known about companies whose country of origin is from emerging economies or developing countries in other continents such as Asia. Essentially, the understanding of the determinants of corporate climate change strategies have been built upon the examination of a small number of major O&G companies from the US and European countries. This has created a critical gap in the disciplinary of, to name a few, business management, institutional theory, international relations, and climate change studies. One interesting exceptional case was Pulver (2007), who studied how developing-country O&G firms chose to adopt a proactive climate strategy, drawing upon a case study of Petroleos Mexicanos (Pemex). According to his findings, home country factors (Mexican political-cultural context) did not explain why Pemex chose a cooperative climate strategy as Mexico was then "decades away from mandating greenhouse gas reductions" (p.241). Rather, it was the 'industry peers and industry leaders' that played a more important role. Pemex (peer) followed BP's proactive climate strategies (leader) and imported "climate protection norms and practices" (p.252), aiming to become a world class company (p.248). The fact that Pemex pursued a cooperative climate strategy proposed an alternative possibility to the study of climate strategies in the O&G industry in developing countries, where the 'race-to-the-bottom' had been one of the prevailing discourses.

2.2.1.2 Literature in the second, third, fourth and fifth group examining O&G industry and environmental responsibility, firms and corporate responses to climate change, firms and corporate environmental responsibility and CSR, and firms and corporate strategies respectively

Literature reviewed in the 2nd, 3rd,4th and 5th group shown in Figure1 has broader study scope than those in the 1st group. The broadest one is the study of firms (in particular MNCs) and the determinants for their corporate strategies. Interestingly enough, the present study found that a broader study scope does not necessarily mean that a larger number of determinants are covered. Much of the literature in this group conducted an in-depth investigation on one or a few specific determinants; while some had proposed multi-determinants which were not so distinctive from those already mentioned in the first group. Some examples of journal papers which studied one or several determinants are a) Sharma (2000), who studied 'managerial interpretations' (whether firm managers interpreted environmental issues as a threat or opportunity) as a determinant for a proactive or reactive corporate environmental strategy of 99 O&G companies in Canada, b) Kolk et al. (2008), who analyzed Financial Times 500 firms and pointed out the importance of institutional investors (investment banks and pension funds in the UK and other regions) in encouraging firms' disclosure of climate change activities through the Carbon Disclosure Project (CDP), which is a well-known voluntary carbon disclosure and reporting mechanism, and c) Reid and Toffel (2009), who investigated activist groups and government actors as factors that drove 524 firms listed in S&P 500 index to disclose climate change activities.

Regarding examples of authors who studied multiple determinants, a) Bansal and Roth (2000) studied 53 firms in UK and Japan and proposed three key determinants for ecological responsiveness, which were competitiveness (firms expected to gain long-term profitability), legitimation (firms complied with legislation, norms, values or beliefs), and ecological responsibility (firms acted out of a sense of obligation, responsibility or philanthropy rather than out of self-interest; environmental protective was the right thing to do or a feel-good issue), b) Kolk et al.(2001) examined Fortune Global 250 firms, suggesting that the nationality and business sector of firms influences the frequency of

environmental reporting (firms whose country of origin had strict legislation and active environmental social movement, as well as being located in non-financial sectors, will result in a higher frequency of environmental reporting), c) Okereke (2007) took UK FTSE 100 companies as an empirical case study and concluded that profits and external pressures from government, NGOs, investors, market shift, and O&G price were motivations and drivers for corporate carbon management, d) Jeswani et al.(2008) conducted a massive study sending questionnaires to 1028 companies in the UK and 450 companies in Pakistan (with 108 and 72 returns, respectively), and drew the conclusion that owners, company management and regulatory agencies had a strong influence, while employees, competitors, industrial associations, insurance companies, clients or customers, financial institutes and NGOs were considered to have a low influence on corporate responses to climate change , and e) Suttipun and Stanton (2012) randomly selected 75 from the 500 companies listed on SET 2007 (Stock Exchange of Thailand) to find out the factors that influenced the amount of environmental disclosure and suggested five key determinants including size of company, type of industry, ownership status, country of origin of the company and profitability.

2.2.1.3 Comparing literature between the 1st group and the 2nd, 3rd, 4th, 5th groups

The first apparent difference is the methodology used by authors in the 1st group and 2nd-5th groups regarded the targets of study and research approaches. It appears that authors in the 2nd, 3rd, 4th, 5th group have taken larger samples than those in the 1st group in term of the number of companies and sectors. Firms that were the targets of study in the 2nd group were more diverse in country of origin, not only including those in the US or EU. They included for example Canada (Sharma, 2000), Japan (Kolk et al., 2001), Pakistan (Jeswani et al., 2008) and Thailand (Suttipun and Stanton, 2012). In addition, the 2nd group literature examined a wide range of sampling, drawing up a 'theory' through a deductive research approach. In the opposite, the 1st group literature thoroughly investigated a small number of O&G companies and generalized the understanding of the determinants that influence climate strategies of O&G industry based on an inductive approach, which resulted in the critical gaps mentioned in section 3.2.1. However, the 1st group literature managed to obtain insights from key stakeholders in O&G companies by interviewing CEOs and management; whereas the 2nd, 3rd, 4th, 5th group relied more on secondary data analysis such as corporate environment reports and quantitative approaches, such as a questionnaire surveys. In addition, the 1st group followed the change in climate strategy of major O&G companies; and took into account the 'time' variable. The results drawn by the 2nd, 3rd, 4th, 5th group literature lacked this chronological context; thus leading to ambiguity of the findings as time passes.

The second difference is the determinants. The present study found one journal paper in the 2nd, 3rd, 4th, 5th group literature that touched upon the host country factors which were overlooked by the 1st group. Sethi and Elango (2000) proposed in their framework for analyzing the country of origin influence on MNCs strategy that the host country has the "bargaining power that provides a country with the wherewithal with which to influence an industry's overall global strategy and structure in ways that are more beneficial to the needs of the host country" (p.295). According to them, the host country context can influence to some extent the corporate strategies of MNCs. However, whether this finding would apply to the climate change strategies of O&G companies has not yet examined.

2.2.2 Gaps in the literature

The existing literature has focused on attempting to examine the variety of factors that can enhance knowledge on the behavior of O&G companies regarding climate change mitigation. A number of determinants from literature, both specifically examining O&G industry's climate change strategies and more general corporate strategies, were illustrated in section 2.2.1. The factors that were considered by other authors were comprised of tangible variables and normative factors (norm, values, culture and regime), and are related to diverse actors i.e. O&G companies (size, profitability, nationality, CEOs, employees, ownership status, organizational structure, main products, renewable energy investment), state actors (home country and host country's government), and non-state actors (NGOs, consumers, company competitor or counterparts, industrial association). Finally, some factors relate to the international level as a majority of O&G companies are MNCs (international industrial association, other industries, peer companies and leaders). However, the present study found that there is one major gap in literature, as all these studies generally focus on the individual corporate responses of each O&G company to climate change. While individual efforts are important, the collective activities on climate change mitigation among companies in the same or across industries is vital if climate change is to be addressed at the macro level.

To fill in this gap Chaiyapa et al. (2016) investigated the factors that can influence the establishment of sectoral approaches, essentially a possible form of collective action by companies in the oil and gas industry to climate change mitigation. Sectoral approaches activities would represent a concerted group effort by companies in the sector to intensify climate change mitigation efforts. If well-established they have the potential to addressing competitiveness distortion as well as carbon leakages, which result from the uneven distribution of responsibility to reduce GHG emissions between developed and developing countries under the Kyoto Protocol. O&G companies in the upstream industry in Thailand were the focus of the study, thus offering an analysis of the climate change strategies of local branches of major multinational oil and gas companies, as compared to those of Thailand's national company. Finally, the authors conducted an online questionnaire and

semi-structured interviews with company and non-company respondents and found that the government of Thailand was considered the most influential actor and should take the initiative in establishing sectoral approaches in the upstream oil and gas industry. Company respondents pointed out that they were willing to comply with government policy and preferred a sectoral agreement with Thai government.

Nevertheless, there is some rooms for further investigation on sectoral approaches to climate change mitigation in the upstream oil and gas industry. Chaiyapa et al. (2016) suggested that the number of company respondents as well as data collecting more data from company headquarters would be an interesting path of future research, in order to examine in more depth factors related to the International Relations model. Changing the area of study from Thailand to other developing countries was another of the suggested potential research directions, examining whether the governments of other developing countries can be considered to be the main determinant of the upstream oil and gas companies. Last but not least, the transnational sectoral approach among companies across countries such as in Southeast Asian region was identified by Chaiyapa et al. (2016) as an attractive research topic. As the region established the ASEAN Economic Community (AEC) in 2015, it might be potentially possible for a transnational sectoral approach to be established amongst member countries.

2.3 Literature examining renewable energy investment and divestment of O&G companies

Some of the literature in this group overlapped with those reviewed in section 2.2, as renewable energy investment is one of climate change mitigation activities that O&G companies have pursued. To name a few examples, Levy and Kolk (2002) and Pulver (2007) both referred to the renewable energy development projects of O&G companies in their studies of what determined corporate responses to climate change. However, besides these there is also a number of other authors who have specifically focused on the renewable energy projects that have been undertaken by fossil fuel companies. The purpose of these studies ranged from merely reviewing actual renewable energy development and commercialization projects of major O&G companies (Csomos, 2014), examining how the companies integrated solar PV business in their organizational structure (Pinkse and Buuse, 2012), to critically examining why the companies entered and left the renewable energy business (Davis, 2006; Penha, 2011; Miller,2013; Johnson, 2015). Additionally, Schweitzer (2015) crosschecked rhetoric and actions to find out if O&G companies put into practice their discourses on sustainability.

2.3.1 Results and discussion on the reviewed literature

Similar to the literature highlighted in section 2.2, most of the literature in this section investigated the green business of USA and EU-based multinational O&G companies; namely ExxonMobil, Chevron, BP, Shell, Statoil, and Total. Penha (2011) was an exception as the author chose as case studies O&G companies which had a high ranking in Petroleum Intelligence Weekly, thus covering both International Oil Companies (IOCs) such as BP, Chevron, ExxonMobil, ConocoPhillips, Shell, Total and National Oil Companies (NOCs) like Gazprom (Russia), PDVSA (Venezuela), Saudi Aramco (Saudi Arabia), Statoil Hydro (Norway), and Eni (Italy). Chaiyapa et al. (2017) pushed the boundary of the subject matter to cover climate change mitigation activities of O&G companies in Thailand and found that most of them did not actually invest in renewable energy. Rather, most of the companies studied by Chaiyapa et al. (2017) undertook basic

mitigation activities such as preparing a GHG inventory, improving energy efficiency, elaborating GHG reduction targets, or conducting reforestation efforts. The study noted that Thailand's national oil company, PTT, was the only one among the five companies analyzed that invested in various alternative and renewable energy projects. The rest were foreign companies that had not yet shown any interest in diversifying their energy portfolio.

The study of the investments in renewable energy that are made by O&G companies is vital to sustainable development, as they could contribute to the transformation and greening of the energy sector, helping the transition to a low-carbon energy future. However, academic literature appears to have limitations in capturing the rapid changes that are taking place in the 21st century. Volatility of crude oil prices, the discovery of shale oil and gas, new global climate change agreements, as well as the global movement to divest from fossil fuel are a few examples of changing world-wise phenomena that is affecting corporate strategies in the renewable energy business. It appears that most up-to-date knowledge on the subject matter has been mostly written in the form of news articles in particular those published by the Economist, the Guardian, and Bloomberg, rather than published as the academic literature. Thus, in the present thesis the author reviewed both academic literature and news articles to design an analytical framework on factors that could influence renewable energy investment/divestment of O&G companies in the course of the 21st century. See more detail in Chapter 3.

2.3.2 Gaps in the literature

Academic literature and media have long scrutinized big oil multinational corporations from both sides of Atlantic Ocean and the renewable energy investments or divestments they have made, which can be traced back to the first oil shocks in the 1970s. Since then the world has kept on changing rapidly, especially in the first 15 years of the 21st century, which caused major changes in the way that O&G companies invest in renewable energy. However, it should be noted that so far academic literature has not moved fast enough to capture those changes, which represents a substantial gap in literature, and highlights the need for academia to catch up with the rapid changes taking place in the industry.

The present research thus aims to expand the horizon of this subject matter. First, the case studies must be enlarged to cover National Oil Companies (NOCs), particularly those that are operating in developing countries. NOCs, as Victor (2007) pointed out, represent around 80% of world's proven reserves; while International Oil Companies (IOCs) have been experiencing decreasing reserves and have been pushed to move to areas where O&G exploration and production are challenging. In addition, special attention should be paid to NOCs in developing countries, where the dilemma between improving energy security to maintain economic growth and investing in sustainable energy to reduce GHG emission is acute. To what extent NOCs in emerging economies welcome the development of disruptive renewable energy technologies appears to be under-examined in literature.

More importantly, there seems to be a wide gap in literature regarding a lack of analysis on the discourses that O&G companies have used to legitimize their business diversification from fossil fuels to renewable energy sources, given the fact that such renewable energy technology is not their core business. A number of authors have applied and carried out a discourse analysis on government energy policy. For example, Andrews (2005) outlined how the discourse on energy security was one of the main rationales behind the US federal energy policies from 1954 to 2003. Lovell (2008) took the case of low energy housing in the UK to illustrate the influence of the discourse on an innovation journey, stating that sustainable housing innovation became narrowly reframed as a low-carbon or low-energy housing as climate change emerged as a dominant part of the UK's policy agenda in late 1990s. Scrase and Ockwell (2010) analysed the UK's energy policy reviews in 2006-2007 and found that the discourse on energy security was particularly emphasized and used consistently to promote nuclear power as an important option for the UK's energy supply. Otherwise, Eckersley (2016) conducted a comparative discourse analysis to examine how German and Norwegian governments have relied heavily on a discourse of Green Growth to legitimate their climate change policies and diplomacy.

However, to date there has been little effort to analyse the discourses of the private sector, in particular O&G companies (Livesey, 2002; Livesey and Kearins, 2002; Breeze,

2012). Conducting a discourse analysis on the strategy of O&G companies regarding renewable energy investment is significant for at least two reasons. First, as many scholars have attempted to understand what could be the driving factors and barriers for renewable energy diffusion or penetration (Dulal et al., 2013; Jacobsson and Lauber, 2006; Painuly, 2001; Reddy and Painuly, 2004; Sovacool, 2009; Sovacool et al., 2011), the findings from a discourse analysis on the investments in renewable energy of O&G companies can provide another missing piece of the total picture. The second reason lies around the argument that O&G companies could play a crucial role in the transition to low-carbon development in low and middle income countries. Essentially, it is crucial to understand the rhetoric or discourses which companies have used to explain their motivations, as this can help explain the way in which the executives in these companies think. Such findings are undoubtedly beneficial for policy makers to attempt to harness the huge resources of companies –even those in the O&G sector- to help in the sustainable energy development of human society. By attempting so solve the gaps in literature that have been highlighted in the present chapter, the author hopes that this thesis will help the sustainable development of human society, and further the field of Sustainability Science.

Chapter 3 Research methodology

3.1 Targets of study (ASEAN's major O&G companies)

The present study aims to expand the study of O&G industry and its renewable energy investment by including National Oil Companies (NOCs) from developing countries. As the starting point, three NOCs in three Southeast Asian countries; namely PTT from Thailand, PERTAMINA from Indonesia and PETRONAS from Malaysia, were chosen as case studies. This is due to the fact that they are primary energy suppliers of their respective countries which are top three countries in term of oil and gas production as shown in Table 2 (adopted from data IEA, 2013). Moreover, all three companies were listed in the Fortune Global 500 as the top 500 companies in the world in term of revenues and profits. They are only three companies from Southeast Asia that were ranked in the list. Besides, the present study included two associates of PTT; Thai Oil and Bangchak for an in-depth analysis of Thailand case. It is noted that PTT has many other associated companies. Yet the study chose to include only Thai Oil and Bangchak because they are only two O&G associates of PTT which have invested in renewable energy. In so doing, the present study aims to examine whether associate companies operating in the same country have similar or different corporate strategies to climate change mitigation. Details of each company are presented in Table 3.

Table 2 Oil and gas reserves and productions in Southeast Asian countries

Country ranks	Natural gas proven reserves (tcm)[2]		Natural gas production in 2011 (bcm)		Oil proven reserve (Billion barrel)		Oil production in 2012 (kb/d)	
1	Indonesia	3.1	Indonesia	81	Vietnam	4.4	Indonesia	889
2	Malaysia	2.4	Malaysia	56	Malaysia	4.0	Malaysia	674
3	Vietnam	0.7	Thailand	28	Indonesia	2.7	Thailand	393
4	Brunei	0.4	Brunei	13	Brunei	1.1	Vietnam	356
5	Thailand	0.3	Vietnam	9	Thailand	0.5	Brunei	140
6	Philippines	0.1	Philippines	4	Philippines	0.1	Philippines	34
	Rest of ASEAN	0.5	Rest of ASEAN	12	Rest of ASEAN	0.1	Rest of ASEAN	17
	Total of ASEAN	7.5	Total of ASEAN	203	Total of ASEAN	12.9	Total of ASEAN	2503
Share of World	**3.5%**		**6.0%**		**0.8%**		**2.9%**	

Table 3 Detail of each company studied

Companies	Rank in Fortune Global 500 (2016)	Ownership structure	Listed in stock market
PETRONAS	125th	100% owned by government	No
PTT	146th	51% owned by government	Yes
PERTAMINA	230th	100% owned by government	No
Thai Oil	No	PTT holds 49.10% of shares	Yes
Bangchak	No	PTT held 27.22% (until2016)	Yes

[2] tcm stands for trillion cubic meter, bcm stands for billion cubic meters and bd/d stands for kilo barrels of oil per day

3.2 Scope of study

Content: The present research aims to investigate how five major O&G companies in Southeast Asian countries can contribute to mitigate global climate change, by focusing on the renewable energy investment as it is one way to achieve the targets of the Paris agreement, the Sustainable Development Goals and to lead to a transition to a low-carbon energy future. Thus, the research exclusively examined the actual renewable energy projects and the language that companies used to justify their investments in green energy. The researcher acknowledges that the role of O&G companies is not necessarily limited to investment in renewable energy in order to reduce GHG emissions, and that renewable energy technology itself is currently being studied regarding both potential and actual social, economic and environmental impacts. However, the former was investigated already in the previous work of Chaiyapa et al. (2017); the latter is beyond the scope of this study.

Study period: The period for the study in sub-objective 1-2 was fixed to 2001-2015. The researcher collected the first year of annual reports which are available in the companies' websites, until the year 2015. For the study in sub-objective 3, the data collection was finished in December 2016. All interview data from stakeholders in Thailand, Malaysia and Indonesia reflected perceptions/opinions and situations at the time in which the interviews were conducted.

3.3 Methodology for sub-objective 1

To achieve sub-objective 1, a thorough review on actual renewable energy investment projects of the five companies, namely PTT, Thai Oil, Bangchak, PETRONAS and PERTAMINA, during the first 15 years of 21st century was carried out. The present study collected all available secondary data of companies i.e. annual reports, sustainability reports to review their actual renewable energy projects. Then the findings were crosschecked with the data found in news articles in online newspapers and websites of private organizations such as biofuels associations in respective countries. Moreover, primary data from semi-structured interviews with company respondents and other stakeholders were also collected to obtain more up-to-date and insightful information in addition to what was written in the companies' reports. Table 4 presents an interviewees list from Thailand, Malaysia and Indonesia.

Table 4 Interviewees list in Thailand, Malaysia and Indonesia

Country	Thailand	Malaysia	Indonesia
Stakeholders			
O&G companies	**PTT Public Co., Ltd.** • Executive Vice President, PTT Research and Technology Institute **Global Power Synergy Public Co., Ltd.** • Division Manager, Corporate Strategy Division **Bangchak Petroleum Public Co., Ltd.** • Vice President, Corporate Sustainability Development Office **Thai Oil Public Co., Ltd.** • Vice President-Strategic Planning	**PETRONAS** • Head(Macro), Strategic Research • Manager, Energy &Environment, Strategy Research, Corporate Strategy	**PERTAMINA** • New & Renewable Energy Business, Gas Directorate **PERTAMINA Geothermal Energy** • Secretary of Board of Commissions
Government offices	• Bureau of Biofuel Development Department of Alternative Energy Development and Efficiency, Ministry of Energy of Thailand (3 persons) • Renewable Energy Expert, Department of Alternative Energy Development and Efficiency Ministry of Energy (2 persons)	• Under Secretary, Biofuel Division, Ministry Of Plantation Industries and Commodities Malaysia • Assistant Secretary, Biofuel Division (2 persons) • Assistant Director, Renewable Energy Technology Division, Sustainable Energy Development Authority Malaysia (SEDA)	• Deputy Director of Program Various New Energy and Renewable Energy, Director General of New, Renewable Energy and Energy Conservation Ministry of Energy and Mineral Resources • Head of Division for Analysis and Evaluation Bioenergy Program, Directorate Bioenergy • Deputy Director for Technical and Environmental Regulation and Compliance, Directorate General of Oil and Gas (Migas) • Preparation and Evaluation of Geothermal Concession Area Division, Directorate of Geothermal • Commercial Attache, U.S. Commercial Service, US Department of Commerce (3 persons)

Country	Thailand	Malaysia	Indonesia
Stakeholders			
Scholars/research institutes/ NPOs	• Thai researcher, Asia Pacific Energy Research Centre (APERC) The Institute of Energy Economics, Japan (IEEJ) • Lecturer of Energy Division, King Mongkut's University of Technology Thonburi, Bangkok • Board of Director, Technical Petroleum Training Institute (Former Director General of Department of Alternative Energy Development and Efficiency) • Analyst, Petroleum Institute of Thailand (PTIT)	• Senior Lecturer Department of Mechanical Engineering, Faculty of Malaya, University of Malaya • Malaysian researcher, Asia Pacific Energy Research Centre (APERC) The Institute of Energy Economics, Japan (IEEJ)	• Agency for the Assessment and Application of Technology (BPPT) • Indonesian research, Asia Pacific Energy Research Centre (APERC) The Institute of Energy Economics, Japan (IEEJ)
Private sector	• Director, Unitrio Technology Limited (Solar PV installment company) • President, Association of Ethanol Producers of Thailand	• Deputy President, Malaysian Biodiesel Association (MBA)	• President, Asosiasi Produsen Biofuel Indonesia
NGOs	• Greenpeace Southeast Asia • Green World Foundation	• Executive Director, Centre for Environment, Technology &Development Malaysia (CETDEM)	nil
Others	•	• One interviewee prefers not to be revealed both name and affiliation.	
In total (persons)	**17**	**10**	**11**

3.4 Methodology for sub-objective 2

The study conducted discourse analysis examining the 'rhetoric' or 'reasons' for each company to make investments in renewable energy by employing the MAXQDA software, which was chosen due to its powerful visualization tools, which suits the research objectives well. It is important to note that MAXQDA only facilitates (re)reading and rearranging of materials, rather than automating the analysis. Hence, all analysis and interpretation processes were conducted by the authors, based on a grounded theory approach which involves coding, identifying recurrent patterns or themes, and finally building up a cohesive representation of the data (Warren and Karner, 2010).

The study analysed the annual reports of five O&G companies, namely PTT- a state-owned company of Thailand and two of its associates- Bangchak and Thai Oil, PERTAMINA – a state-owned company of Indonesia and PETRONAS- a state owned company of Malaysia. The annual reports do not only illustrate overall business operations but also include speeches and messages from CEOs. These annual reports were available from company websites, and the present study made use of all which are available online until the 2015 annual report, the latest published at the time of writing. PTT and Thai Oil were listed in the Stock Exchange of Thailand (SET) in 2001 and 2004 respectively, and thus their annual reports started in these years. Bangchak was listed in SET since 1994, but despite the best efforts by the researcher, only annual reports from 2002 could be accessed. As of December 2016 Bangchak's website only holds annual reports from 2007. PERTAMINA and PETRONAS are not listed in the Stock Exchange; thus they are not obliged to publish annual reports. Table 4 presents the annual reports collected from each company's website.

Table 5 Annual reports of five companies studied

Company	Annual reports	Number of reports
PTT	2001-2015	15
Bangchak	2002-2015	14
Thai Oil	2004-2015	12
PERTAMINA	2006-2015	10
PETRONAS	2008-2015	8
Total		59

To answer research question No.1 in sub-objective 2 "what are discourses each oil and gas company applies to justify a given source of renewable energy?",the present study ran a discourse analysis starting by identifying key words regarding different types of renewable energy i.e. biofuels (gasohol[3], biodiesel[4]), solar PV, wind, geothermal, ocean, tidal, biogas[5] and key conjunctions reflecting causes of action i.e. 'to', 'in order to', 'so that', 'for'. Sentences or phrases which had such key words embedded were recorded as discourse fragments. Then, the authors conducted a thematic coding to group all related discourse fragments under a theme or a discourse strand by 1) systematically identifying key words that occurred repeatedly, such as 'government', 'environment', 'HM the King', 'farmers' or 2) interpreting the meanings of those sentences. To give some examples, the discourse fragments "the innovation could respond to the government policy" (PTT, 2008),

[3] **Gasohol,** "a gasoline extender made from a mixture of gasoline (90%) and ethanol (10%; often obtained by fermenting agricultural crops or crop wastes) or gasoline (97%) and methanol, or wood alcohol (3%). Gasohol has higher octane, or antiknock, properties than gasoline and burns more slowly, coolly, and completely, resulting in reduced emissions of some pollutants, but it also vaporizes more readily, potentially aggravating ozone pollution in warm weather. Since 1998 many American automobiles have been equipped to enable them to run on E85, a mixture of 85% ethanol and 15% gasoline" (The Columbia Encyclopedia, 2016).

[4] **Biodiesel**, "a fuel made from natural, renewable sources, such as new and used vegetable oils and animal fats, for use in a diesel engine. Biodiesel has physical properties very similar to petroleum-derived diesel fuel, but its emission properties are superior. Diesel blends containing up to 20% biodiesel can be used in nearly all diesel-powered equipment, and higher-level blends and pure biodiesel can be used in many engines with little or no modification" (The Columbia Encyclopedia, 2016).

[5] **Biogas:** "a mixture of methane and carbon dioxide resulting from the anaerobic decomposition of such waste materials as domestic, industrial, and agricultural sewage. The decomposition is carried out by methanogenic bacteria (see methanogen); these obligate anaerobes produce methane, the main component of biogas, which can be collected and used as an energy source for domestic processes, such as heating, cooking, and lighting" (The Columbia Encyclopedia, 2016).

"investment on palm oil plantation is in line with government policy on alternative energy and global warming caused by oil consumption" (PTT, 2009, 2010) were grouped under the discourse strand "Response to government policy"; while the discourse fragments "gasohol replaces gasoline and biodiesel replaces diesel", "promoting alternative energy like gasohol, bio-diesel and NGV for greater self-reliance" and "E85 gasohol, with a higher ethanol content, will lead to less dependence on imported fuels" were grouped under the discourse strand "Enhance energy security and lessen imported oil" (PTT, 2007, 2008, 2010).

Following the work of Van Leeuwen and Wodak (1999) and Erkama and Vaara (2010), the present study then categorised discourses found in the annual reports of each company into four discursive legitimation strategies. This method is to answer research question No.2 in sub-objective 2, "what sort of discursive legitimation strategies are used to justify a given renewable energy by oil and gas companies in Thailand, Indonesia and Malaysia?". Table 6 shows the four types of discursive legitimacy strategies with the explanation on what the legitimacy was drew upon.

Table 6 Discursive legitimation strategies

Grammar of legitimation (Van Leeuwen and Wodak 1999)	Legitimacy was drew upon	Rhetorical strategies (Erkama and Vaara (2010)	Examples
Authorization	References to authorities	**Ethos**	- Persons (experts, ministers, CEOs) - Laws, regulations, policies, Bible
Rationalization	References to knowledge claims or argument	**Logos**	- Economic benefits - Financial performance
Moral evaluation	References to value system	**Pathos**	- Fairness - Human equality
Mythopoesis	Legitimation achieved by narratives, stories on the past or the future	**Authopoiesis**	- Business plan
		Cosmo	- Future - Inevitability of globalization

After Van Leeuwen and Wodak proposed four categories of discursive legitimation strategies in their work in 1999, many other scholars have further studied and advanced the four fundamental categories by adding additional categories or changing the labels of the original ones. The work of Ekama and Vaara (2010) is one example of attempts to push forward the knowledge on discursive legitimation strategies. In their work, the authors renamed Authorization, Rationalization and Moral evaluation strategies as Ethos, Logos, and Pathos respectively in order to emphasize the rhetorical aspect of discourses rather than their semantic functions which Van Leeuwen and Wodak used in their work. As for the Mythopoesis strategy, the authors divided it into two sub-types; namely Authopoiesis and Cosmo. It is noted that there are other studies that proposed other types of legitimation strategies. Drawing upon Van Leeuwen and Wodak's work, Vaara and Tienari (2008) studied discursive legitimation strategies of Multinational Corporations. However, they

proposed five strategies instead of four; namely they added Normalization which is separated from Authorization in order to "emphasize the importance of strategies used to render specific actions or phenomena normal or natural". Vaara (2014) studied how media in Finland did legitimation, delegitmation and relegitimation on the Eurozone crisis. The author identified more types of legitimation strategies, which are Position-based authorization, Knowledge-based authorizations, Rationalizations, Moral evaluations, Mythopoiesis [6] and Cosmology. The aforementioned works demonstrate that the understanding on discursive legitimation strategies is ongoing research and open for new interpretations. However, the present research chose to follow the four types of discursive legitimation strategies of Van Leeuwen and Wodak (1999). This is because while these are the fundamental concepts, the new type of legitimation strategies that other scholars have added on are more like sub-types of those four basic categories.

3.4.1 Strength of discourse analysis on annual reports

The use of annual report is a well-established unit of analysis in discourse studies. Particularly in organizational legitimacy theory scholars have used annual reports as raw data to run discourse analysis, for example, the study of legitimation strategies in annual reports of O&G companies after the Deepwater Horizon incident (Breeze, 2012), and the study of discourses in CEOs' letters written in annual reports (Hyland, 1998). Annual reports are official documents of companies. In each annual report, there are a wide range of contents, ranging from CEOs' speeches and financial fact sheets to descriptions of business operations for core businesses and new projects they are implementing. PTT, Thai Oil and Bangchak are listed in the stock market; thus, every year the companies are organizing Annual General Meeting (AGM) which serves as a platform for the companies to meet their shareholders. However, only shareholders are invited to participate and what the companies say in the AGM is not shared to the public. Thus, annual reports are among a few available sources of information regarding the performance of companies and their operations, which anyone can access. In addition, a literature review in discourse studies

[6] In the work of Vaara (2014), the term is spelled as Mythopoiesis; while in the work of Van Leeuwen and Wodak(1999) it was written as Mythopoesis (without-i).

indicates that scholars have used either annual reports or sustainability reports (Han Onn and Woodley, 2014). However, the five companies examined in this study just started producing sustainability reports recently (PETRONAS in 2007, PTT in 2008, Thai Oil and Bangchak in 2009 and PERTAMINA). As a result, the number of sustainability reports from these companies is not sufficient to trace back their green energy investments in the past 15 years, which is the focus of sub-objective 1.

3.4.2 Limitations of discourse analysis on annual reports

The discourse analysis on annual reports is based on the idea that the public are obtaining the messages that the companies convey in their annual reports. However, in reality people in general are unlikely to read the report, while investors and NGOs are the most likely to follow and investigate the performance of the companies through annual reports. Consequently, the discourse the companies used in annual reports may not be able to influence the wide public acceptance or awareness of renewable energy projects.

Moreover, the contribution of discourse studies is to reveal the communication strategies which O&G companies used to promote or justify their new green energy products, though what the companies used as a reason for their green investment cannot be regarded as an actual rationale for them to take action. This limitation is common in existing literature regarding applied discourse analysis on secondary data, such as the sustainability reports of the mining industry (Han Onn and Woodley, 2014). To clarify the limitation of discourse analysis, the present study sought consultation with an expert in the discipline, Florian Schneider, who kindly explained as following:

> *"Discourse analysis itself can never fully establish what specific intentions are or what the people engaged in discourse are actually thinking. From a strict discourse-theoretical perspective, these intentions and thoughts do not really matter. All that matters is how different agents shape the 'truths' of the topic. From that perspective, the documents you are analyzing aren't interesting because they tell you what the companies are actually doing. They are interesting because they demonstrate how the companies 'make*

> *sense' of what they are doing. The focus here is on their conceptual labour and how this discursive work informs conceptions of green energy, production processes, etc. Whether their statements are genuine or 'just' PR is secondary. At any rate, if we wanted to establish intentions or deep thoughts about such things, we would have to do so through other research approaches, for example trick questions in surveys, psychological experiments, etc"* (Schneider, 2016).

As a result, in the study of sub-objective 3, the researcher applied a different methodology to investigate factors that influence O&G companies to invest in or divest from low-carbon energy.

3.5 Methodology for sub-objective 3

The study began with a review on existing literature both academic journal, books and news articles from well-known business newspapers/magazines i.e. the Guardian, the Economist and Bloomberg since 2000 to 2017 to identify all factors, which are matter for decision-making of O&G companies for renewable energy investment. As majority of those literature examined a small group of major O&G companies such as ExxonMobil, Shell, BP, Total, Statoil, Saudi Aramco, the factors identified are those which influence world major IOCs from the western developed world and NOCs from the middle east. The present study thus aims to examine whether these factors can be applied with five O&G companies from Thailand, Malaysia and Indonesia or not, and whether there are novel factors that are specific to NOCs and its associates from developing Southeast Asian countries.

The factors were grouped into three sets in an analytical framework in order to analyze the data systematically. The criteria of grouping is based on works of Skjærseth and Skodvin (2009) and Chaipaya et al. (2016). Three groups are company's specific features, national factors and global factors. The first group- Company's specific features- proposes that company's own characteristics influence its behavior, which is in this case a renewable energy investment. The first group comprises of ownership structure and role of CEOs and shareholders, short-term economic advantages, long-term economic advantages, compatibility of RE to core expertise, corporate social responsibility, lesson learned from experiences in renewable energy business, and view on global climate change.

The second group-National factors, proposes that "corporations are affected by a social demand for environmental protection, governmental supply of climate policies and the political institutions linking supply and demand (Skjærseth and Skodvin, 2009). These national factors are discussed only to factors at home countries of the O&G companies and not including those in the host countries where they have business operation. They are national policy and incentive on renewable energy and climate mitigation policy, country O&G reserves and resources on renewable energy, and civil society.

The third group-Global factors, proposes that corporate strategies of O&G companies get affected by the international factors and phenomenon, be them global

divestment movement, development and cost of RE technology, world crude oil prices, global climate change agreement, peer influence among companies in industry and discovery of shale oil and gas. Overview of factors in the analytical framework is shown in Table 7. It is noted that the factors under a column Tier 1 are those found in the literature; while Tier 2 factors are created to show a theme which Tier 1 factors have commonly. For example, shortage of capital, maturity of company's operation and carbon intensity of company (company's O&G reserve and production) are the factors which were studied in the literature. However, the present study grouped them together because they affect the short-term economic advantage of the O&G companies.

To investigate the factors which influence five O&G companies in Thailand, Malaysia and Indonesia to invest in renewable energy (research question No.1 in sub-objective 3), the present study applied both secondary data and primary data. The semi-structured interviews with various stakeholders in three countries (see Table 4) were conducted to obtain such primary data. Interview data from company respondents were crosschecked with data from non-company respondents i.e. government authorities, NGOs, academics and private renewable energy companies. In addition, to answer research question No.2 in sub-objective 3, the present study discussed first how a given factor affected major O&G companies (western IOCs and major NOCs from Middle East). Then how five O&G companies in the case study were influenced by the given factor were illustrated. Finally, the study recorded all characteristics of O&G companies which are the most and the least active in renewable energy investment to build a model (research question No.3 in sub-objective 3). The study proposes that the model can be a stepping-stone for scholars and policy makers to predict corporate strategies in renewable energy investment of other NOCs companies in developing countries and O&G companies in general. However, a greater number of case studies certainly enhance a projection ability of the model. The study encourages for further research on O&G companies in other developing countries.

Table 7 Analytical framework to examine factors that influence renewable energy investment of O&G companies

Group	Tier one	Tier two
Company specific features	• CEO's leadership and vision • Ownership structure • Shareholder pressure	• Ownership structure and role of CEOs and shareholders
	• Shortage of capital • Maturity of company's operation • Carbon intensity of company (Company's O&G reserve and production)	• Short-term economic advantages
	• View on profitability of renewable energy • View on future energy mix	• Long-term economic advantages
	• Compatibility of renewable energy to core expertise	• Compatibility of renewable energy to core expertise
	• Company respond to public criticism	• Corporate social responsibility (CSR)
	• Experience loss in renewable energy investment	• Lesson learned from past experiences in renewable energy business
	• Acknowledge that global climate change is real	• View on global climate change
National factors	• National policy and incentive on renewable energy and climate mitigation policy	• National policy and incentive on renewable energy and climate mitigation policy
	• Country's oil and gas reserve • Country is importer or exporter of energy • Country's RE resources	• Country O&G reserves and renewable energy resources
	• Social movement on environmental issues	• Social demand for environmental conservation
	• Business-government relations	• Business-government relations
Global factors	• Volatility of world crude oil prices	• Volatility of world crude oil prices
	• Discovery of shale oil and gas	• Discovery of shale oil and gas
	• Development and cost of renewable energy technology	• Development and cost of renewable energy technology
	• Global divestment movement • The unburnable, stranded assets notion	• Global movement to divest from fossil fuels companies
	• Global climate change agreement	• Global climate change agreement
	• Companies follow leaders in the industry	• Peer influence among companies in industry

3.6 Relationship of the three sub-objectives of the study

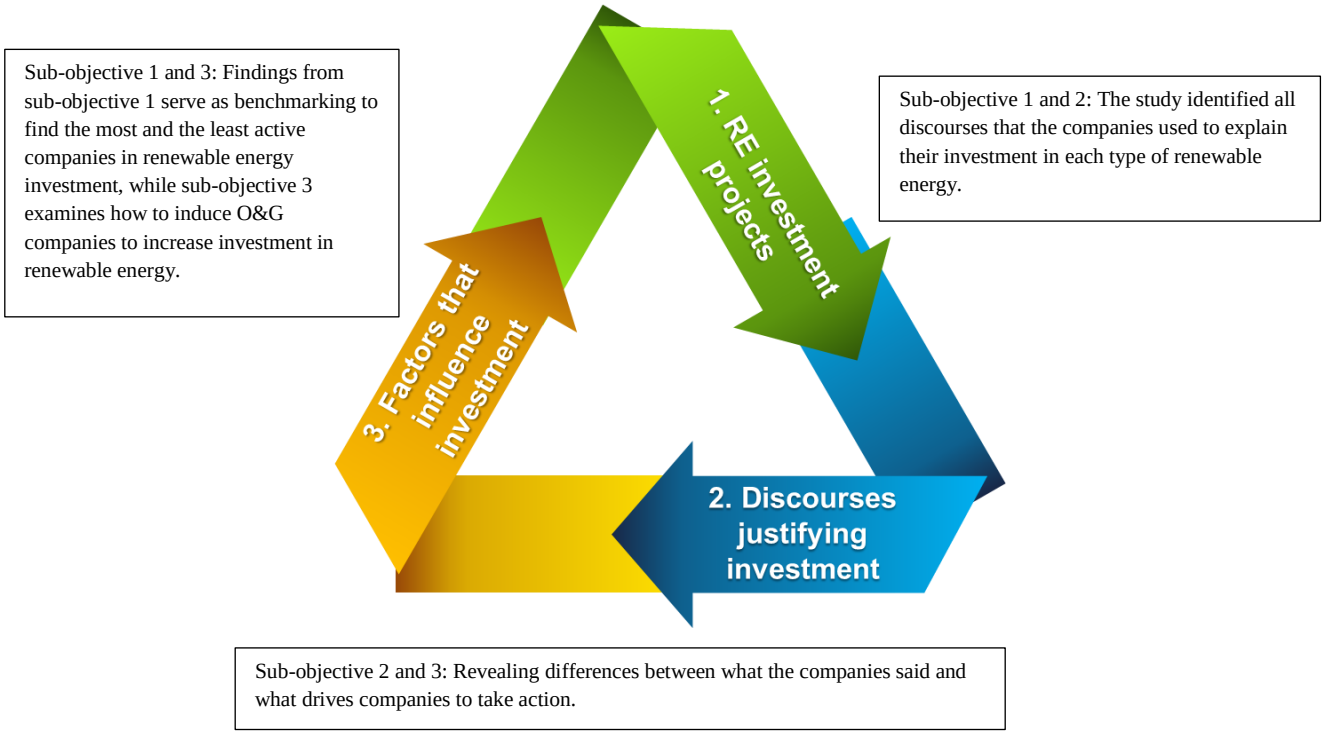


Figure 2 Relationship of the three sub-objectives of the study

- **Relationship between sub-objective 1 and 2**

After a thorough review on actual renewable energy projects done by O&G companies in the first 15 years of the 21st century in sub-objective 1, the study identified the discourses that the five O&G companies used to explain why they invested in each type of renewable energy. The discourse analysis revealed that O&G companies applied different discourses varying to the type of renewable energy and that those discourses changed over time.

- **Relationship between sub-objective 1 and 3**

The study recorded actual renewable energy projects of the five O&G companies studied since 2001 until 2015 and conducted benchmarking among them to find which companies are the most active and the least active in diversifying their business portfolio from fossil fuel to renewable energy. Listing of investment activities among the five companies served as a reference for investigating what factors can influence companies to invest in renewable energy. In return, the findings from sub-objective 3 enhance understanding on why some O&G companies are more active in renewable energy investment than others. Additionally, the policy suggestions can be drawn to encourage O&G companies in each country to increase their green energy business.

- **Relationship between sub-objective 2 and 3**

Due to the fact that discourse analysis only reveals the communication strategies of O&G companies in gaining legitimacy on their new renewable energy projects, the study on influential factors in sub-objective 3 provides knowledge on what are the actual incentives for O&G companies to make decisions in investing. The findings of sub-objective 2 and 3 can be compared to reveal differences between what the companies say and what actually drives them to take action. As the results in Chapter 5 and 6 show, some discourses found in companies' annual reports, i.e. government policy and economic profits, are referred to as important factors for the companies when making decisions to invest in renewable energy business. However, some discourses appear unrecognized, i.e. the King's initiative in biofuel production and helping farmers secure their incomes. In addition, there are some factors that are important to decision-making process, though the companies do not mention them in their annual reports i.e. pressure from shareholders and business-government relations.

Chapter 4 Renewable energy investments of ASEAN's major O&G companies

4.1 Investment by Thailand's O&G companies

4.1.1 Biofuels (biodiesel and gasohol)

Biofuels (gasohol and biodiesel) have been the prime focus of investments in renewable energy by Thailand's O&G companies, and this was first mentioned in the 2002 annual reports of both PTT and Bangchak. In 2003, both PTT and Bangchak started selling Gasohol 95 (10% of ethanol) at their service stations in Bangkok. Along with expanding the number of service stations that offer such products, PTT and Bangchak have made constant efforts to offer their customers new products. Gasohol E20 and E85, as well as B2 and B5 biodiesel, started to be sold by PTT and Bangchak service stations from 2008 and 2009, respectively. Bangchak started running a marketing strategy by introducing the Gasohol Club Card in 2006, which was followed with the Gasohol Club Lady Card in 2011[7]. PTT, rather than using price promotion, has continuously attempted to introduce new fuel products, which their annual reports suggesting that these provide better performance regarding engine maintenance and environmental conservation.

Thai Oil's main business activities relate to the refining of oil, and it does not participate in the retail market (as opposed to PTT and Bangchak). Nevertheless, Thai Oil has engaged in ethanol and biodiesel production. Starting in 2005, slightly later than the other PTT and Bangchak, Thai Oil took a bold step on biofuels development by signing a memorandum of understanding (MOU) with partners for a joint study to establish an ethanol producing plant which would have a capacity of 1 million litres per day (the largest facility in Thailand and the world's largest ethanol plant using cassava as the primary feedstock at the time). The company also established a joint venture with Padaeng Industry Plc. and Petrogreen Co., Ltd. in 2007 to set up Maesod Clean Energy Co., Ltd. as the first ethanol producer from sugarcane in Thailand, with a capacity of 200,000 liters per day.

[7] The card provides a special discount of 0.2 baht per litre for members who fill their cars with gasohol.

Later in 2008, Thai Oil Ethanol Co., Ltd. was established to facilitate investments in ethanol production from cassava, with a capacity of 500,000 liters per day. In 2011 Thai Oil Ethanol acquired a 21.28% share in Ubon Bio Ethanol (UBE) Co.,Ltd. with Bangchak obtaining a further 21.28%. The UBE plant, located in Ubon Rachathani province, has a capacity of 400,000 liters per day, producing ethanol from fresh cassava and cassava chips supplied by local farmers. With such a large supply of ethanol and limited domestic demand at the time, Thai Oil Ethanol considered starting to export ethanol to other countries whose governments had enforced ethanol-blending in gasoline policy (such as the Philippines, which according to Thai Oil's 2011 annual report would raise the rate of ethanol blending from 5% to 10% by February 2012).

Similar to Thai Oil, Bangchak also started the production of ethanol and biodiesel. Apart from acquiring shares in Ubon Bio Ethanol, in 2008 Bangchak made a joint investment with Universal Absorbent and Chemical Company Limited (UAC) to construct a 1,000 million baht-biodiesel plant (approximately $US 33 million). This plant is known as the "Bangchak Biofuel Company Limited" at Bang Pa-In, Ayutthaya province, running biodiesel production from crude oil palm, with a capacity of 300,000 liters per day. In 2012 the plant was improved to raise its capacity to 360,000 liters per day.

PTT is not directly involved in the running of any ethanol and biodiesel production plants. Nevertheless, it has focused on developing non-crop plants for biofuel production by actively cooperating with a variety of external organizations. This includes crops such as jatropha and algae, which PTT claims can reduce the risk of shortages in raw-materials that could arise from using agricultural products for biofuel production (PTT, 2008). The Petroleum Product and Alternative Fuels Research Department vice-president, Arunrat Wuttimongkolchai, announced at a press conference that the institute had been given around 3% of PTT's profits for research and technology (Aquino, 2015), which amounted to 1,426.6 million baht in 2014 (approximately $US47 million).

Another interesting development in PTT's biofuels business strategy was its investment in palm oil plantations in Indonesia. In this sense, Bangchak has also invested in palm oil plantation since 2012, though only within Thailand (together with the Bank of

Agriculture and Agricultural Cooperatives, to convert abandoned orange farms to palm oil plantations). Thai Oil has not pursued any investments in palm oil plantations. PTT Green Energy Co., Ltd. (PTTGE), a wholly owned subsidiary of PTT, was established in 2007 in Singapore to oversee the palm oil business. PTTGE acquired 1.2 million rai (192,000 hectares of landbank), mainly located in Kalimantan, Indonesia for palm oil plantation. It has also started to operate crude palm oil production facilities at Pontianak on West Kalimantan and Palembang on Sumatra island, with a capacity of 45 tons/hours and 30 tons/hours, respectively (PTT, 2012). However, PTT's annual report in 2014 recorded that PTTGE had experienced losses from impairment of operating assets, amounting to THB 2,816 million. The palm oil plantation project was considered 'costly and unprofitable', and eventually the company decided to sell 95% of the shares of Mitra Aneka Rezeki (MAR), the subsidiary of PTTGE that was established to operate PTT's palm plantation and palm-oil refinery business in Indonesia, to Prasada Jaya Mulia (The Nation, 2014). Moreover, in 2015 PTTGE signed a Share and Purchase Agreement (SPA) to sell 77.56% of its shares in Chancellor Oil Pte.Ltd., which ran palm oil business through PT. First Borneo Plantations (PT FBP) in Indonesia (PTT, 2015). The situation on biofuels has apparently not been so positive for PTT recently. According to a key respondent interview at PTT the company decided to shut down its algae biodiesel R&D project, in which the company had invested around 800 million baht during the course of the past decade. The interviewee stated the reason for this cancellation is that the algae-based biodiesel has never succeeded in reaching the commercialisation stage (PTT interviewee, August 2016).

4.1.2 Solar PV and wind energy

Thailand's geographical location along the equator offers a plentiful supply of solar PV power –with an average radiation of 18.2 MJ/m2/day- and wind energy. Content analysis of the annual reports suggested that PTT, Thai Oil and Bangchak have responded differently to the country's plentiful resources. Thai Oil only once mentioned solar and wind energy, more specifically in their annual report in 2009. As a response to the then government's alternative energy policy, Thai Oil became a partner of the MFC Energy Fund- a team of energy and financial sectors established in 2007-, allowing it to access data on various types of alternative and renewable energy for use in future investment. Such data was crucial for Thai Oil to reduce risks regarding entering new energy businesses, though no further details were later provided on any investment on solar and wind energy. Thus, it would appear that all of their efforts to date have been on the development of biofuels.

For PTT and Bangchak, the active development and commercialization of solar PV did not come about until recently. PTT's solar PV development was first mentioned in its 2007 annual report, which explained that the company had installed a total of 243 solar cells -generating 180 watts of power- at the roof of service pumps at a gasoline station in Samutprakan province. PTT continued installing solar cells at its service stations in other locations, but more concrete investment on solar PV began with the establishment of Global Power Synergy Co., Ltd (GPSC) in 2013, which was considered PTT's power-business flagship. GPSC entered into a joint venture with Thai Solar Energy Co., Ltd. (TSE) to form Thai Solar Renewable (TSR), in which GPSC holds 40% of shares and TSE 60%. TSR founded Siam Solar Energy 1 (SSE1), which aimed to generate 80 MW from a total of 10 photovoltaic solar power plants in the provinces of Kanchanaburi and Suphanburi by investing more than 7 billion baht (approximately US$ 233 million) (TSE, 2011). Recently, PTT invested in the 20.8-MW Ichinoseki Power 1 through GPSC, generating electricity to utilities companies in Japan (PTT, 2015). This project shows that PTT sought business opportunities in the Solar PV industry overseas. A key informant from

GPSC explained that the company invested overseas because of limited quota on Solar PV Feed-in-Tariff (FiT) from the government of Thailand (PTT interviewee, August 2016).

Bangchak appears to have also actively pursued investments to develop and commercialize solar PV in the power generation business. In 2009-2010 the company, with a 4,200-million-baht loan (approximately US$ 120 millions) from the Asian Development Bank (ADB), launched an investment in photovoltaic (PV) power generation project called 'Sunny Bangchak'. Bangchak Solar Energy Co., Ltd., (BSE), a wholly owned subsidiary, was founded to run the project, which was comprised of three phrases. The first phase was a 38 MW-solar farm located in Bang Pa-In district in Ayutthaya province, which became operational in 2012. The second phase, 32MW, in Bamentnarong district, Chaiyaphum province and Bang Pa-Han district, Ayutthaya province was completed in 2013. In the same year, the company signed a 118-MW power purchase agreement (PPA) with the Electricity Generating Authority of Thailand (EGAT) and the Provincial Electricity Authority (PEA). As a result, the third phase was launched at locations that were close to the previous phases, in the provinces of Prachinburi, Chaiyaphum and Nakhon Ratchasima, in order to reach 118 MW of power generation. For this, the company received an adder rate from the government, which was as high as 8 baht per kWh (approximately US$ 0.3). The company considered the project as a big success, considering the total revenue being 2,692 million baht (approximately US$ 82 million) over electricity sales of 232 million kWh. In 2015, Bangchak underwent a big organizational restructure by founding BCPG Co. Ltd., a wholly owned subsidiary, to operate all renewable-energy power generation business and investment, including the solar farms under the operation of Bangchak Solar Energy Co., Ltd (Bangchak, 2015). Moreover, the Extraordinary Meeting No.1/2015 approved BCPG to be listed in the Stock Exchange of Thailand (SET) in 2016 in order to raise funding, with an initial public offering (IPO) for up to 30% of the paid-up capital.

Both PTT and Bangchak have given wind energy much less attention than solar power. PTT indicated that it had made some small investments in activities related to wind energy during the early years analysed in this study, carrying out a joint study in 2007 with Electricity Generating Co., Ltd. (EGCO), Wind Energy Generating Co., Ltd. (WEGCO),

and Eurus Energy Japan Corporation (EURUS), regarding "investigating the feasibility of developing Thailand's first commercial wind-energy power generation project on the southern seaboard, with a capacity of 35 MW". PTT eventually signed "a letter of agreement with the Provincial Electricity Authority (PEA) for a wind farm project with a generation capacity of 5 - 10 megawatts (MW) in the South and the East. Commercial operations are expected to begin in 2014 to replace 2.3 - 4.5 million litres of oil every year" (PTT, 2010). Nevertheless, in the 2014 annual report the company did not report any further details on the aforementioned wind farm project. Rather, most of their activities regarding wind energy were fields visits to countries like Turkey, Greece and Portugal, which according to them "greatly benefited the directors in exchanging views with experts in leading energy companies overseas, fostering understanding of energy, and the government policy on energy from other countries in order to formulate strategies, especially the trend of the renewable energy business".

Similarly, Bangchak conducted a field study concerning wind energy, but the location was not identified in their annual report (Bangchak, 2009). Nevertheless, while it was experiencing the negative impacts of the highly volatility in oil prices, Bangchak's annual reports in 2010 and 2011 set a goal to restructure its then revenue stream of 70%: 30% between refining and marketing businesses to be 50% : 20% : 30% for refining, marketing and new businesses by 2015. Wind energy, together with solar power plants, palm-oil biodiesel production and palm oil plantations were included as potential candidates in the new emerging businesses. Interestingly, according to Bangchak annual reports in 2013 and 2014, the goal was dramatically adjusted to 50% refining income and 50% for emerging clean energy businesses by 2020. However, wind energy seems to be seen as a much smaller venue for income than biofuels or solar PV.

4.1.3 Hydropower and biogas from wastes

Amongst the three companies, only PTT has invested in hydropower energy so far. Hydropower was mentioned for the first time in the 2011 annual report, though investment appears to be different from other low-carbon energy sources. Instead of directly investing in R&D, conducting feasibility studies, organizing field visits to energy projects abroad, or even launching new facilities, PTT made an indirect investment through a subsidiary which acquired equity in another company. As explained in PTT's 2011 annual report, PTT International Co., Ltd., (PTTI), a wholly-owned PTT's subsidiary, established Natee Synergy Company (NSC), which acquired a 25% equity in a hydropower project in Lao People's Democratic Republic, together with the main investor, Xayaburi Power Company Limited (XPCL). In 2012, PTTI took 40% of shares in the Namk-Lik-1 project, a 64.7 MW hydropower plant in Laos (which is expected to be completed in late 2016).

Both PTT and Thai Oil have developed biogas from waste, starting from 2010 and 2013, respectively. PTT's part in biogas projects is mostly as a purchaser, though Thai Oil has been involved in the production and commercialization of biogas from cassava waste, which fuels a 5.6 MW electricity power generation project that sells power to the grid through the Provincial Electricity Authority (PEA) from Q1/2015 (Thai Oil, 2013). This project constituted an internal cooperation amongst Thai Oil's subsidiaries, manifesting that the company has both vertically and horizontally expanded into low-carbon energy businesses. Not only was biofuel developed, but the company utilized the waste to generate electricity for sale. Thai Oil's annual report in 2014 explained its integrated business cooperation among subsidiaries and associates companies, "NP Bio Energy Co., Ltd., was founded by Ubon Bio Ethanol Co., Ltd., to generate biogas from dried cassava pulp, residue from ethanol production of Ubon Bio Ethanol and from tapioca starch production of Ubon Agricultural Energy Co., Ltd.".

4.2 Investment of Indonesian O&G company: PERTAMINA

4.2.1 Biofuels (biodiesel)

For PERTAMINA biofuel development is currently limited to biodiesel. In 2006 the company launched a biofuel development project which complied with the government policies known as the "Presidential Regulation No.5/2006 on National Energy Policy" and "Presidential Instruction No.1/2006 on Provision and Utilization of Biofuel" (PERTAMINA, 2006). On May 20, 2006 PERTAMINA started sales of B5 Bio Solar in Jakarta, followed by Surabaya and Denpasar. Bio Premium and Bio Pertamax (ethanol 3-5%) started to be sold on August 13th 2006 in Malang and on December 11th 2006 in Jakarta, followed by Surabaya, Malang and Denpasar (ESDM, 2008). PERTAMINA's committed to biofuel production in 2007, when the company revised its vision to become a world class national oil company with the mission to conduct "core business in oil, gas and biofuel in an integrated manner, based on string commercial principles" (PERTAMINA, 2007). PERTAMINA conducted a study on a Biodiesel Plant with 15,000 liter/day capacity using palm oil or Jatropha as raw materials. However, the project was cancelled in 2007 and replaced with a cooperation program in biodiesel and bioethanol with external organizations such as SK Corp, Mitsui, and EMR and BPPT (PERTAMINA, 2007). In 2010, after a prolonged price dispute between PERTAMINA and ethanol producers, PERTAMINA decided to stop sales of bioethanol (namely Bio Premium and Bio Pertamax. GAIN, 2010). The lower prices offered to ethanol producers by PERTAMINA was the main reason why the factories did not want to supply ethanol to PERTAMINA.

Despite the existence of many challenges that originate from volatile prices of feedstock and crude oil, PERTAMINA has responded and complied with the government's blending rate of biofuels, which has been adjusted many times through regulation of the Ministry of Energy and Mineral Resources. The latest adjustment was made in March 2015, which have set ambitious targets on both biodiesel and bioethanol as shown in Table 7 (adapted from GAIN, 2016).

Table 8 Blending mandate of biofuels according to Regulation of the Ministry of Energy and Mineral Resources No.12 issued in March 2015

Biodiesel mandate (minimum)				
Sector	**April 2015**	**2016**	**2020**	**2025**
Transportation, Public Service Obligation (PSO)	15%	20%	30%	30%
Transportation, Non-PSO	15%	20%	30%	30%
Industry	15%	20%	30%	30%
Electricity	25%	30%	30%	30%
Bioethanol (minimum)				
Transportation, Public Service Obligation (PSO)	1%	2%	5%	20%
Transportation, Non-PSO	2%	5%	10%	20%
Industry	2%	5%	10%	20%

Note: Public Service Obligation (PSO) for biodiesel is a subsidized fuel for road vehicles. It is uniquely sold through PERTAMINA. Non-PSO refers to unsubsidized fuel sold through private sector shops. The Public Service Obligation (PSO) for ethanol is a subsidized fuel used by small scale industries, fishing and agriculture (GAIN, 2016).

To be able to cover the national goal for biofuel blending rates in the next 10 years, PERTAMINA has felt the need to launch an enormous investment plan in biofuel projects. For instance, PERTAMINA plans to invest US$ 200 million in the state owned plantation company, PTPN, to develop palm oil plantations (Biofuel digest, May 11, 2015). To comply with the B15 mandate implemented in 2015, PERTAMINA signed contracts with 11 companies which would supply approximately 1.84 million liters of fatty acid methyl ester. This supply was used to produce B15 from November 2015 to April 2016 (PERTAMINA, 2015). In addition, the company planned to invest over US$ 480 million to produce Bio-aviation turbine fuel and build a jet fuel refinery that could produce up to 26 million liter /year using palm oil (aiming to start production in 2017), as stated by the Manager of Technology and Product Development, Directorate of New and Renewable

Energy, PERTAMINA, Andianto Hidayat (ANTARA News, 2015). Last but not least, at the PERTAMINA Energy Forum 2016, held on 13-14 December 2016, the company also showcased various biofuel development plans at different sites throughout the country (see Figure 2). These included a bioethanol Project from Napier Grass in West Java with a capacity of 76,000 kl/year, the Green Diesel Project in Riau using crude palm oil (CPO), palm stearin, palm fatty acid distillate (PFAD) as feedstock with capacity of 420,000 kl/year, and pilot plant for Micro Algae in Yogyakarta.

4.2.2 Geothermal

Indonesia is blessed with an abundant geothermal potential, estimated to be around 40% of the total world's potential. Unlike other types of renewable energy, geothermal has been included in PERTAMINA's core upstream business (together with oil and gas) since the company was established. PERTAMINA has been conducting geothermal exploration and production activities since 1974, resulting in over 70 geothermal areas generating electricity. In 2000, PERTAMINA was ordered to return 16 out of 31 of its geothermal working areas to the government by the Presidential Decree No. 76/2000. Later in 2003, with the Governmental Regulation No.31/2003, PERTAMINA was assigned to transfer geothermal business to a subsidiary, which was established three years later as PT PERTAMINA Geothermal Energy (PGE). In addition, PERTAMINA set up a new subsidiary called PT PERTMINA Drilling Services Indonesia in 2008 to run drilling service on exploration and production of both O&G and geothermal (PERTAMINA, 2008). PERTAMINA and its subsidiaries only conduct geothermal exploration and production activities domestically mainly, as Indonesia possesses a huge geothermal potential and the government is trying to achieve an ambitious target to supply 10,000 MW of electricity to meet the high domestic power demand through a second phase of fast-track projects (PERTAMINA, 2009. Around 3,900 MW from this 10,000 MW-target was planned to come from geothermal power plants (PERTAMINA, 2011). PERTAMINA, through PGE, has operated geothermal production facilities through own-operation and Joint Operating Contracts (JOCs). Under JOCs, PGE is entitled to earn PGE production allowances at the rate of "2.66% for Darajat JOC and 4% for the Salak, Wayang Windu, Sarulla and Bedugul JOCs of the JOC contractors' annual net operating income as calculated in accordance with the JOCs" (PERTAMINA, 2015).

According to the latest annual report available at the time of writing this thesis, PGE as of 31 December 2015 operates 4 geothermal working areas and 7 development projects throughout Indonesia. Table 9 presents PGE's geothermal projects, which are divided into two categories, namely those operated by itself and those with JOCs.

Table 9 Geothermal working areas of PERTAMINA Geothermal Energy (PGE) as of 31 December 2015

Own operations			
Working area	**Location**		**Field status**
Gunung Sibayak-Gunug Sinabung	Sibayak, North Sumatera		production
Gunung Way Panas	Ulubelu, Lampung		production
Kamojang-Darajat	Kamojang, Jawa Barat/West Java		production
Lahendong	Lahendong, Sulawesi Utara/North Sulawesi		production
Lumut Balai dan Marga Bayur	Lumut Balai/South Sumatera		Development
Karaha-Cakrabuana	Karaha,/West Java		Development
Sungai Penuh	Sungai Penuh, Jambi		Exploration
Hululais	Hululais, Bengkulu		Exploration
Gunung Iyang Argopuro	Argopuro/East Java		Exploration
Kotamobagu	Kotamobagu/ North Sulawesi		Exploration
	Joint Operation Contracts (JOCs)		
Working area	**Location**	**Field status**	**Contractors**
Cibeureum - Parabakti	Salak, Jawa Barat/ West Java	Production	Chevron Geothermal Salak Ltd
Pangalengan	Wayang Windu, Jawa Barat/West Java	Production	Star Energy Geothermal (Wayang Windu) Ltd.
Kamojang-Darajat	Darajat, Jawa Barat/ West Java	Production	Chevron Geothermal Indonesia Ltd.
Gunung Sibualbuali	Sarulla, Sumatera Utara/North Sumatera	Development	Sarulla Operation Limited
Tabanan	Bedugul, Bali	Exploration	Bali Energy Ltd.

4.2.3 Other renewable energy sources

Apart from biofuel and geothermal, PERTAMINA has aimed to move towards other types of new and renewable energy business. By referring to the changing global development policies, PERTAMINA decided to set a new vision in 2011 to become a 'World Class National Energy Company'. The construction of Waste Power Plant (PLTSa) using municipality waste (around 2,000 tons per day to generate electricity of 138 MW, of which 120 MW will be sold) was mentioned in the 2012 annual report as the first types on non-geothermal or biofuel renewable energy projects. This project is located at the Integrated Waste Disposal site in the Bantargebang, Bekasi area and aimed to start operation in 2016 (PERTAMINA, 2012). PERTAMINA underwent restructuring through the establishment of the Directorate of New and Renewable Energy (NRE) in November 2014, which later in May 2015 included gas business and was changed to the Directorate of Gas, New& Renewable Energy (GNRE) (PERTAMINA, 2014, 2015).

The new department supervises gas business ranging from gas commerce to downstream (except gas exploration and production) and renewable energy development projects, which are divided into renewable energy for power plant and renewable energy as non-conventional biofuel. Renewable energy for power plants includes mini and micro hydro, biomass energy, solar PV, wind energy, and marine energy, whereas non-conventional biofuel covers green diesel, bioethanol and bioavtur (PERTAMINA, 2015). However, in its 2015 annual report the company stated clearly that most of its renewable energy activities were still in the research and planning phase. Documents obtained during the PERTAMINA Energy Forum 2016, held on 13-14 December 2016 at Ritz Carton Pacific Place Hotel, Jakarta, Indonesia displayed various renewable energy plans in multiple sites throughout the country. Figure 3 presents future investment plans of PERTAMINA in various sites.

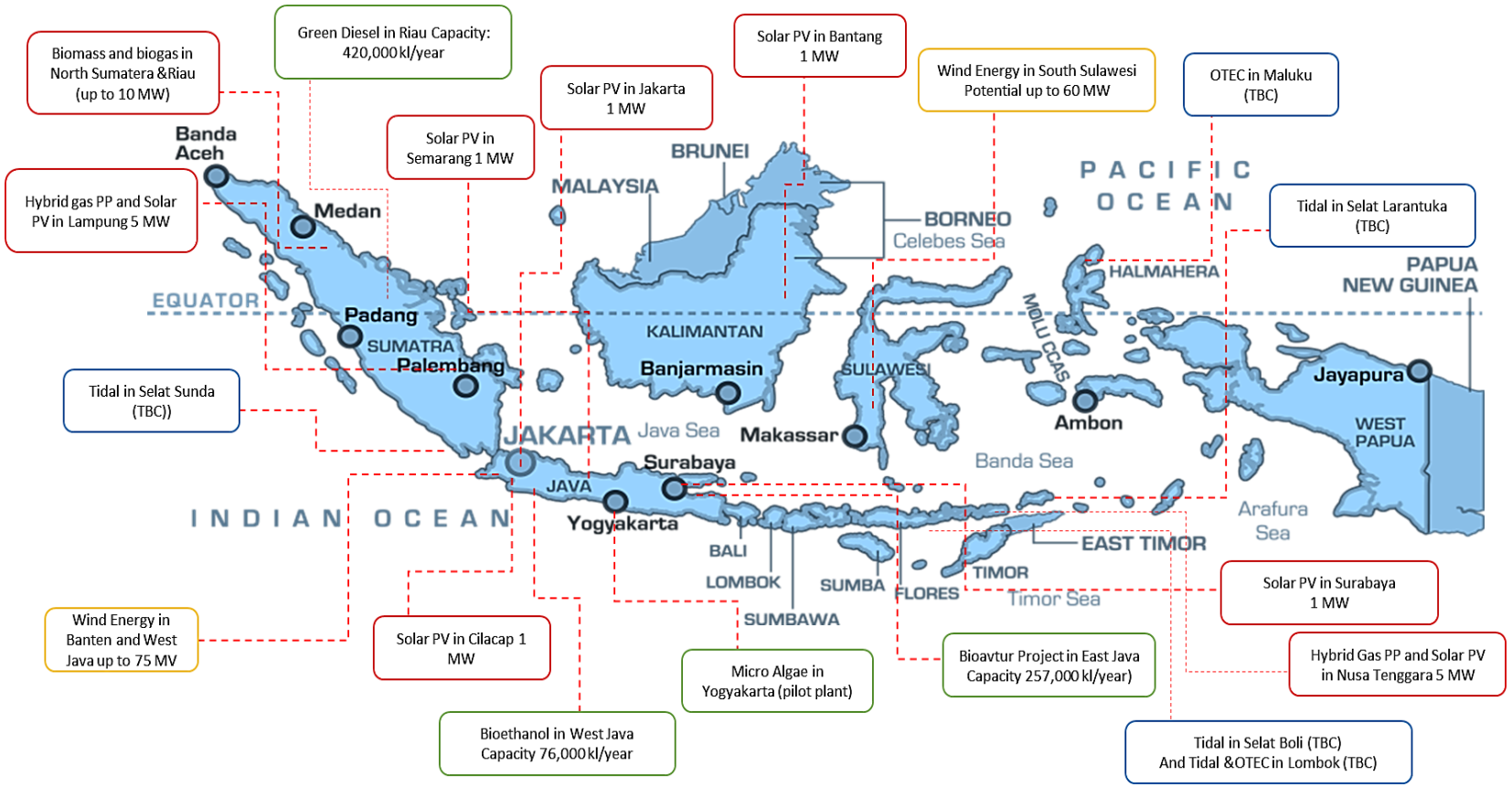


Figure 3 PERTAMINA's new and renewable energy development projects (Adopted from material received during the PERTAMINA Energy Forum 2016, held on 13-14 December 2016 at Ritz Carton Pacific Place Hotel, Jakarta, Indonesia

4.3 Investment of Malaysian O&G company: PETRONAS

4.3.1 Biofuels (biodiesel)

PETRONAS took part in biodiesel development as early as the 1980s. After the Malaysian Palm Oil Board (MPOB) initiated the palm oil based biodiesel laboratory in 1982, the result they obtained were so promising that a pilot plant was constructed in collaboration from PETRONAS in 1984. This pilot plant produced 3,000 metric tonnes of palm oil methyl ester per year. Although in the following years there were a number of testing, stationary engine evaluation and even field trials, biodiesel in Malaysia did not really make a breakthrough until the government implemented the Fifth Fuel Policy in 2001 and National Biofuel Policy in 2005 (see more detail of policies in Appendix G). According to PETRONAS' own data sources, the very first activity on biofuel that can be traced back in the annual report was in 2007, where PETRONAS signed an agreement with Battelle Memorial Institute of the US, Battelle-Japan Corporation and Mitsubishi Corporation for setting up a renewable energy laboratory at PETRONAS Research Sdn Bhd's premises in Bangi, Selangor. The first phase of research was focused on bio-fuels and products from oil palm waste (PETRONAS, 2007). In 2009, PETRONAS's wholly owned subsidiary: PETRONAS Dagangan Berhad (PDB) which runs a retail business on O&G products, delivered B5 to the Ministry of Defense and Dewan Bandaraya Kuala Lumpur in accordance with the Malaysian Biofuel Industry Act 2007 (PETRONAS, 2009). PDB was the first oil company which ran a test drive with B5 and the result were considered to be positive (Borneo Post, 2010).

In developing biodiesel, PETRONAS was given financial supports from both MPOB and the government of Malaysia. In 2010 funds worth RM1 million were allocated by MPOB to each oil company to set up infrastructure for B5 biodiesel blending facilities, including PETRONAS, Shell, BHP, ExxonMobil and Chevron (Adnan, 2010). Starting on June 1, 2011 five of PETRONAS's service stations, together with one of Shell in Putrajaya, sold B5 biodiesel for the same price as of normal diesel (at RM1.80 per liter, Lim, 2011). Later on, in an attempt to boost biodiesel usage and help companies comply with its mandate, the government provided a fund of RM300 million through MPOB to construct

more blending facilities nationwide. PETRONAS Dagangan Bhd (PDB), Shell Malaysia Trading, Petron (formerly Esso Malaysia Bhd), Boustead Petroleum Marketing and Chevron Malaysia Ltd. collaborated in such an attempt, by incurring other costs such as the blending and transportation costs (Borneo Post, 2010). Early in 2016 the Ministry of Plantation Industries and Commodities pushed forward for a B10 biodiesel mandate. Oil companies are required to reset blending ratio and find the necessary supply of palm methyl ester. In August 2016, PETRONAS Dagangan Bhd launched Dynamic Diesel Euro 5 in six service stations in Klang Valley and two in Johor Bahru. When asked about the progress in producing and supplying B10, a PETRONAS Fuel engineer, Mr. Mohamad Hariz Abd Aziz, stated that the government needs to have an agreement with the car manufacturers on the issue of warranty before implementing B10 mandate. PETRONAS has no difficulty in producing B10, but so far only Mercedes Benz Malaysia showed confidence on the compatibility of their diesel car engine with B10 biodiesel (Tong, 2016).

4.3.2 Solar PV

PETRONAS has explored other types of renewable energy, in particular solar PV. The landmark of its Solar PV development program started in January 2010 when it signed a Memorandum of Understanding (MOU) with Mitsubishi Corporation to conduct Solar PV demonstration projects in Malaysia (PETRONAS, 2010). The aim was to test different solar technologies and find out which type was suitable for Malaysia's climate. In this regard, two of PETRONAS's facilities installed solar panels. The first one was the Solar PV demonstration project with a 685 kWp capacity installed on the rooftop of Suria KLCC's shopping mall. It was officially launched in 2012 to supply electricity to Suria KLCC, meeting 30% of its power demand (PETRONAS Sustainability Report, 2012). The solar rooftop on Suria KLCC was in 2013 awarded the first runner-up in the Commercial Based On-Grid Category of the ASEAN Energy Award (PETRONAS, 2013).

The second one was at two new service stations; namely PETRONAS Solaris Putra and PETRONAS Solaris Serdang. Apart from those mentioned earlier, PETRONAS also runs a solar farm that sells power to the national grid. PETRONAS, through its wholly owned subsidiary, PETRONAS Power Sdn Bhd (PPSB) PPSB won a bidding to have 10.2

MWp FiT quota from the Sustainable Energy Development Authority (SEDA) in 2011. The quota was for PPSB to generate electricity from solar PV as an Independent Power Producer (IPP) (PETRONAS Sustainability Report, 2011). In late 2013, the Solar IPP project in Gebeng, Kuantan, Malaysia was complete and started operation. The project can produce around 12 GWh of energy per year, which is enough to supply 4,500 households with electricity, and help reduce emissions by approximately 8,000 tons of CO_2 equivalent annually (PETRONAS Sustainability Report, 2013).

Table 10 Milestone of biofuel development projects of PTT, Bangchak, Thai Oil, PETRONAS and PETAMINA in the past 15 years

Year	PTT	Bangchak	Thai Oil	PETRONAS	PERTAMINA
2003	Started sale of Gasohol 95 (E10) in Bangkok	Started sale of Gasohol 95 (E10) in Bangkok			
2004					
2005			Signed MOU to establish ethanol producing plant from cassava		
2006		Running Gasohol Club Card, a special discount of 0.2 baht per liter for members			- Started sales of Bio Solar (B5), Bio Premium (E3-5) and Bio Pertamax (E3-5)
2007	Set up PTT Green Energy(PTTGE) investing in palm oil plantation in Kalimantan, Indonesia		Joint venture to set up Maesod Clean Energy Co.,Ltd., the first ethanol plant from sugarcane in Thailand, with capacity of 200,000 liters per day	-In November signed an agreement with Battelle Memorial Institute of the US, Battelle-Japan Corporation and Mitsubishi Corporation in setting up a renewable energy laboratory at PETRONAS Research Sdn Bhd's premises in Bangi, Selangor. The first phrase of research will focus on bio-fuels and products from oil palm waste	- 10 December 2007, PT Pertamina introduced its new vision: "To Become a World Class National Oil Company With a mission is to perform he core business in oil, gas and biofuel in an integrated manner, based on strong commercial principles
2008	-Started sale of Gasohol E20, E85 and B2 and B5 in Bangkok - Conducted R&D on non-crop plants to produce biodiesel such as jatropha and algae	Joint venture to set up Bangchak Biofuel Co.,Ltd. running biodiesel production from crude oil palm with a capacity of 300,000 liters per day	Established Thaioil Ethanol Co., Ltd. produced ethanol from cassava with a capacity of 500,000 liters per day	-49% of retail network in Thailand started selling gasohol (Annual report)	

Year	PTT	Bangchak	Thai Oil	PETRONAS	PERTAMINA
2009		-Started Sale of E85 -Installed biodiesel unit using used cooking oil with a capacity of 20,000 liters per day.		-PETRONAS Dagangan Berhad (PDB), a retailer for O&G products, delivered B5 to Ministry of Defense and Dewan Bandaraya Kuala Pumpur(DBKL) in support of the Malaysian Biofuel Industry Act 2007 -Petronas Dagangan was the first oil company that had initiated a test-run on B5 mandate.	
2010	Expanded the sale of E85 outside Bangkok		-Thaioil Ethanol Co.,LtD. acquired 50% of share in Sapthip Co.,Ltd producing cassava based ethanol with a capacity of 200,000 litres per day.	- PETRONAS, Shell, BHP, ExxonMobil and Chevron were allocated with a start-up fund worth RM 1mil each by the Malaysian Palm Oil Board (MPOB) to set up infrastructure for B5 biodiesel blending facilities	-Stopped sales of bioethanol due to prolonged price dispute between PERTAMINA and ethanol producers
2011	PTTGE had a net ownership of 1,085,989 rai of land used for palm oil plantation. The company conducted feasibility study to invest in plam oil plantation in Myanmar and Cambodia. -PTTGE Service Netherlands BV (PTTGE BV) acquired a 75% shareholding of 7 companies of PT Kalapataru Investama (PT KPI) operating palm oil business in Indonesia	-Acquired a 21.28% shares in Ubon Bio Ethanol Co,Ltd., using cassava with a capacity of 400,000 litres per day	-Thaioil Ethanol Co., Ltd. acquired a 21.28% shares in Ubon Bio Ethanol Co. Ltd., using cassava with a capacity of 400,000 liters per day -Sapthip Co.Ltd. entered a10-year ethanol agreement with PTT (2011-2021)	-The Malaysian government had set June 2011 for oil operators in the country to start selling biodiesel commercially. - June 1, From today, however, it is available at point of retail: B5 biodiesel will be sold at the six petrol stations – five from Petronas and one from Shell – located in Putrajaya, the first location in the Central Region to deploy the fuel. It was priced at the equivalent of petroleum diesel, at RM1.80 per litre****	- Set a new vision of the company, “To Become a World Class National Energy Company”. with the mission of running the business of oil, gas and new and renewable energy in an integrated manner, based on strong commercial principles.

Year	PTT	Bangchak	Thai Oil	PETRONAS	PERTAMINA
2012	- PTTGE had a net ownership of 1.2 million rai of land used for palm oil plantation -PTTGE began Crude Palm Oil planting, around 35,600 tons has been produced	-Converted 1,200 rai of abandoned orange farms to palm oil plantation - Increased capacity of Bangchak Biofuel Co.,Ltd to 360,000 liters per day.	-Ubon Bio Ethanol Co.Ltd., board approved 300 million Baht to modify the plant operation to use molasses as another raw material.		
2013	-PTTGE produced 55,095 tons of CPO to this date -Participated in promoting the use of B7 in Bangkok Mass Transit Authority (BMTA)	-Approved 1,400 million baht budget to build second biodiesel unit with a capacity of 450,000 liter per day, which would increase Bangchak's combined production of biodiesel to 810,000 liters per day	-Maesod Clean Energy Co.,Ltd. increased a capacity to 230,000 liters per day	-In November 35 depots nationwide with in-line blending facilities were set up by Government, together with participating petroleum companies, namely Petronas Dagangan Bhd, Shell Malaysia Trading, Petron (formerly Esso Malaysia Bhd), Boustead Petroleum Marketing and Chevron Malaysia Ltd. This was to produce B5 biodiesel*. The government provided a budget of RM300Millionfor the construction. Other costs such as blending and transportation costs would be absorbed by oil companies in the country	
2014	PTTGE experienced losses, and was closed the operation. (source: online news)	-The second biodiesel unit under construction at Bang Pa-In Terminal, Phra Nakhon Si Ayuttaya province, using raw palm oil as feedstock., expected to finish in 2016 -Planed to acquire a 150,000 liters per day ethanol plant in Chachengsao province, expected		-B5 program was complete in peninsular Malaysia in March, but not yet nationwide because the delay of construction of 15 blending facilities in the states of Sabah and Sarawak and the federal territory of Labuan in East Malaysia	

Year	PTT	Bangchak	Thai Oil	PETRONAS	PERTAMINA
		to realize commercial sale in 2015			
2015	-PTTGE signed a Share and Purchase Agreement (SPA) to dispose its entire investment of 77.56% in Chancellor Oil Pte.Ltd.,which operated a palm oil business through PT. First Borneo Plantations (PT FBP) in Indonesia. - PTTGE Singapore disposed the shares, transferring liabilities and advance investment payment of PT.Mitra Aneka Rezeki(PT.MAR) to Harvey BayOverseas(HBO) on 9 June2015 (PTT, 2015)	-Continue the acquisition of the ethanol plant in Chachengsao province			-Planned to invest US$ 200 million with the state owned plantation company, PTPN, to develop palm oil plantation (Biofuel digest, May 11, 2015 -Signed a contract with 11 companies to supply approx. 1.84 million liters of fatty acid methyl ester. to PERTAMINA, in order to produce B15 from November 2015 to April 2016 (Kurniawan, 2015)
2016	- Shut down R&D project on algae (interview)			- August 2016, PETRONAS Dagangan Berhad announced the availability of their Dynamic Diesel Euro 5, which will be currently sold alongside their Euro 2M diesel. At the time of launch, only six Petronas stations in the whole of Klang Valley and two in Johor Bahru carry the higher quality diesel fuel	

Table 11 Milestones on solar PV, wind energy, hydropower and biogas development projects of PTT, Bangchak and Thai Oil, PETRONAS and PERTAMINA in the past 15 years

Year	PTT	Bangchak	Thai Oil	PETRONAS	PERTAMINA
2006					Established PT PERTAMINA Geothermal Energy (PGE) to manage business activities in geothermal. PERTAMINA has a 90% shares and PT PERTAMINA DANA Ventura has 10% shares
2007	-Installed a total 243 solar cells generating 180 watts of power at the roof of service pumps at a gas station - Joint study on wind energy power generation project on the Southern seaboard with a capacity of 35 MW				
2008					
2009		-Took a loan from Asian Development Bank to launch Bangchak Solar Energy Co.,Ltd operating solar farm projects comprising of three phrases. - Conducted a field study on wind energy	Became a partner of MFC Energy Fund, allowing it to access data on renewable energy for use in future investment		
2010	Signed a letter of agreement with Provincial Electricity Authority for a wind farm project with a capacity of 5-10 MW. (the project was not taken placed at the end)	Restructured the revenue sources to have 50%: 20%:30% for refining, marketing and new business in green energy (i.e. Solar PV) by 2015		- January 2010 when PETRONAS signed a Memorandum of Understanding (MOU) with Mitsubishi Corporation to conduct the Solar PV demonstration projects in	

Year	PTT	Bangchak	Thai Oil	PETRONAS	PERTAMINA
				Malaysia	
2011	PTT International Co.,Ltd established Natee Synergy Company (NSC) which acquired a 25% equity in a hydropower project in Laos			- PETRONAS Power Sdn Bhd(PPSB), secured 10.02 MWp of FiT quota, allowing PETRONAS to run the first Solar Independent Power Producer project, expected to be complete by 2014 -With a Mitsubishi Corporation, installed the Solar PV Demonstration Project on the rooftop of Suria KLCC shopping complex with a capacity of 685 kWp.	Set a new vision "to become a World Class National Energy Company", moving towards new and renewable energy
2012	PTT International Co.Ltd took 40% of shares in the Namk Lik-1 project, a 64.7 MW hydropower plant in Laos	The first phrase of solar farm with 38 MW was started.		-Launched the rooftop solar PV system at Suria KLCC shopping mall, generating more than 600 MWh which supplied about 30% of the shopping mall's demand. -Installed solar PV at two service stations: Solaris Putra and Solaris Serdang	Plans to build a Waste Power Plant (PLTSa) in the Integrated Waste Disposal site in the Bantargebang, Bekasi area
2013	Set up Global Power Synergy Co.,Ltd (GPSC) to run power business. GPSC started joint venture	-The second and third phrase with 32 MW and 118 MW were started.	NP Bio Energy Co., Ltd., was founded by Ubon Bio Ethanol Co., Ltd., to	-Solar Independent Power Producer (IPP) project in Gebeng, with a capacity	

Year	PTT	Bangchak	Thai Oil	PETRONAS	PERTAMINA
	in Solar farm generating 80MW	- Restructured the revenue sources to be 50% refining income and 50% for energy clean energy business by 2020	generate biogas from biogas from cassava waste which fueled a 5.6 MW power sold to the Provincial Electricity Authority	of 10 MWp. Energy produced is sold to domestic use which could supply up to 4,500 households. The project is under Infrastructure&Utility department. -Solar rooftop on Suria KLCC's shopping mall won a first runner-up award at the ASEAN Energy Award 2013	
2014				-Acquired 30% of shares in Pacific Light Power Pvt Ltd in Singapore	Established Directorate of New and Renewable Energy (NRE)
2015	- Invested in the 20.8-MW Ichinoseki Solar Power 1 in Japan, which is set to distribute electricity to utility companies in Japan. - Global Power Synergy Public Company Limited (GPSC) completed IPO of its shares and started the first trading day on 18 May 2015 at THB 27 per share.	- Extraordinary Meeting No. 1/2558 approved to establish BCPG Co., Ltd. to operate renewable-energy power generation business and investment, including the operation of phase 1 (38 megawatts, MW) of the solar power generation ("Sunny Bangchak") project, also granted an approval for BCPG to list on the Stock Exchange of Thailand (SET) with an IPO (initial public offering) for up to 30% of the paid-up capital planned for the beginning of 2016.	nil	nil	Restructured the NRE and changed to the Directorate of Gas, New and Renewable Energy (GNRE) .

4.4 Conclusions

The study summarized various investment activities of PTT, Thai Oil, Bangchak, PERTAMIAN and PETRONAS in Table 12. The investment activities can be carried out in the forms of R&D, commercialization, and even CSR activities. Moreover, in biofuel production, the companies may engage in various steps during biofuel supply chain. From Table 12 it is found that PTT and Bangchak have involved in many investment activities. The companies entered the upstream biofuel industry through palm oil plantation; whereas Thai Oil, PERTAMINA and PETRONAS did not have such investment. Moreover, Bangchak and PTT did R&D on 2nd and 3rd generation of biofuel, an activity which Thai Oil, PERTAMINA and PETRONAS have less or no investment in. Finally, yet importantly, the solar PV installation capacity which Bangchak and PTT have are much higher than that of PETRONAS; whereas PERTAMINA has not yet installed any solar PV panels at the time which this research was conducted. The findings in this chapter will be used in the chapter 6 that investigates factors that influence O&G companies to invest in renewable energy. Further explanation why PTT and Bangchak are relatively more active in renewable energy than the other three companies are also illustrated in Chapter 6.

Table 12 Overview of renewable energy investment activities of PTT, Bangchak, Thai Oil, PERTAMINA and PETRONAS

Company	R&D	Type of energy crop plantation	Commercialization	Corporate social responsibility (CSR)
PTT	• 2nd and 3rd generation of biofuels	• Palm oil (Sumatra, Indonesia)	• E10, E20, E85, B5, B7 • Solar PV (100 MW) • Hydropower (Laos) • Biogas	• Small hydropower • Solar roof • Wind • Biofuels for farming vehicles
Bangchak	• 2nd and 3rd generation of biofuels	• Palm oil (Thailand)	• E10, E20, E85, B5, B7 • Solar PV (182 MW)	• Biofuels from used cooking oil
Thai Oil	• Nil	• Nil	• Biofuels (ethanol production)	• Small hydropower • Solar rooftop
PERTAMINA	• Pilot projects on biofuel production	• Nil	• B15 • Solar PV (plans) • Geothermal • (over 700 MW)	• No data
PETRONAS	• Solar PV	• Nil	• B10 • Solar PV (10 MW)	• No data

Chapter 5: Discourse analysis on rationales to invest in renewable energy ASEAN's major O&G companies

5.1 Introduction

The focus of this chapter is first on the discourses that O&G companies used the most repeatedly to justify their investment in any given renewable energy sources. The present study analyzed the discourses on the annual reports of PTT, Thai Oil, Bangchak, PETRONAS and PERTAMINA, which are all available in the companies' website. Details on how to conduct discourse analysis and the data sources are presented in Chapter 3. In section 5.2, the rationales for investing in each type of renewable energy of each company were summarized from the annual reports, and placed into particular themes or discourse strands as shown in all tables in the section. It should be noted that in each Table those years in which there are no annual reports available for analysis are painted in grey color. The years painted in white color refer to those were no discourses were found on renewable energy. However, this should not mean necessarily that in those years there were no development or investment activities. Rather, the company may have conducted such activities, but they did not mention them in their annual reports.

In section 5.3, the present study carried out an in-depth discussion on discourses of Thailand O&G companies (PTT, Bangchak, Thai Oil) which appear to employ a wide range of discourse on their renewable energy investment. PETRONAS and PERTAMINA used few discourses in their annual reports, and thus there is not sufficient data for discourse analysis. Then in section 5.4, the discourses on each type of renewable energy employed by all five companies were categorized into four discursive legitimacy strategies; namely Authorization, Rationalization, Moral evaluation and Mythopoesis. Because five companies have different focus on which type of renewable energy projects, the study selected top three sorts to present in this chapter- biofuel, solar PV and geothermal.

5.2 Discourses to justify the rationale to invest in renewable energy

5.2.1 PTT

As presented in Chapter 4, PTT has invested and developed various types of renewable energy; namely, biofuels (gasohol and biodiesel), solar PV, wind energy, hydropower and biogas. The present research identified the discourses found in the annual reports that PTT used to explain the reasons to investment and develop activities in each type of renewable energy source. PTT's annual reports from 2001-2015, which were available in the company website, were analyzed through the process explained in Chapter 3. The results of the discourses on biofuels, Solar PV, wind energy, hydropower and biogas are shown in Appendix A. Table 13 presents an overview of biofuel discourses by years without the quotes from annual reports, so that the dynamic of discourse strands by years can be seen clearly.

Table 13 Summary of discourses on biofuel investment of PTT

Year / Discourse PTT Biofuels	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy (4)															
Environmental reason (8)															
Help farmers (3)															
Help alleviate consumers' burden esp. during high crude oil prices (3)															
Be a leader in RE business and active R&D and establish viable sustainable business (5)															
Build self-reliance and national energy security from lowering oil imports (9)															
Follow HM the King's initiative (2)															
Reduce risk of raw material shortage from using agricultural products (1)															

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

5.2.2 Bangchak

As can be seen from Chapter 4, Bangchak has been very active in diversifying their business portfolio to become an energy company. For more than a decade the company has invested in various types of renewable energy. Biofuels (gasohol and biodiesel) and Solar PV have been both developed and commercialised by the company. Given this fact, the present study found a large number of discourses used to justify the green investment in Bangchak's annual reports from 2002-2015. Like PTT, those years in which there are no annual reports are painted in grey colour in each table; while those years in which the study did not find discourses on such renewable energy are painted in white. Table 1 and 2 in Appendix B present discourses on biofuel and solar PV investment respectively; whereas Table 14 and 15 show the summary of discourses on biofuel and solar PV investment without the direct quoted sentences.

Table 14 Summary of discourses on biofuel investment of Bangchak

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy (16)															
Environmental and health reasons (11)															
Enhance national energy security by lowering oil imports (9)															
For business sustainability, diversify income risk, and be a leader in RE (17)															
Be a responsible company, run business model with benefit to environment and social development(6)															
Help alleviate consumers' burden esp. during high crude oil prices (2)															
Thailand has potential as an agricultural country (1)															
Follow HM the King's initiative on biofuels project and self-sufficient philosophy (8)															
Enhance Thailand to step forward in the era of RE (1)															
Respond to demand from consumers (3)															
Help farmers (8)															

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 15 Summary of discourses on solar PV investment of Bangchak

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Enhance national energy security by lowering oil imports (1)															
Be a responsible company, run business model with benefit to environment and social development (2)															
For business sustainability, diversify income risk, and be a leader in RE (19)															
Environmental and health reasons (6)															

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

5.2.3 Thai Oil

Among the three Thai O&G companies in this present study, Thai Oil has strived the most to maintain a vision of mostly being an oil refinery company. It has, however, invested in biofuel production by conducting joint ventures with other partners, including Bangchak. The present study analyzed Thai Oil's annual reports from 2004-2015, available in the company website. Table 1 in Appendix C presents discourses on biofuel investment of Thai Oil; while Table 16 summarizes discourses by years without the direct quotes.

Table 16 Summary of discourses on biofuel investment of Thai Oil

Discourse strands \ Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy (9)															
Environmental reasons (4)															
Help farmers (2)															
Enhance national energy security by lowering oil imports (3)															
See business opportunity and become a leader (5)															
Adhere to business objectives with environmental and social responsibility (3)															
Enhance quality of life of Thai people (1)															

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

5.2.4 PERTAMINA

The two major concrete types of renewable energy investment that PERTAMINA is carrying out relating to geothermal and biofuels (biodiesel) energy sources. The company, as presented in Chapter 4, has only become active in new renewable energy investment in the past few years, and many projects remain in the research and development phase i.e. Solar PV, wind and ocean energy. Thus, the present research identified mostly discourses that the company used to explain their investment on geothermal and biofuels. The annual reports from 2006-2015 were collected from the company website and a discourse analysis was conducted on them. Table 1 and 2 in Appendix D present discourses on geothermal and biofuels investment respectively; while Table 17 and 18 summarize discourses on geothermal and biofuels in years without direct quotes.

Table 17 Summary of discourses on geothermal of PERTMAINA

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy (7)															
Enhance national energy resilience (3)															
Geothermal is upstream business of PERTAMINA (4)															
Mitigate the risk of decreasing oil and gas reserve (5)															
Economic prosperous and enhance well-being of Indonesia people (8)															
GHG emission reduction and obtaining CER climate credits (4)															
Growth and profits for company (2)															
Company vision (6)															
Potential geothermal in Indonesia (5)															

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 18 Summary of discourses on biofuel investment of PERTMAINA

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy (8)															
Company mission (5)															
Mitigate the risk of decreasing oil and gas reserves(7)															
Economic prosperous and enhance well-being of Indonesia people (3)															
GHG emission reduction and obtaining CER climate credits (1)															
Business opportunity for company (1)															

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

5.2.5 PETRONAS

Among the five companies analyzed, PETRONAS committed the least to invest in renewable energy, with these investments related to biofuels (biodiesel) and solar PV. However, the volume seems not to be as significant, as the company maintains its visions to be ‘a leading O&G multinational of choice’ (PETRONAS, 2015). As a result, the present research found only a small number of discourses on renewable energy in PETRONAS annual reports 2008-2015. Table 19 presents discourses on biofuels with direct quoted sentences. Table 20 summarizes discourse on solar PV without direct quoted sentences and Table 1 in Appendix E shows discourses on solar PV with directed quoted sentences.

Table 19 Discourses on biofuel investment of PETRONAS

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy									- PETRONAS Dagangan Berhad marked its first biodiesel (B5) delivery to Ministry of Defense (MINDEF) and Dewan Bandaraya Kuala Lumpur (DBKL), an initiative in support of the Malaysian Biofuel Industry Act 2007						

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 20 Summary of discourses on solar PV investment of PETRONAS

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Positive results for business (2)															
Reduce GHG emissions (2)															
Respond to Government policy(1)															
Sustainability commitment (4)															

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

5.3 Discussion on discourses used by Thailand O&G companies

Through MAXQDA the study identified and recorded the discourses that PTT, Bangchak and Thai Oil employed to legitimize their green energy investments. The study paid close attention to any given discourses which were found repeatedly. Figure 4, 5 and 6 show an overview of the discourses used by each company, as explained in the remaining part of this section.

5.3.1 PTT: A diverse discourse player

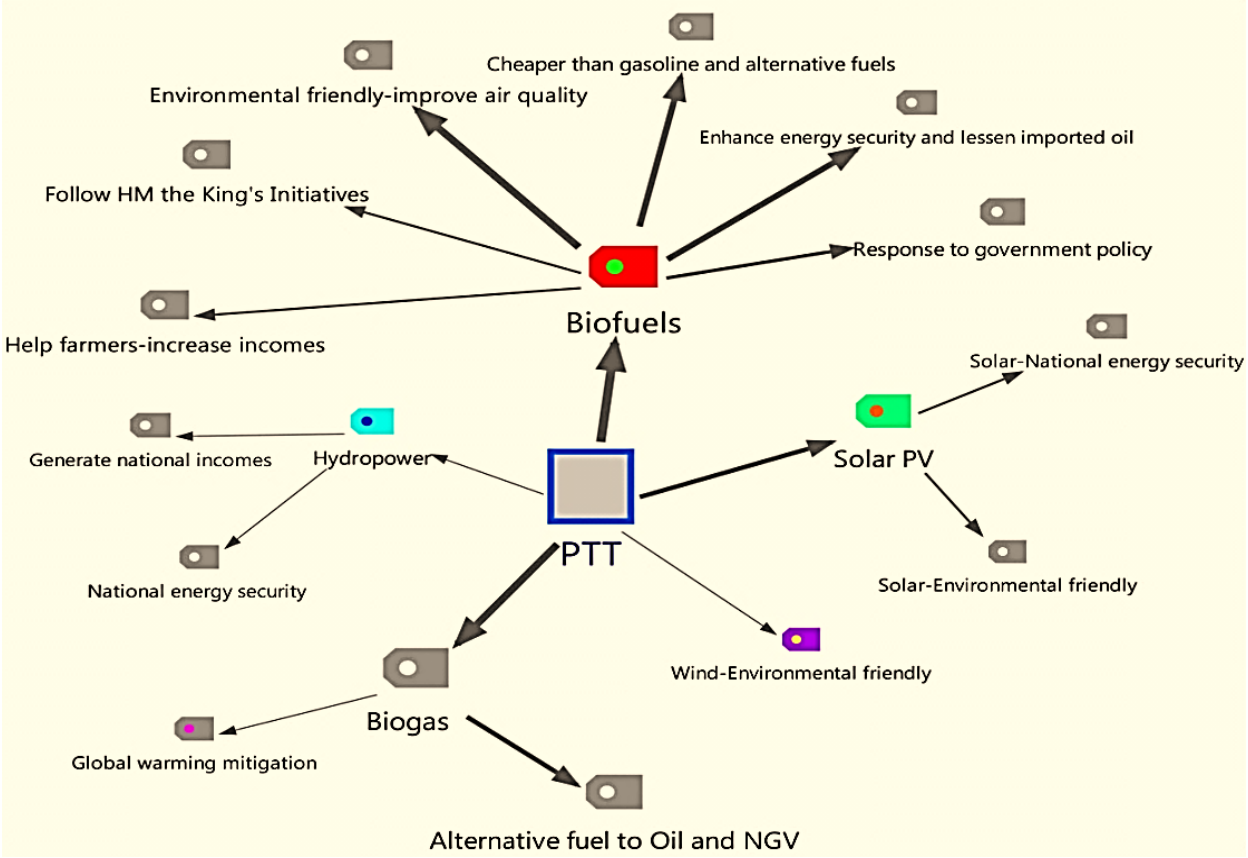


Figure 4 PTT's discourses on renewable energy investment

Figure 4 shows that PTT employed a wide range of discourses to justify their investment activities in biofuels, solar PV, wind, hydropower and biogas from waste. Also, it is clear that PTT has employed more diverse discourses regarding the development of

biofuels than other renewable energy sources, as the company prioritises biofuels over other types of renewable energy. This was done by stating that (in order of ranking regarding the number of times that a certain discourse was employed) biofuels are 1) environmental friendly, particularly regarding air quality improvement, 2) cheaper than normal gasoline, and they serve as alternative fuels to gasoline and diesel, 3) enhance Thailand national energy security and lessening the country's burden on importing oil, 4) a response to government policy, 5) following HM the King's initiative and 6) generating income for Thai farmers.

Interestingly, it was not until 2008 that the company started to replace the 'environmental friendly-air quality improvement' discourse with 'environmental friendly-addressing global warming' discourse. This change can be seen from this excerpt from the 2008 PTT annual report, which states that *"May 30, 2008: PTT and Toyota Group joined hands in the research and development of a new diesel technology called Bio-Hydrogenated Diesel or BHD, the first of its kind in Thailand (...) The innovation could respond to the government policy and, more importantly, is environment friendly through reduction of global warming"* (PTT, 2008). The "environmental friendly-addressing global warming" discourse was continuously mentioned in all annual reports between the years 2009 and 2011, going as far as having the company point out that global warming was being caused by oil consumption. *"Investment in this area (oil palm planting) was made through PTT Green Energy Co., Ltd. (PTTGE), (...) in the production of biodiesel as an alternative energy in line with the government policy on alternative energy and reduction of global warming caused by oil consumption"* (PTT, 2010).

The "National energy security- reducing imported oil" discourse was employed when talking about other types of renewable energy, beside biofuels. However, biofuels seem to hold an important status within the company. A message from the board of directors, written in the 2008 annual report, intended to send a message to stakeholders and clearly stated that "gasohol and biodiesel sales were the public's other choices in the collective efforts for greater self-reliance" (PTT, 2008). Statements like 'reduce the national burden of long term oil imports', 'less dependence on imported fuels' or 'lower

petroleum imports' were found repeatedly in annual reports between the years 2005 and 2008. However, the discourse on energy security was dropped and substituted with a discourse reasoning that biofuels are cheaper and can serve as a replacement for conventional gasoline and diesel. Later, in their annual reports between 2010 and 2014, the company reiterated the discourse that biofuels are cheaper than conventional fuels, stating that PTT continued to promote biofuel energy as an alternative option (where gasohol and biodiesel would replace gasoline and diesel, respectively). The other three discourses that PTT used to justify their investment on biofuels highlighted that these were a response to government policy, followed HM the King's initiatives and helped increase the income of Thai farmers. Although the discourse on HM the King was found with less frequency than the other discourses mentioned previously, it noteworthy to mention that it was used in 2003 when the company first started selling gasohol at gas stations. This discourse is unique to biofuels development and is related to the monarchy, an important socio-political institution in Thailand. Interestingly, PTT combined this discourse with other socio-political ones ('helping Thai farmers'), as can be seen clearly from excerpts from annual reports:

Regarding how they were following initiatives from HM the King and helping to increase Thai farmers' income, they mentioned how they were aiming, *"to provide a less expensive alternative for users of 95-octane gasoline, support His Majesty the King's efforts in promoting alternative energy, and help provide more income for Thai farmers; PTT offered gasohol at 12 locations in Bangkok. PTT first offered gasohol at its Head Office station. It was the first oil company to do so in Thailand"* (PTT, 2003).

Regarding how they were following HM the King and responding to the government's policy discourse, part of one of the reports reads: *"recognizing its role as the national oil company, PTT is committed to supporting the government's energy policy in various aspects: security of supply, promotion of alternative forms of energy to cut imports, and promotion of economical and efficient use of energy. Above all, PTT is committed to laying down a solid foundation for sustainable energy management in line with His Majesty the King's sufficiency approach, a royal initiative for Thailand* (PTT, 2006).

Although PTT's annual reports do not provide much detail on HM the King's initiative on biofuels and how Thai farmers obtained benefits from such developments, the company did refer to various government policies and measures which directly promote investment in biofuels. Examples of this include "the policy on a single commercial biodiesel grade with a 4% to 5% mixture of palm oil (B100), depending on the internal palm oil market" (PTT, 2011), "ethanol consumption of 2012 rose by 13.0% as a result of the government's price intervention to reduce oil fund contribution from gasoline-gasohol mixture at a lower rate than for pure gasoline. More and more people have turned to gasohol 91 and gasohol 95" (PTT, 2012), "because of the first-car scheme and the abolishment of sale of gasoline 91 from January 1, 2013, more vehicles will flood the traffic system and higher consumption of gasohol is unavoidable" (PTT, 2012), and "biodiesel (B100) consumption soared by 23.7% to 3.5 million litres per day as the Department of Energy Business increased blending requirement of B100 in diesel from 5% to 7%" (PTT, 2014).

Finally, PTT used several conventional discourses for the remaining renewable energy sources that they mention (solar PV, wind, biogas from waste and hydropower), in the same manner as they did with biofuels. The discourse on 'enhancing national energy security' and 'producing environmentally friendly products' was among the most commonly employed. Typically, solar PV and wind energy were mentioned in the same statement, usually under the label of 'clean energy'. However, it should be noted that the solar PV projects that PTT mentioned in its annual reports were those conducted by Bangchak, its associate company. However, what appeared to be different were the discourses used to justify PTT's investment on biogas from waste and hydropower. Biogas from waste has been portrayed as an alternative fuel to both oil and natural gas for vehicles, particularly in for rural areas where NGV fuel stations cannot be built, and where biogas from waste water or animal manure was promoted as a potential energy source. The company presented information showing a large potential for biogas to substitute diesel or natural gas. Finally, the hydropower project was also justified by a rather novel discourse, stating that it could generate income for Thailand as a country. According to PTT's 2013

annual report, “In addition, GPSC (Global Power Synergy Public Company Limited) has expanded investment in the ASEAN region, such as hydropower plant in Laos, to generate revenue for Thailand”. GPSC is an associate company of PTT which was established in 2013, engaging in electricity, steam and water supply for industries in Thailand (essentially, it generates electricity from natural gas, solar energy and hydropower). It should be noted that PTT, although investing abroad in various projects such as palm oil plantation in Indonesia, did not employ this discourse of generating revenue for the country for any other energy sources. This finding suggests that the company does not randomly form discourses to justify each type of renewable energy, but rather that these are carefully thought out and form part on an internal logic within the company.

5.3.2 Bangchak: A company in transition

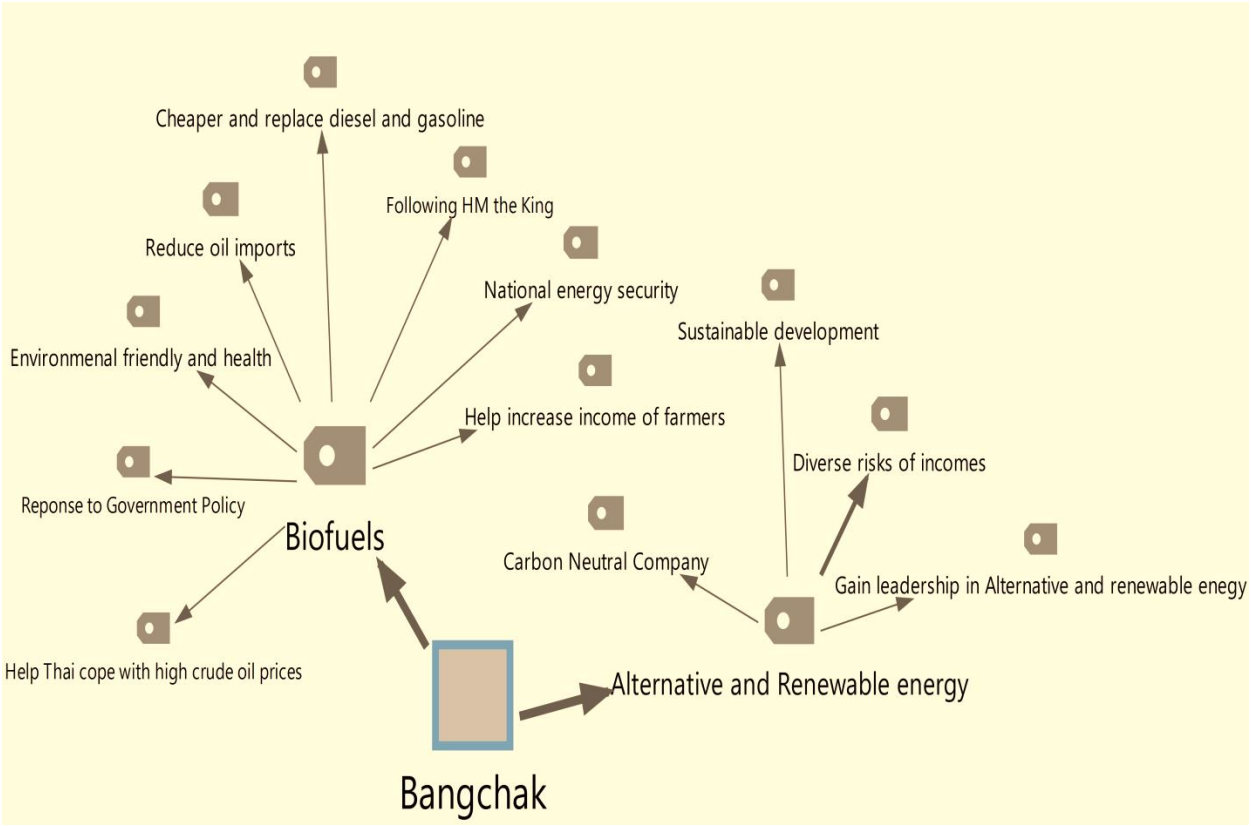


Figure 5 Bangchak's discourses on renewable energy investment

Figure 5 shows that in order to legitimize its biofuels investment Bangchak employed a combination of discourses that were similar to those used by PTT. Namely discourses mentioned a response to government policy, biofuels being a cheaper alternative to normal gasoline, biofuels enhance national energy security by reducing imported oil, biofuels help Thai people cope with rising oil prices, biofuels were initiated by HM the King and helping increase farmers' incomes, and that biofuels are environmental friendly and prevent health problems resulting from the consumption of used cooking oil. However,

an interesting characteristic of Bangchak's discourses is that many of them appear together, and thus it is difficult to judge which single discourse is the most frequent. For example, extracts from its reports mention how:*"expansion of sales of Bangchak Gasohol 95 at 99 service stations in Bangkok Metropolitan to honour His Majesty the King for the royal initiative on gasohol promotion project in Thailand, to support the Clean Oil policy of the government and to promote more utilization of Gasohol 95 especially in big cities with heavy traffic" (Bangchak, 2003),,*or *"2007 was the auspicious year as His Majesty the King celebrated his 80th birthday[…] He is determined to ensure most subjects who are farmers to be able to stand on their own feet under the sufficiency economy philosophy. […] the company has integrated the philosophy into business operations and we have produced and marketed crops-based gasohol and biodiesel upon the initiative research at His Majesty's Chitralada Palace" (Bangchak, 2007)*, and *"the company is always aware of the importance of the renewable energy, especially ethanol and biodiesel which contributes to the country's energy security, reduction of foreign currency losses from oil imports, and supports of local agricultural sector in terms of local employment and improve their quality of living"* (Bangchak, 2009).

The aforementioned discourses show that Bangchak employed a wide range of rationales, including economic, social, political, and environmental and health aspects, for justifying the development and commercialization of biofuels. However, in the first period (before 2007) none of the discourses employed referred to any benefits that the company could expect for itself. Nevertheless, such discourses started to appear in the second period, when the company introduced a solar power plant project into an ongoing biofuels business as part of its "Greenery Excellence Vision".

When oil prices started to increase in 2007-2008, the company became aware that its business structure was vulnerable to the volatility of oil prices, and a number of novel discourses that were not present in the first period started to appear. These included becoming a carbon neutral company, achieving alternative and renewable energy leadership, risks diversification from the volatility of oil prices, and sustainable development. In the second period, the company has mentioning solar power plants, palm oil biodiesel plants,

palm planting, and ethanol plants as emerging green businesses. Through renewable energy investment, Bangchak appeared certain that it would achieve its goal to become a carbon neutral company; and that its carbon dioxide emissions would be reduced by more than 50% from its business-as-usual model by 2015 (Bangchak, 2013). In addition, renewable energy was considered as a means for Bangchak to diversify income risks away from its conventional oil business. Bangchak (2010, 2011, 2012, 2013, 2014) claimed that these clean energy businesses provide a steady source of income and have lower risks than refining oil, and thus were carried out to add value to their business in order for the company to achieve sustainable growth.

To summarize, Bangchak considered that to sustain its energy business it needs to expand into clean energy and become the leader in alternative and renewable energy. The message was never this clear in annual reports of PTT and Thai Oil. An explanation for this emphasis on economic discourses is that Bangchak has been a Public Company Limited since 1994, with PTT holding 27.22% of its shares and the rest being held by private shareholders (iBizChannel, 2015). PTT has never appointed any chief officers to become management executives in the Board of Directors of Bangchak (unlike what they did with Thai Oil). In essence, Bangchak has been operating rather independently from PTT, which has resulted in them having a more focussed business approach and the need to return profits to private shareholders, helping to explain why economic discourses were given more importance than socio-political ones.

5.3.3 Thai Oil: A complying corporate citizen

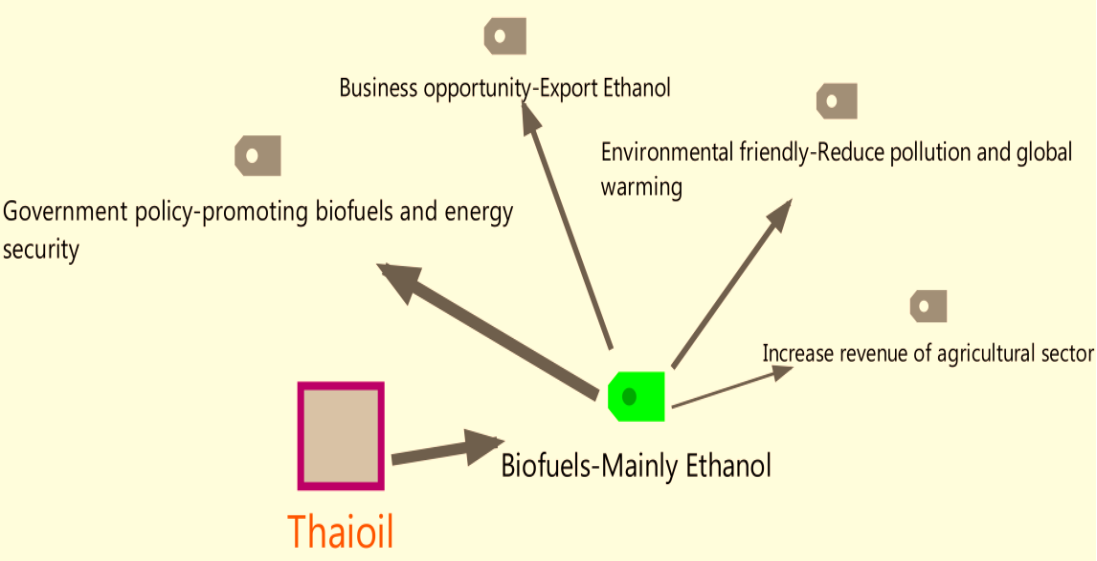


Figure 6 Thai Oil's discourses on renewable energy investment

Due to a high level of investment in biofuels (mainly ethanol) production, most of Thai Oil's discourses on renewable energy are related to this type of energy (Figure 6). Unlike the variety of discourses used by PTT, Thai Oil's rationale for pursuing biofuels was more focused, centred around (ranked in order of the number of times it appears in their annual reports between 2004 and 2014): 1) addressing government policy, which promotes biofuels usage to enhance energy security by reducing imported energy, 2) seeking business opportunities from exporting ethanol, 3) biofuels are environmental friendly, reducing pollution/emissions and reducing global warming, and 4) production of biofuels helps to improve and stabilize revenue for the agriculture sector.

What appears to be special for the case of Thai Oil is that the use of discourses regarding compliance with government policy for promoting biofuels outnumbered the use of all other discourses. This appears to be because the majority of its shares (49.10%) are held by PTT, which is a state-owned company. Furthermore, many members of the top management of PTT or the Ministry of Energy are typically appointed to become board members or top management in Thai Oil (as shown in annual reports, see The Board of

Directors, 2015). The company appears to think that government policy regarding the development of alternative energy, and especially biofuels, is beneficial to its business, and has sought to invest more in this sector. This has resulted in Thai Oil creating joint ventures with other companies to establish new ethanol and biofuel production plants and boost production capacity. The company has aimed high, as stated in its 2010 annual report, with regards to developing an ethanol business from agricultural supplies in Thailand, attempting to make the country an ethanol hub for the regional market. The 2011 annual report showed that biofuel production projects had become the company's long-term strategic plan for alternative energy and ethanol market development.

Discourses on 'environmental friendly' and 'increase income of agriculture sector' were employed by Thai Oil, in the same manner as with PTT. However, the discourse on 'biofuels are cheaper than normal gasoline' and 'following the HM King's initiative' were not found in Thai Oil's annual reports. This could be due to the company not having a distribution market, and instead being exclusively engaged with the midstream industry, as suggested in its vision that the company aims to be "a leading fully integrated refining and petrochemical company in Asia Pacific (Vision, 2015). Hence, there is no need to employ discourses which could impact end-consumers, such those on retail prices and on HM the King. As for the discourse on following HM the King's initiative, the study found that the company referred to the "Sufficiency Economy", which was introduced by HM the King, when it illustrated Corporate Social Responsibility (CSR) activities. One example is Umphang Energy Town Project in Tak province, which Thai Oil launched as a tribute to HM the King on the occasion of his 84th Birthday Anniversary. The project aimed to enhance the living standard of villagers who lived far away from the power grid by setting up renewable energy development projects such as a Pico-Hydro Power plant, cooking biogas production, and biomass energy production. To do so Thai Oil has cooperated with various organizations, such as the United Nations Development Programme (UNDP), the Ministry of Energy of Thailand, and Energy for Environment Foundation (E for E), in launching renewable energy development projects in rural areas of Thailand. However, it has done so as part of CSR projects, which are not the focus of the present study.

5.4 Discursive legitimation strategies

5.4.1 Discursive legitimation strategies for biofuel investment

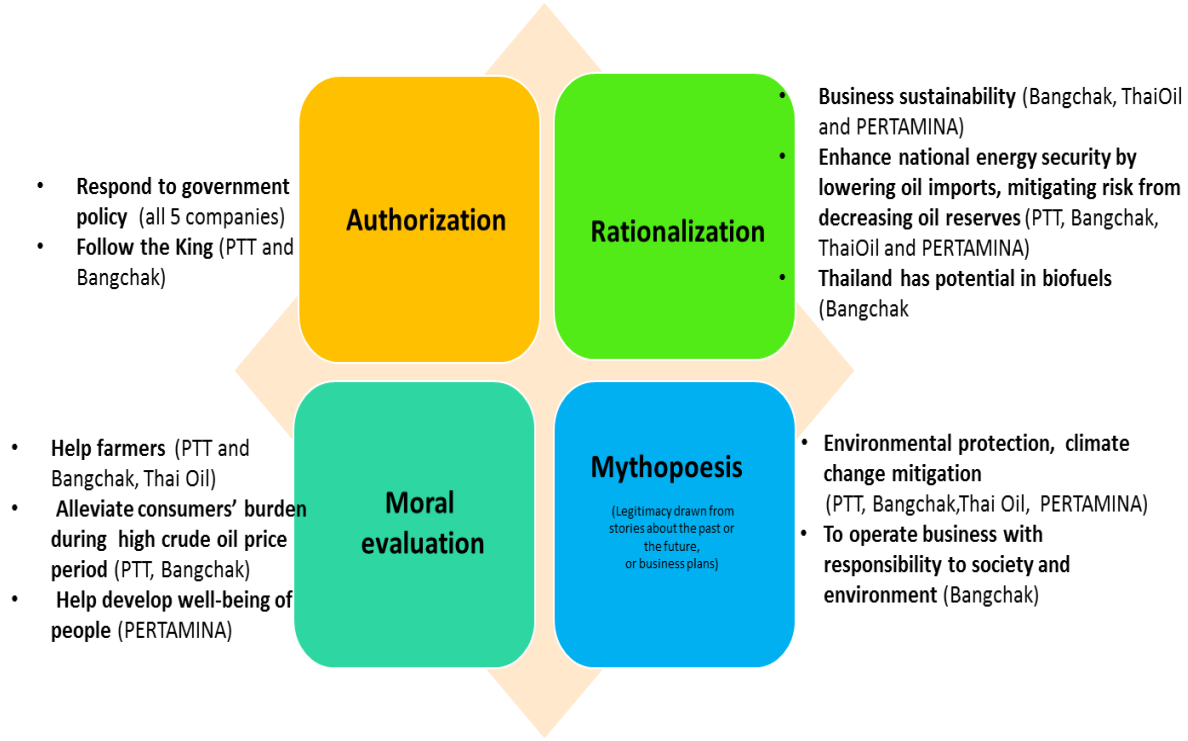


Figure 7 Discursive legitimation strategies for biofuel investment of PTT, Bangchak, Thai Oil, PERTAMINA and PETRONAS

To legitimize biofuel products, five O&G companies applied all four types of discursive legitimation strategies as shown in Figure 7. Authorization strategy, in particular 'referring to government policy', was used by all five O& companies. Only PTT and Bangchak from Thailand referred to HM the King as an important authority figure in order to acquire legitimacy on their biofuel products. This discourse is unique for Thailand O&G companies as the discourse on 'following the King's initiative' makes sense only in the specific socio-political context of Thailand.

Rationalization strategy, which proposes that legitimacy is obtained through a reference to business profits or to rational issues, was widely used by O&G companies to

promote biofuel products. Bangchak, Thai Oil and PERTAMINA highlighted that biofuel products provide them business sustainability or positive economic profits. PTT, Thai Oil, Bangchak claimed that biofuel can enhance national energy security by lowering oil imports while PERTAMINA promoted biofuel to address the decrease of crude oil reserves in Indonesia. Moreover, Bangchak made a rational choice to do biofuel business by referring to the fact that Thailand has huge supply of energy crops i.e. sugar cane and cassava, a good material for ethanol production.

Moral evaluation strategy proposing that legitimacy can be drawn upon social values or norms of the society was used by four companies. PTT, Thai Oil and Bangchak from Thailand claimed that their biofuel business increased incomes of Thai farmers. This is based on the social perception that Thai farmers are usually poor and uneducated. Thus, the fact that the companies purchase energy crops from those farmers show that they have sympathy on those poor farmers and that the biofuel business helps uplifting the well-being of those farmers. Similar to the claim about helping farmers, PTT and Bangchak also claimed that their biofuel products lessened the burden of Thai consumers during the time of high crude oil prices. This discourse was found only during a short period from 2007-2008 when the world crude oil prices went over US$ 120 per barrel. Thai Oil from Thailand did not use this discourse because the company does not have service stations. Lastly, PERTAMINA claimed that biofuel production which is one of their core businesses enhanced the well-being of Indonesian people. It is noted that PERTAMINA applied discourse on ‘developing well-being of Indonesian people’ to not only biofuels but also their core businesses in O&G and new energy businesses as a whole.

Mythopoesis strategy suggests that legitimacy is obtained through stories or narratives about the past or the future as well as business plans. The discourses which fall under this Mythopoesis strategy are environmental concerns about global climate change and the company’s business plans or missions. PTT, Thai Oil, Bangchak and PERTAMINA applied the former discourse saying that biofuels reduce GHG emissions and air pollution. Only Bangchak incorporated biofuel business in their mission in conducting business which is responsible to society and environment. Under this mission, Bangchak has actively

pursued many renewable energy investment projects, especially solar PV in which the company applied a number of discourses as will be shown in the next section.

5.4.2 Discursive legitimation strategies for solar PV investment

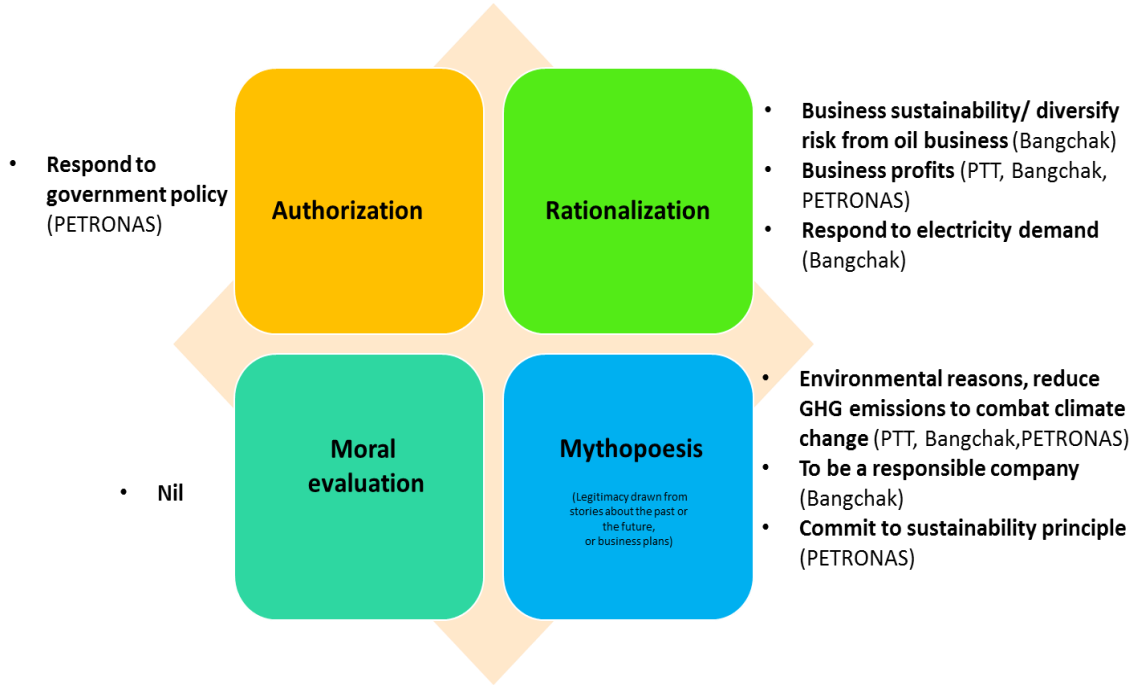


Figure 8 Discursive legitimation strategies for solar PV investment of PTT, Bangchak, and PETRONAS

Solar PV has recently been invested by the O&G companies studied. The discourses on solar PV were found only in the annual reports of PTT, Bangchak and PETRONAS. Thai Oil invests in solar PV business through a joint venture with PTT. As a result, the company does not explain their solar PV investment in annual reports. PERTAMINA has a plan to set up solar farms in various sites throughout the country as presented in Figure 3; however the company does not attempt to legitimize their solar PV projects in annual reports.

Among the three companies, only PETRONAS applied Authorization strategy to gain legitimacy on solar PV project by referring to the government policy. Rationalization strategy was used by PTT, Bangchak and PETRONAS. Bangchak claimed that solar PV provided business sustainability by diversifying its income sources. The company claims that there is a risk in oil business due to volatility of world crude oil prices while the solar PV business is a low risk and low return project which can offer business sustainability to the company. During the time of high crude oil prices in 2007-2008, Bangchak obtained income from solar PV business to complement decreased revenue from its oil business. In addition, Bangchak referred to the high electricity demand as another way to gain legitimacy for solar PV business. Lastly PTT, Bangchak and PETRONAS claimed that solar PV offers positive economic profits.

Mythopoesis strategy was used by PTT, Bangchak and PETRONAS. First of all, these three companies applied discourses on environmental concern and global climate change mitigation to legitimize solar PV projects. Solar PV is portrayed to be a clean energy which releases zero GHG emissions when generating electricity. Another type of discourse under Mythopoesis strategy is business plan and company mission. Bangchak set a mission to be a responsible company for society and environment; while PETRONAS has claimed that it follows the sustainability principle through conducting solar PV business.

Moral evaluation strategy was not used by all five O&G companies studied. The present study assumes that it is because of the nature of solar PV business. The O&G companies usually generate electricity and sell to the grid which is managed by utility companies. The O&G companies do not have to engage with a wide public as they do in the biofuel business. Consequently, the companies do not apply moral evaluation strategy to gain legitimacy on solar PV business.

5.4.3 Discursive legitimation strategies for geothermal investment

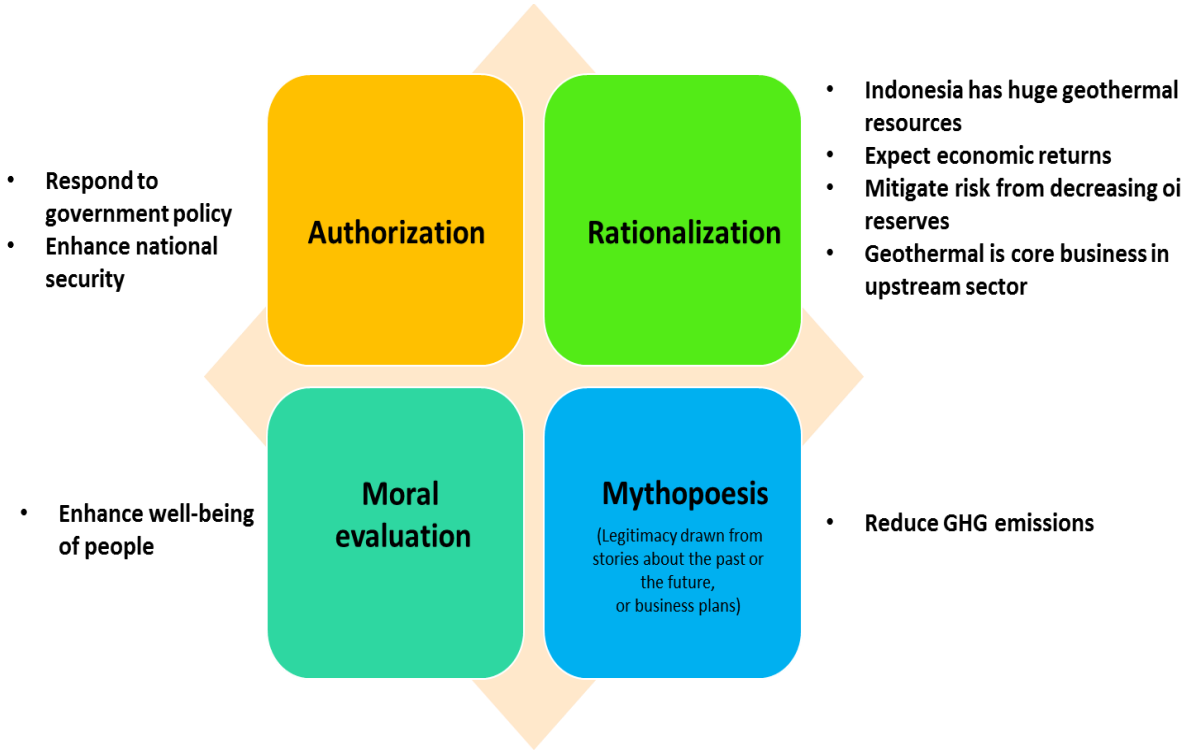


Figure 9 Discursive legitimation strategies for geothermal investment of PERTAMINA

Only PERTAMINA has so far invested in and produced electricity from geothermal energy. The present research thus only has discourses applied by PERTAMINA. In order to obtain legitimacy on geothermal projects, PERTAMINA applied four types of discursive legitimation strategies. Rationalization strategy was applied the most. PERTAMINA claimed that geothermal offers positive business profits, referred to the fact that Indonesia has huge geothermal resources while facing a decrease of oil reserves, and finally referred to the fact that geothermal is the company's core business in upstream sector.

Authorization argument which PERTAMINA applied includes the discourse on 'complying with government policy'. After Indonesia became a net oil importer in 2005

and had to leave OPEC because it could not meet the production quota in 2008, the government of Indonesia has intensively urged the national oil company to find alternative energy sources so that national energy security can be achieved; PERTAMINA's geothermal business serves the government policy in that sense. Moral evaluation strategy was also applied through the discourse on developing well-being of the people of Indonesia. This discourse is identical with PERTAMINA's discourse in biofuels. Thus, the Moral evaluation strategy is not unique for the geothermal case. Lastly, Mythopoesis strategy was used through the discourse on GHG emissions reduction. Geothermal is portrayed as one of the clean energy sources.

5.5 Conclusions and policy implications

The present study found that Thailand's O&G companies have been active in the development of renewable energy in recent years, mostly in biofuels and solar energy. By reviewing annual reports from the past 15 years it is clear that PTT, Thai Oil and Bangchak have made solid efforts during the last decade to develop and commercialize biofuels. PTT and Bangchak have also pursued investment in solar PV from 2010, and have spent a large amount of resources on solar farm projects to generate electricity for the grid under a contract with the Electricity Generating Authority of Thailand (EGAT) and Provincial Electricity Authority (PEA). Thai Oil focused on the production of ethanol and biogas from waste, which were also used to generate electricity that was fed into the grid. Finally, PTT has also shown an interest in hydropower projects in Laos and wind power in the southern and eastern seaboard of Thailand, though the company did not show further progress on these projects in any recent annual reports.

The fact that all three O&G companies in Thailand have invested so much in biofuels is logical given that biofuels align well with their conventional core business. Nevertheless, it is interesting to note that all three companies have attempted to legitimize their investment in biofuels by using socio-political rationales. Discourses on following HM the King's initiative, as well as helping increase the income of farmers, are unique in justifying biofuel projects in the annual reports of Thai O&G companies. In other words, companies referred to the most powerful political figure in the country to gain legitimacy

for their new products. This strategy is very interesting, as it highlights the role of socio-political discourses on renewable energy development and diffusion, in particular at the early stages in their development and commercialisation. In addition, as a state-owned company and associate companies of a state-owned company, PTT, Bangchak and Thai Oil used discourses on responding to government policy and enhancing national energy security as primary reasons to invest in renewable energy. Reference to economic reasons, such as those concerning business sustainability and responding to volatile oil prices, came only after reference to socio-political issues and national energy security.

Understanding how companies think is crucial to harnessing their vast resources into a direction that can help bring about a transition to a low-carbon energy future. The present work drew four important policy implications and suggestions from the case study of Thailand's O&G companies. First, the government can clearly have a profound impact on business strategy, considering the fact that all three companies referred to government policy and the rhetoric of 'national energy security' and 'reducing national burden from importing oil' to justify their green business. As a result, the government should continue sending companies a clear message and policy direction regarding alternative and renewable energy promotion. Otherwise, there is the risk that these companies could divest from the sector, in a similar way what happened with O&G companies in OECD countries after the governments withdrew subsidies for renewable energy when the oil prices went down in the 1980s.

Second, Bangchak has showed great ambition to become a leading company in renewable and alternative energy, seeing how it has restructured its business portfolio over the years to reduce the risk from the high volatility of oil prices. However, how the company will react to current oil prices of around US$ 50 per barrel remains to be seen. The author thus proposes that there should be a continuous examination on the renewable energy business strategy of O&G companies for a longer period of time, in order to observe any potential changes over longer time-scales. This will provide a better picture of the long-term business strategy, which is vital to promote efforts to transition to a low-carbon energy future Third, as discourses not only shape one's view of the world and reality, but also

produce or construct social roles, responsibilities and identities (Eckersley 2016), the government may induce companies to contribute to the transition to low-carbon energy development by referring to them as energy companies rather than as O&G companies. Media should also run a campaign to raise public awareness and urge these businesses to be recognised as 'energy companies'. The discourse on being an 'Energy Company' would hopefully bind O&G companies into transforming their operations to meet their new identity and responsibilities.

Fourth, the discourse on following HM the King's initiative on biofuel development is unique to Thailand and played a crucial role in Thai consumers accepting biofuel products. This finding is particularly interesting, though it is difficult to suggest that other countries should implement it, as it is clearly specific to Thailand's socio-political context. However, it serves as an example of a socio-technical approach, and Sovacool (2009) suggested that for any new technology to be successfully introduced it requires not only to be technologically successful, but also to have socio-political backing. Thai companies gained legitimacy on their biofuel products by referring to HM the King, as the monarchy (particularly under the previous kind) is an important and respected institution in the country. Authorization, (van Leeuwen and Wodak, 1999), could thus be seen to be a powerful discursive legitimation strategy for introducing and diffusing renewable energy.

In conclusion, the study applied a discourse analysis on renewable energy business strategies of O&G companies in Thailand and revealed discursive dimensions beneficial for understanding the way of thinking of PTT as well as of two of its associate companies. Through the insights obtained from the case of Thailand the author believes that the same methodology could be used to further examine other case studies, in particular multinational O&G companies like BP, Shell, Chevron, or ExxonMobil. Discourse analysis can thus shed light on the underlying rationales of the investment in and divestment from renewable energy that O&G companies conduct, which would certainly push forward knowledge on the discursive differences between O&G companies in developed and developing countries. As a result, policy makers would be able to better formulate discursive strategies to introduce and diffuse renewable energy technology in their societies.

Chapter 6 Factors that influence ASEAN's major O&G companies

6.1 Introduction

In this chapter, the present study investigates factors that influence five O&G companies namely: PTT, Thai Oil, Bangchak, PERTAMINA and PETRONAS, attempting to draw comparisons with other major O&G companies that were described in existing literature. The factors discussed here were taken from the analytical framework presented in Table 7 in section 3.5 "Methodology for sub-objective 3". The study first described Company specific features, followed by National factors and Global factors. Both interview data and secondary data from official documents and company reports were used to discuss how a given factor affects the corporate strategy of each of the five O&G companies to invest renewable energy. The names of all interviewees are kept anonymous, and only their affiliation and gender (where they gave consent to do so) are presented.

6.2 Company specific features

6.2.1 Ownership structure and the role of CEOs and shareholders

6.2.1.1 Ownership structure

Penha (2011) made an observation that state-owned companies (100% owned by the government) i.e. Saudi Aramco, NIOC (Iran), and CNPC (China) did not invest or had less investment in renewable energy than those private-owned companies such as BP, Shell and Total. Hence, the author proposed that ownership structure of companies could be one of factors to determine if O&G companies will steer their resources into renewable energy business. The present study examined this assumption with five O&G companies- PTT, Thai Oil, Bangchak, PERTAMINA and PETRONAS. The findings are corresponding to the observation made by Penha (2011). As shown in Table 21, Bangchak which has the most shares owned by private investors is the most active renewable energy investor among these five companies; while PERTAMINA and PETRONAS are 100% owned by the states

and have relatively less green investment activities. However, it should be noted that ownership structure is not always applicable. There is an exception such as ExxonMobil which is 100% private-owned company but is against renewable energy investment.

Table 21 Ownership structure and years of establishment of PTT, Thai Oil, Bangchak, PERTAMINA and PETRONAS

Rank of companies in term of activeness in Renewable energy investment activities	Year of establishment	Ownership structure
Bangchak	1984	• PTT owned 27.22% of shares until 2016 • The rest is owned by private investors in the Stock Exchange of Thailand
PTT	1978(in the period of second world oil crisis)	• Since 2001 the company was listed in Stock Exchange of Thailand (SET) • Ministry of Finance (51.1%) Krung Thai Bank (7.4%); the rest is owned by private investors
Thai Oil	1961	• PTT owns majority shares as 49.1%
PERTAMINA	1968 (as a result of merging between PN PERMINA and PN PERTAMIN)	• 100% stated owned
PETRONAS	1974	• 100% stated owned

6.2.1.2 The role of Chief Executive Officers (CEOs)

The role of CEOs is recognized as one of key factors that influence corporate strategies to climate change mitigation of O&G companies. A well-known example of CEOs which literature usually referred to is a former CEO of BP, Lord John Browne (Rowlands, 2000; Kolk and Levy, 2001; van den Hove at al., 2002; Macalister, 2007; Skjærseth and Skodvin, 2009). BP under his leadership from 1995-2007 changed from being a climate change denier to become a proactive actor in mitigating climate change. Starting with withdrawing from Global Climate Coalition (GCC) in 1996, a lobby group of

heavy industries against climate change agreement, the company had set a new slogan as 'beyond petroleum' conducting GHG reduction activities such as emission trading and renewable energy investment. Although environmentalist NGOs criticized his attempt for being a greenwash, it was found after he left that the company turned back to conventional fossil fuel business (Kolk, 2008; Pearce, 2008; Macalister, 2009). Shell's former CEO Mark Moody Stuart was also another important figure. He was reported to have a vision toward the low-carbon energy: "we want to meet our customers' need for energy, even if that means leaving hydrocarbon behind" (The slumbering giants awake, 2001). However, similar to BP, after CEO Mark Moody Stuart moved out, "the hydrocarbon supremacists rapidly regained the ground they had lost" (Porritt, 2015).

Four O&G companies, except PERTAMINA, mentioned the role of CEOs in their interviews. The most obvious expression is from Bangchak interviewee who highlighted the fact that former CEOs established a culture of Bangchak to run business with social and environmental responsibility. Outstanding role of CEOs of Bangchak was confirmed by an academic interviewee:

> *"From an external glance, CEOs of Bangchak are the most outstanding. They present green image and show concerns on community development, especially former CEO Mr. Sopol who helped Bangchak survive financial crisis in 1997 and former CEO Dr. Anusorn who set the GHG reduction targets of Bangchak well before Thailand had a national reduction commitment"* (Scholar, male)

Former CEO and President Dr. Anusorn Sangnimnuan, in position from 2004-2012, was the one who initiated various green energy investment starting with biofuel production and solar farms "Sunny Bangchak". Company interviewee referred to his educational background in environmental engineering as one of main reasons why he gave special focus on business operation which was align with environmental concerns. As an associate of PTT, some of Bangchak's Board of Directors were PTT executives. However, the President position was given to Bangchak's own personnel. In this regard, Dr.Anusorn

Sangnimnuan had employed his authority to commence many green investment projects. Serving as the President for two full terms (eight years), he successfully put his green energy investment ideas into practice. However, the company interviewee recalled tension between PTT and Bangchak:

> *"PTT appointed their personnel to serve as Directors. Dr. Anusorn was then selected to be CEO. He started renewable energy projects. He was determined to do anything, which would be beneficial to Bangchak. PTT at that time focused more on natural gas business and less on environmental problems. PTT did not let Bancghak run gas business, so we turned to renewable energy. But that caused PTT view Bangchak as a stubborn child"* (Bangchak interviewee, female).

The case of PTT and Bangchak shows that although being an associate of PTT, Bangchak can run its own business strategies thanks to the key role of CEOs. Yet the situation is different in the relation between PTT and Thai Oil because PTT holds higher shares in ThaiOil than it does in Bangchak. Thai Oil seems to comply more with the PTT's business strategies:

> *"PTT appointed Top1 and 2 of ThaiOil executives. We are a listed company and 50% of our shares are owned by other investors. Although we do not have to always follow PTT, but we consult with PTT about investment projects and align our direction with PTT Group (meaning PTT and its all subsidiary and associates)*" (Thai Oil interviewee, female).

As for PTT itself, the interviewee did not mention the role of CEOs in the interview. However, the review in annual reports showed that PTT's former president and CEO from 2012-2015, Dr. Pailin Chuchottaworn, had played a key role in increasing the green investment. As presented in PTT annual reports (2011-2014), he initiated the new strategic direction of PTT as to become a Technologically Advanced and Green National Oil Company or TAGNOC. The green investment was officially recognized as one of three

main company strategic plans. The statement in PTT annual report (2012) was read as "TA (Technologically Advanced) means business on the basis of knowledge application or development of PTT's own technology instead of mere consumption of natural resources, G (Green) means environmentally friendly investment in energy and petrochemical businesses and NOC (National Oil Company) means establishment of energy security and prosperity for the nation".

In the case of PETRONAS, the company and NGOs interviewee stated identically that CEOs of PETRONAS reported directly to Prime Minister (PM) according to the Petroleum Act 1974, meaning that Malaysian PM has absolute authority in PETRONAS. "If PM did not tell PETRONAS to go green, then it will not do", said NGOs interviewee. To give a clear example, NGOs respondent cited what happened to Mr.Mohd Hassan bin Marican, a former CEO and president of PETRONAS since February 1995 until February 4, 2010. According to NGOs, Prime Minister Najib Razak who took power in 2009 ended CEO contract of Mr. Hassan because of his disagreement with the government. The former CEO was reported to have conflict with PM Najib over issues ranging from who should be appointed as PETRONAS board to which Formula One car to sponsor (Koswanage and Kaiser, 2012). The fundamental conflict however seems to be rooted in his refuse to let the governments use PETRONAS as a cash trough.

6.2.1.3 The role of shareholders

Shareholder pressure, specifically referred to private shareholder, is considered as an important factor on O&G companies' responses to environmental issues; in particular, IOCs whose shares are owned by individual and institutional investors. Many have reported various occasions where shareholders and investors met the O&G companies' executives in the Annual General Meeting (AGM) and raised their concerns on the impact of companies on climate change (Logan,2014; Associated Press ,2015; Gunther, 2015; Macalister and Carrington, 2015; Neate, 2016b). Shareholders can pressure the companies through limiting the funds they provide for O&G exploration and production operations or rewarding the CEOs who worked to achieve the climate change mitigation targets (Davis, 2006; Fight the power, 2015; Farrell, 2016). However, the companies responded to shareholders' pressure

differently. Shell and BP accepted shareholder demands to increase transparency about how their operations affected climate change; while CEO Rex Tillerson of ExxonMobil (now appointed as a secretary of state of the US) rejected shareholder resolution and insisted on his view that "cutting oil production was not acceptable for humanity" and that "the world is going to have continue using fossil fuels, whether they like it or not" (Neate, 2016b).

The role of shareholders to some degree have impact on O&G corporate strategies in particular European-based companies; however, this factor appears to play trivial role on five O&G companies studied. Interviewees from Bangchak and Thai Oil did not mention they have received shareholder pressures although they are listed companies in the Stock Exchange of Thailand (SET). However, PTT interviewee mentioned the dilemma that PTT faced when making decisions, which was caused by the fact that the government owns 51% of its shares while the rest of 49% is owned by private investors:

> "*Whether PTT will invest in renewable energy or not depends on two factors. First of all, we are a listed company, so we have to think about the return of profits to shareholders. However, we are half-blood as majority of shares, around 50%, owned by the state. Thus, we need to balance these two factors. Nevertheless, in reality we cannot find the balance. Government policy is more dominant. We comply with the government policy in the end*" (PTT interviewee, male).

Interviewees from Malaysia and Indonesia also did not mention private shareholder pressure as the governments of Indonesia and Malaysia are sole shareholders. Whether or not the two companies take proactive strategies in green energy business is thus depending on the government policy. However, both Indonesian and Malaysian governments are viewed as having contradiction between an urge to generate electricity from cheap/abundant fuels like coals and an aim to achieve GHG emissions reduction target. This issue will be discussed in the section of National factors.

6.2.2 Short-term economic advantages

In this factor, the study examined sub-factors which affected the short-term economic advantages of O&G companies; namely shortage of capital, maturity of company's operation, and carbon intensity of company. During economic downturn in 2008-2009, companies like BP and Shell pulled back their investment in renewable energy due to the shortage of capital in the clean energy business. It was reported that banks which suffered in the crisis i.e. RBS, Lehman Brothers, Washington Mutual and Fortis, were among the biggest finance sources for green energy business (The green slump, 2009). Apart from the aforementioned shortage of capital, Davis (2006) in his study to find out why oil companies did not commit in renewable energy investment stated that oil industry had reached its maturity and thus pursuing lean business approaches. The R&D budget, a crucial driver of renewable energy, was cut as it was not profitable as other activities.

The carbon intensity of companies, which is referred to core business areas, fossil fuel reserves and production volume, has an important influence for short-term economic advantage of O&G companies (Skjærseth and Skodvin, 2009). The companies with high carbon intensity (producing coal and oil more than gas) are likely to be a target of regulations and to have reactive climate change strategies (Rowlands, 2000). Many companies were reported to clean their portfolios by switching to gas as well as pursuing GHG reduction activities such as installing Carbon Capture and Storage (CCS) technology, energy efficiency and flaring-venting reduction. Gas production has been promoted by major O&G companies as a response to Paris agreement in 2015. The new articles by the Economist and the Guardian have reported a wide collection of O&G companies' efforts in promoting natural gas as the cleanest fossil fuel. To give some examples:

- Total, Iberdrola, E.On and Enel influenced trade bodies such as the European Wind Energy Association (EWEA) and European Photovoltaic Industry Association (EPIA) to advocate for a renewable-gas alliance as to achieve Europe's energy security targets (Neslen, 2015a)
- The Oil and Gas Climate Initiative (OGCI) comprising of 10 companies (BP, CNPC, Eni, Pemex, Shell, Total, Statoil, Repsol, Saudi Aramco, Reliance

Industries) set up one US$ billion fund for 10 years which will be used in implementing technology to monitor and reduce fugitive gas emissions in gas production process (Carrington, 2016a)

- Shell did a US$ 54billion acquisition of BG, a British producer of natural gas as its strategic planning in cleaning up its energy portfolio and addressing the decrease of oil demand (Katakey, 2016; Nodding donkeys, 2015; On the oil wagon; 2016)
- Statoil argued that fossil fuels are not carbon equal; thus switching to use gas in electricity generation instead of coal is cost effective and reasonable measure for governments (Sverdrup, 2015).

Five O&G companies studied in this research raised issues concerning two sub-factors; the shortage of capital and the carbon intensity. For the first sub-factor, PTT and PETRONAS interviewees referred to the lower budgets caused by the lower income in the period of low crude oil prices. The study will explain this issue in the investigation of global factors as the decrease in capital was caused by world crude oil prices.

Carbon intensity is taken into consideration on short-term economic advantages by three companies studied; namely PETRONAS, PERTAMINA and PTT. For Bangchak and Thai Oil, company interviewees did not mention about switching to gas as a way to cope with GHG emissions. This is due to these two companies do not run upstream industry (exploration and production), but rather in midstream (refinery) and downstream (end-products distribution and petrochemical).

Interviewees from PETRONAS, PERTAMINA and PTT raised issue on switching to gas production to reduce carbon intensity of the companies, but with different perception. PETRONAS interviewee claimed that the company promotes gas production as one of ways to mitigate climate change. The 2015 Sustainability Report of PETRONAS showed that the company viewed natural gas as a cleaner energy:

> *"Natural gas will play a key role towards achieving a low-carbon economy and PETRONAS aspires to strengthen its position as a global Liquefied Natural Gas (LNG) player. In supporting this pursuit, the Company embarked on its first PETRONAS Floating LNG (PFLNG) Satu Project, a*

versatile facility comprising LNG production, processing, liquefaction and offloading facilities. The structure, which limits the need for extensive pipelines or heavy infrastructure, will further unlock value from Malaysia's remote and stranded gas fields. PFLNG is PETRONAS' new game-changer that will transform the landscape of energy production" (PETRONAS, 2015).

In addition, the company reported to implement energy efficiency, venting-flaring reduction process and investments in the area of carbon capture and storage as its carbon commitments.

As for PERTAMINA, the company started gas business in 1970s in the form of Liquefied Petroleum Gas (LPG). In 2006 PERTAMINA developed Coal Bed Methane (CBM), an unconventional gas, in an attempt to increase its national gas reserve (PERTAMINA, 2006). The company has been since then active in gas business but later realized that only gas seemed insufficient to meet rising energy demand of the country. In 2014 a new sector was set up to manage gas, new and renewable energy business, called "Directorate of Gas, New and Renewable Energy (PERTAMINA, 2014). The new and renewable energy included a wide range of energy i.e. nuclear, wind, solar, ocean and tidal. PERTAMINA interviewees concluded firmly that even for the short-term economic consideration the company needs to move further than switching to gas production:

"The reserves are not balancing. Finding new reserves and exploiting reserves is not balance. We already become a net importer of oil. Soon we will be a net importer of gas. We want to increase sustainability of energy in Indonesia. Renewable energy is part of our obligation for our next generation" (PERTAMINA interviewee, male).

In the case of PTT, the company through its subsidiary- PTTEP has explored and produced crude oil and gas onshore and offshore in both Thailand and abroad. During 2000-2010 PTT spent huge investment to develop gas business in two main areas, Liquefied Petroleum Gas (LPG) for cooking and natural gas for vehicles. In addition, to

promote the use of NGV fuel, a then unconventional fuel in transportation sector, PTT initiated a number of campaigns. They are for instance installing NGV kits for thousands of taxis for free of charge, sponsoring 10,000 baht (US$ 330) for installing NGV in 5,000 private cars, and cooperating with Ministry of Energy and Ministry of Transport in a project "Bangkok Clear Sky with NGV" in which PTT's NGV Fund worth 5 billion baht (approximately US$145 million) was given to Bangkok bus operators to install NGV kits and buy new NGV buses. (PTT, 2001, 2002, 2005, 2007). The demand of gas for NGVs increased substantially from 23 MMcf/d in 2007 to 74 MMcf/d in 2008 and then to 134 MMcf/d in 2009 (PTT, 2009). Despite this success, the company reported enormous loss in profits since it was assigned by the government to sell gas with a retail price lower than production cost. Particularly during the time of high crude oil and gas prices in 2008, PTT was ordered to fix the retail price of NGV fuel at 8.50 baht (US$ 0.3) per kilogram against the cost of production of 14 – 15 (US$ 0.5) baht per kilogram in order to help alleviate burdens of Thai people (PTT, 2008). PTT interviewee sharply stated how the company prioritized compliance with government policy over business profits:

> *"The government ordered PTT to sell NGV fuel with much lower prices than production costs. PTT's accumulated loss in NGV business was over 120,000 million baht (approximately $US 3,484 millions). Former CEO Mr.Prasert Boonsampun once commented that CEOs of PTT have easy work because they can run business without concerning on making profits"* (PTT interviewee, male).

It is not until 2015, the company can successfully negotiate with the government authority to push for gradual and continual adjustment in the retail price of gas for NGV vehicles to reflect its real production costs (PTT, 2015). Gas business for PTT appeared to be a burden and the company is unlikely to switch to gas production to gain short-term economic advantage.

To conclude, the companies with still high gas reserve like PETRONAS switched to gas production as well as implementing CCS technology as a way to gain its short-term

economic advantage. Due to low gas reserves and experience in negative business profits, PTT appears to pursue a different path by moving toward renewable energy sources to full fil their short-term economic advantages. Similar to PTT, PERTAMINA has been in an urgent urge to find more energy sources as only oil and gas cannot meet the country's high-energy demand. Lastly, Bangchak and Thai Oil do not possess gas reserve; thus having no choices but to find other lines of energy business.

6.2.3 Long-term economic advantages

Two sub-factors, views on profitability of renewable energy and views on future energy mix, are considered for the long-term economic advantages of O&G companies. Literature review on renewable energy investment done by major O&G companies suggested that the difference in views on long-term economic advantage cause different corporate strategies in diversifying business portfolio from fossil fuels to renewable energy. However, it is noted that companies changed their views throughout years resulting in an on-off relation with renewable energy (See the history of renewable energy investment of major O&G companies in Appendix F). Back in 1970s and early 2000s, O&G companies were active in entering into green business (When virtue pays a premium**,** 1998); mostly European-based companies like BP and Shell who held positive view on the future of the growth in renewable energy and believed that the first movers will get more advantages (Wee, 2002; Miler, 2013; Johnson, 2015). In early 2000s BP envisaged renewable energy will account for 5% of revenue by 2020 and 50% by 2060 and Shell had a long-term planning scenario suggesting that RE will account for 30-40% of global energy by 2060 (Levy and Kolk, 2002).

However, late 2000s the world had seen 'back to petroleum' of major O&G companies. To name a few, in 2007 Shell then CEO, Jeroen van der Veer, commented that "contrary to public perceptions, renewables is no the silver bullet that will solve all our problems" (Macalister, 2007). Later in 2009 Shell exited all solar business and all types of renewables i.e. wind, hydropower saying that they were not economic. Rather, Shell was going to invest only in biofuels (Pearce, 2009; Wedd, 2009). BP shut down its alternative headquarter in London in 2009 before leaving solar PV in 2011 after 40 years in this

business, saying that it could not make money from solar and pointed to low-cost solar panel produced in China as a main competitor of its products (Macalister, 2009, 2011b). ExxonMobil, the US-based major O&G company, has been expressing its long-held view that renewable energy is not economic and that oil and gas will maintain dominant in energy mixes especially those of developing countries in the next 40-50 years (Levy and Kolk 2002; The unrepentant oilman, 2003; Perry, 2012; AP, 2014; Elgin, 2014; Logan, 2014; Katakey, 2016; Neate 2016b). However, this view is in the line with BP, a major European-based company who once had gone 'Beyond Petroleum'. BP Energy outlook (2016) forecasted that fossil fuels remain the dominant and will be accounting for almost 80% of total energy supplies in 2035; while the shares of renewables (including biofuels) in primary energy will rise from around 3% today to 9% by 2035.

The study on five O&G companies from Thailand, Malaysia and Indonesia shows diverse views on profitability of renewable energy and on what the future energy will look like. Before going into details, it is noted that the present study captures companies' perceptions at the time of conducting fieldwork in August to December 2016. The changes of their views in late 20th century are important but beyond the scope of study which focus on the changing world of 21st century.

6.2.3.1 Views on profitability of renewable energy

Views on profitability of renewable energy is separated between views on biofuels for transportation and on renewable energy i.e. solar PV for electricity generation. Starting with biofuels, PTT, Bangchak and Thai Oil interviewees perceived that biofuels business is not economic at the moment due to low crude oil price. PTT interviewee claimed that biofuel production cost is lower than normal fuel because of subsidy from government's oil fund not because it has cheaper price. Moreover, the interviewee raised that many R&D on biofuel projects were shut down or paused as a result of low crude oil price. According to the interviewee, those projects are for instance R&D on algae-based biofuel which PTT had invested for 6-7 years and spent around 700-800 million baht (US$30 million), R&D on B20 biodiesel, and 2nd generation of biofuels:

> *"The R&D on algae-based biofuels was shut down everywhere in the world. Shell did so before PTT did. The reason to shut down is that it cannot reach commercialization point. I was the one who ordered to shut down the project in early of 2016. … The celluloid-based ethanol was suspended. We started it when the time of high crude oil price. Now that the oil price is very cheap, using celluloid as a raw material for ethanol is like burning a teak tree to make a firewood*" (PTT interviewee, male).

Thai Oil interviewee has similar view with PTT on biofuels:

> *"At the moment, ethanol business is quite challenging. Although it has benefits for national energy security, help farmer, reduce oil imports, but actually Thai Oil found it is difficult to run business. First of all, we do not have upstream and downstream industry of biofuel*[8]*. In addition, we face limitations to export ethanol due to a law. The ethanol production of Thailand cannot compete with that of Brazil. They have larger sugar yields and better economic of scale. Thus they can sell ethanol cheaper price than Thailand"* (Thai Oil interviewee, female).

Association of ethanol producers of Thailand confirmed difficulty of biofuels business. According to the president of association, biofuels is helpful in the period of high crude oil price:

> *"Biofuel can help a lot when crude oil price was high. But when the price decreases to US$ 30 per barrel, ethanol is much more expensive than crude oil. Ethanol is food-based fuel, so its production cost is always expensive than that of crude oil or shale gas. At this moment, biofuels is a burden than a solution"* (President of association, male).

It appears that biofuel business of Thailand O&G companies are affected by volatility of world crude oil price. However, the companies continue producing biofuel for

[8] Upstream industry of biofuel means energy crop plantation; while downstream refers to retailing of end products.

domestic consumption due to biofuel blending mandate. PERTAMINA and PETRONAS are also required to produce biofuels in a blending rate, which their national governments implemented. These two national oil companies also had trouble in running biofuel business during the period of low crude oil price and viewed that biofuel at the present was a burden. As PETRONAS interviewee explained:

> *"B10 mandate if implemented is going to be a burden. No matter we don't like or not, we have to do it. Our retail oil price is not flexible like price in Thailand. We have to set prices to meet market price if we would move towards biodiesel business"* (PETRONAS interviewee, female).

The next issue examined is views on profitability of renewable energy for electricity generation. Starting with a company which appears to have a positive view; namely Bangchak. The company received benefits from high adder rates (8 baht per kWh) for solar PV-electricity generation projects (see details on financial incentives in the section of 'National factors'). As a low-risk & low-return business, Bangchak's solar farms with a power purchase agreement for 130 MW with Electricity Generation Authority of Thailand provided substantial income for the company especially during the time of high crude oil price. As Bangchak interviewee recalled:

> *"Two years ago when the crude oil price was very high, many oil companies experienced income deficit, except Bangchak. This is because we have supplementary revenues from solar PV business. If we only run oil business, our future is not sustainable. Solar PV business depends on solar radiation, but the oil business depends on crude oil price. Solar PV helps enhance business sustainability. We view that oil will be run out, so we find alternative energy. We aim to be a 100-years old company"* (Bangchak interviewee, female).

Bangchak clearly sees renewable energy profitable and pursues green energy business as a way to enhance its business sustainability. However, this was viewed with suspicion by both PTT and Thai Oil:

> *"Strategies are choices. We choose different choice from Bangchak. At the moment no one knows who is right, who is wrong. There are supporters of choices of Bangchak, and of Thai Oil. We chose to do what we are good at. Whether or not the choice is sustainable, we have to see which organization can last in the next 50 years. Now Bangchak chose to go green. We have to consider if their business has competitiveness advantage or not. We have our own competitiveness advantage. We have learned that we cannot do everything, but only things that we are good at"* (Thai Oil interviewee, female).

> *"Bangchak's advantage is from the merit of high adder rate. Bangchak has received this financial incentive for 5-6 years already. Only 2-3 years left before the contract would finish. So after the adder scheme is finished, we can then see if Bangchak will maintain its business or not. We should see how sustainable of its business is under the FiT scheme"* (GPSC interviewee, male).

Both PTT and Thai Oil interviewees suspicious Bangchak's long-term commitment to solar PV business. The in-depth investigation in Thailand companies reveal the new finding that although companies are associated with each other, they may pursue different business strategies. More importantly, it highlights the importance of having a first mover especially in a conventional O&G business which has been operating since late 19th century (PBS, 2004). Bangchak appears to be the first mover among O&G companies in Thailand; while Total from France was perceived to be the first major O&G company who breaks from the pack and this time it will stick to renewable energy business (Macalister, 2015a). The study will discuss further on the influence of first mover and peer pressure among O&G companies in the section of Global Factors.

Despite the skeptical perception on Bangchak's solar PV business, PTT itself considers solar PV as profitable but is not yet sustainable without the state's financial subsidy. The clear example that PTT sees profitability in solar PV is an establishment of a new subsidiary, Global Power Synergy Co., Ltd (GPSC), in 2013 to run power business using natural gas and solar PV as well as to invest in energy storage technology (GPSC, 2016). Nevertheless, The GPSC interviewee explained that the company faces limitations which mostly caused by limited quota from the government to buy electricity from renewable energy:

> *"We set target to use 10% of renewable energy to generate electricity by 2019. However, because the government did not increase quota, we have to seek business opportunity abroad such as Japan and Myanmar in order to achieve the target. We recently won the lottery to install 5MW-capacity solar farm cooperative although we can install much more capacity"* (PTT's subsidiary interviewee, GPSC, male)

Thai Oil has 24% of shares in GPSC. The company interviewee viewed that renewable energy is a new trend in 21st century and a direct substitute of O&G products. So the company has closely inspected the development of low-carbon energy business. However, due to insufficient competitiveness advantage in renewable energy and smaller capital capacity than PTT, the company decided to do joint venture with PTT in GPSC rather than taking on the investment itself. Besides, Thai Oil interviewee provided an interesting view on future energy. This will be discussed in the section of views on future energy mix.

PERTAMINA also has positive views on profitability of renewable energy for electricity generation. Moreover, the company has faced similar limitations, as the national electricity company, PLN, does not yet agree with the FiT rate and prices of electricity from renewable energy. Rather than seeking business opportunity abroad as Thailand O&G companies did, PERTAMINA made a business-to-business contracts with local authorities or private companies located in small islands far away from the national grid to

sell electricity from renewable energy sources. Because of this business strategy, the future renewable energy projects of PERTAMINA is thus to install as small as 1 MW-capacity of renewable energy in various sites nationwide (see the figure 2). The conflict between PLN and PERTAMINA is elaborated in the section of National Factors.

> *"We want to make good commercial business from renewable energy. We explore solar, wind, biomass and produce power and sell to either PLN or private sector. One regular approach is through selling to the grid and get FiT. But we do not rely on this FiT only, we are also seeking other opportunities between PERTAMINA and other state owned company. In some areas, there is no grid and no electricity supply yet, so we want to cooperate with local government offices in remote areas. We can do business to supply power for them… PERTAMINA tries to sell power inside country because we have many islands."* (PERTAMINA interviewee, male)

Among five companies studied, PETRONAS is only one who viewed that renewable energy is not profitable, or to be more specific, renewable energy is not as profitable as oil and gas both in domestic and international market:

> *"Renewable energy business grows very fast but does not make good profits as O&G. O&G is dirty but make profits. For solar, people don't think that it needs a large area to install, where can we find such land?...If you have money, will you buy condominium in Kuala Lumpur and get profits or buy a house outside the city? Of course, you have to put money into the thing that will give you more profits"*(Anonymous interviewee, Malaysian, male[9]).

How the companies view on profitability of renewable energy is one of key factor influencing business strategies. On the spectrum, there is Bangchak at the far right having positive views on profitability of renewable energy business, PETRONAS at the far left viewing renewable energy as not as profitable as O&G; while PTT, Thai Oil and

[9] This interviewee required both his name and affiliate to be kept anonymous.

PERTAMINA are somewhere in between. Additionally, views on future energy mix plays important role in decision making for the long-term economic advantages of O&G companies.

6.2.3.2 Views on future energy mix

Among the five companies studied, PETRONAS appears to have a strongest view regarding the future dominance of fossil fuels, which they believe will still represent 80% of world energy mix in 2050, according to an anonymous interviewee in Malaysia. Such a view resembles that of ExxonMobil, which continuously presents its own future energy mix projection to favor fossil fuels (Associated Press, 2014; Neate, 2016b). As for Thai Oil, the company interviewee agreed that renewable energy is currently fashionable, though it is unlikely that oil industry will disappear completely from the world energy mix:

> *"Our oil business is a heavy industry. It is not like the technology of Nokia or battery that would be out of date easily. Rather, we have infrastructures that cannot be abolished easily. Also, we are improving our oil refinery so that it will be listed in first quartile[10]. In so doing, our oil business will not be replaced easily*" (Thai Oil interviewee, female).

From this point of view, Thai Oil's focus is to strengthen its core business in oil refinery; whereas PETRONAS continues with the exploration and production of oil and gas, especially LNG business, as explained earlier in the section on short-term economic advantages.

6.2.4 Compatibility of renewable energy to core expertise

O&G companies in general are engaging in biofuel production as a renewable energy source, as it aligns well with their core expertise and business as usual models. In this regard, oil companies can easily be influenced to undertake biofuel development and commercialization. Literature has recorded on-off investment in most other types of

[10] First quartile in Solomon index which is a benchmarking for energy industries (exploration & production, refining, petrochemicals, pipeline & terminals, gas processing, power generation, etc (author). See more detail in https://www.solomononline.com/about

renewable energy i.e. solar PV or wind, though almost all major O&G companies have maintained their investment in biofuels (Ferris and Gronewold;2014). In particular, this is the case of Shell, which started a joint venture in 2010 with Cosan, the world's third largest sugar producer and fifth largest ethanol producer, with $12 billion investment (D'Altorio, 2010). At present Shell advertises in its website that it is one of the largest blenders of biofuels in the world.

The incompatibility of other types of renewable energy, such as solar PV and wind, with the core expertise of O&G companies has been used as one of the main rationales for divestment (Juhasz, 2013; Elgin, 2014; Johnson, 2015). Ferris and Gronewold (2014) interviewed a former head of Chevron's clean energy subsidiary, Chevron Energy Solutions, that was the second largest solar integrator in California, on his views regarding the compatibility of solar PV with the core expertise of oil companies. The former Chevron executive pointed that “the oil companies know molecules, and solar isn't about molecules. It's about electrons”.

The argument that solar PV does not match oil companies’ core expertise seems convincing; however, scholars presented that this issue can be addressed. Miller (2013) investigated the business strategies of BP, Shell and Total in Solar PV using an innovation theory. The author showed that although solar PV does not represent the core expertise of oil companies, they can still run solar PV business through the acquisition of shares in solar PV companies. This was allegedly a better strategy than establishing an in-house solar PV section in oil companies. French oil Major-Total was the good example of this business strategy as it acquired a 60% shares of SunPower Corporation, the U.S.-based solar-panel maker, for US$ 1.37 billion in 2011 (Gold, 2011). Total chose to keep SunPower’s executive team, who were specialists in solar PV. Doing so helped Total continued its solar PV business until present; whereas Shell and BP left the industry since 2009 and 2011, respectively (Miller, 2013; Macalister, 2015a). In addition, Johnson (2015) argued that O&G companies used the incompatibility of solar PV with core expertise as an excuse not to invest in renewable energy. This is especially surprising considering the fact that companies have actually invested in non-energy business, which were certainly not part of

their core expertise. For example, ExxonMobil has invested in real estate and electric motors.

6.2.4.1 Compatibility of biofuels to core expertise

For the case of five O&G companies analyzed in the present study, all of them have invested in to different degrees in biofuels. Thailand O&G companies are relatively more enthusiastic to make biofuel investment than PERTAMINA and PETRONAS, mainly because Thailand needs to enhance national energy security by reducing oil imports. A thorough review on biofuel investment of all five O&G companies was presented in Chapter 4. PTT and Bangchak started the commercialization of biofuels earlier than PETRONAS and PERTAMINA. PTT and Bangchak started the sale of E10 since 2003, and later in 2008 E20, E85 and B2-B5 were all available in their gas stations while PERTAMINA started the sale of B5 and E3 in 2006 and PETRONAS started supplying B5 to the Ministry of Defense in 2009. PTT and Bangchak have spent substantial amounts of their budget for R&D of 2nd and 3rd generation of biofuels (both bioethanol and biodiesel). This is especially the case of PTT, which has its own Research and Technology Institute established since 1993, while PERTAMINA was reported to recently plan to establish one:

> "*We are setting up a Research and technology center which will have four focus areas: O&G (biodiesel development), Geothermal, Petrochemical, new energy and renewable energy. The center will help our company set up new business in renewable energy. At the moment R&D is now running, but in different businesses like in upstream or downstream. But all of them will be integrated into one next week, (December 2016) and report to the CEO*" (PERTAMINA interviewee, male)

PETRONAS's annual report also mentioned that the company signed a strategic alliance with Battelle, Battelle-Japan and Mitsubishi in 2007 to develop and operate a renewable energy lab in Malaysia. One of its first attempts was R&D on bio-fuels and biomass from palm oil waste (PETRONAS, 2008). However, there is no further explanation on the R&D activities of biofuels of PETRONAS in its other annual reports.

Deputy President of Malaysian Biodiesel Association (MBA) elaborated that R&D on biodiesel was mostly done by Malaysian Palm Oil Board (MPOB), which started research on the use of palm oil for car engines in 1984. As for bioethanol, "there is no organization working on bioethanol in Malaysia. No development, no research in Malaysia" (MBA Deputy President, male). Last but not least, PTT and Bangchak invested in palm oil plantation, whereas Bangchak and Thai Oil set up ethanol and biodiesel production plants. These are investment in an upstream industry that is part of the biofuel supply chain, which conventionally involves stakeholders like farmers, palm oil mill and plantation companies or sugar companies (Lim and Ouyang, 2012). Both PERTAMINA and PETRONAS did not have such upstream business. President of Asosiasi Produsen Biofuel Indonesia (APROBI) commended on the business strategy in biofuel of PERTAMINA and PTT:

> *"I think it is smart thing for PTT to secure supply through investing in palm oil plantation. Why PERTAMINA does not join us? PERTAMINA has plan and intention, but has never taken action. Their situation is like they think it is enough for them already. But they are at risk of having problem in supply, at least if they join they could have control. If not, they are at risk. From national point of view, it will be good if they join. But from a private company's viewpoint, it is good for us if they don't join*" (APROBI President, male).

Biodiesel supply could be a problem for PERTAMINA, according to an interview with the president of APROBI. However, for PETRONAS supply is guaranteed by the Malaysian Biodiesel Association (MBA). One possible explanation why PETRONAS does not take part in upstream industry of biofuel is because of the huge volumes of supply in palm oil:

> "*MBA assures that supply will not be an issue in Malaysia. So we have more than enough supply of CPO. So maybe that's why PTT has to be active in investing in supply too*" (MBA Deputy President, male).

6.2.4.2 Compatibility of renewable energy (i.e. solar PV) with core expertise

Among the five companies studied, only PETRONAS appears to view that renewable energy is not part of their business. One of the staff members interviewed at PETRONAS stated that nobody in the company perceived renewable energy as being disruptive to their business operation. However, according to an anonymous interviewee, PETRONAS's renewable energy business will lead to a conflict with the electricity company, TNB:

> *"PETRONAS is O&G company. If we do power business then we compete with TNB[11] which is the state-owned too, how could that happen? There is no government strategy to let two state-owned companies competing with each other"* (Anonymous interviewee, Malaysian, male).

The role of the state-owned O&G company and state-owned electricity company is viewed differently by PERTAMINA interviewees. For them, PERTAMINA is supplying electricity to PLN as IPPs (Independent Power Producers), thus not competing with PLN's business:

> *"PLN runs transmission grid, but we are injecting supply to the grid. We are complementing just as IPPs. We are not going into transmission business. We are competing in the open market* (PERTAMINA interviewee, male).

For Thailand's case, there is no conflict between national O&G companies and the electricity generational authority, EGAT. It is clearly that O&G companies sell electricity to the grid, which is owned solely by EGAT. Moreover, the compatibility of renewable energy in general, and solar PV specifically, to core expertise is not a problem at all for PTT and Bangchak. GPSC interviewee explained:

> *"Renewable energy is the simplest business. The coal-fired plants need a lot more human resources to run and monitor operations. But for*

[11] TNB or Tenaga Nasional Berhad is a state-owned electric utility company in Peninsular Malaysia and also the largest power company in Southeast Asia. See more detail in www.tnb.com.my

renewable energy, the operation is very simple because we do not store the power. All electricity generated will be send to the grid immediately. So the operation and monitoring is not complicated at all. Anyone can invest in solar PV business. We did not do R&D by ourselves. There are many organizations and companies doing R&D and solar PV technology has been a lot advance. We just bought such technology and hire a consulting company to help us" (GPSC interviewee, male).

An interviewee who is a Director of UniTrio Technology Limited, a solar PV installation company in Thailand, confirmed that O&G companies are not required to have expertise in solar PV to be able to run this business:

"Bangchak is only an investor. They have money and use it to hire a construction company to install solar panels. Bangchak Solar company has only a small group of engineers, no labor for construction. One of our customers is Bangchak too. They hired us to install solar panels in the roof of their gas stations. It is like real estate companies. They have money and hire construction companies or architecting companies to build houses or condominium for them" (Interviewee, Thai, male).

Lastly, Thai Oil considers that its core expertise is in oil the refinery business, though it can see the possibility of making profits from the renewable energy business. Thus, it decided to invest together with PTT in taking a 24% stake in GPSC. This strategy helps Thai Oil enhance its economies of scale in the renewable energy business and save budget when hiring new human resources. Moreover, the interviewee stated that Thai Oil would not mind to increase its investment in GPSC in the future.

6.2.5 Corporate social responsibility (CSR)

After the 2010 oil spill in the Gulf of Mexico caused by BP, the British O&G company - and the oil industry in general- faced extreme public criticism. BP was forced to sell all its less profitable business (including renewable energy businesses i.e. wind farm) in order to

obtain money to pay for the damage, which was considered the worst environmental disaster in American history (Ferris and Gronewold, 2014). After years of lawsuits, BP received a finalized court order to pay an estimated US$ 20 billion in settlement for the damages it caused to the environment and economy of five Gulf States (Kasperkevic, 2016). Moreover, regaining legitimacy for O&G industry's operation after such disaster was found very challenging (Breeze, 2012; Du and Vieira, 2012; Summerhays and de Villiers, 2012).

The 2010 oil spill caused BP to divest from renewable energy. However, it drove other oil companies to take proactive efforts in social and environmental responsibility. Chevron launched a global campaign titled "We agree" in October 2010, as a response to public concerns on the environmental impacts of oil industry. The theme of the campaign can be seen through the speech of Rhonda Zygocki, vice president of Policy, Government and Public Affairs of Chevron, "we hear what people say about oil companies – that they should develop renewables, support communities, create jobs and protect the environment – and the fact is, we agree", (Chevron, 2010). Whether Chevron takes their campaign seriously or not is one issue to be examined (Sneirson and Cherry, 2011). However, it shows that corporate social responsibility (CSR) can influence O&G companies to invest in renewable energy.

Among the five companies studied in the present work, Thai Oil has carried out a wide range of CSR activities. The company's annual reports, and especially its sustainability reports, presented the community development projects which Thai Oil has conducted alone or in cooperation with other stakeholders i.e. government authorities, NGOs and international governmental organizations. A Thai Oil interviewee also said that Thai Oil has conducted CSR activities, which are related to renewable energy development projects at the community level:

> *"Thai Oil can be green by various approaches. It is not necessary that we have to run renewable energy business. Rather, we can be green through CSR activities or enhance energy efficiency in oil refinery plants. We are taking responsibility for society and environment as CSR, not business investment*" (Thai Oil interviewee, female).

One good example of its CSR activities related to renewable energy development is Umphang Energy Town Project in Tak province, which the company launched as a tribute to HM the King on the occasion of his 84th Birthday Anniversary. The project aimed to enhance the living standard of villagers who lived far away from the power grid by setting up renewable energy development projects such as a Pico-Hydro Power plant, cooking biogas production, and biomass energy production. It is noted that Thai Oil has cooperated with various organizations, such as the United Nations Development Programme (UNDP), Ministry of Energy of Thailand, and Energy for Environment Foundation (E for E), in launching renewable energy development projects in rural areas of Thailand.

6.2.6 Lesson learned from past experiences in renewable energy business

Prior losses in renewable energy business can discourage O&G companies from investing in renewable energy (Kolk and Levy, 2002; Davis, 2006; Penha, 2011). ExxonMobil referred to their huge loss in the 1970s as a reason why they do not invest in low-carbon energy. Scholars then pointed to changes in the US policy as a main cause for the company's losses in the renewable energy business. To address the first oil shock in 1973, President Richard Nixon and Jimmy Carter's administration in 1974-1980 period gave strong financial support on R&D for energy research, but those funds were cut off by President Reagan's Administration in 1981 (Johnson, 2015). Shell is another company that experienced losses in the solar PV business. Shell CEO recently expressed that the company "had learned a painful lesson with a previous foray in photovoltaics that taught the company that petroleum geologists did not make the best electrical engineers" (Macalister, 2016c). However, such losses may not be only due to the company lacking expertise in solar cells, but could be also because of the poor management strategies Shell used to run such a novel innovative technology, as Miller (2013) indicates.

Among the five companies, only PTT was reported to have experienced a loss in the biofuel business. In 2007 PTT established a subsidiary called PTTGE to oversee the palm oil business in Kalimantan, Indonesia. However, PTT's annual report in 2014 stated that PTTGE had experienced losses from impairment of operating assets, amounting to 2,816 million baht. The palm oil plantation project was considered 'costly and unprofitable' and

finally the company decided to sell 95% of its shares of Mitra Aneka Rezeki (MAR), the subsidiary of PTTGE established to operate PTT's palm plantation and palm-oil refinery business in Indonesia, to Prasada Jaya Mulia (The Nation, 2014). Despite the previous losses and current low crude oil prices, PTT maintains its biofuel production due to a government biofuel mandate. This also applies to Bangchak, ThaiOil, PETRONAS and PERTAMINA.

As for the solar PV business, none of the five companies have reported making a loss yet. Rather PTT and Bangchak are expanding their solar PV business abroad to address limited power purchase quotas from the government of Thailand. PERTAMINA perceives the potential economic profits that could arise from selling electricity that is generated by renewable energy to private sectors and local governments in small islands far away from the national grid. Lastly, PETRONAS runs a solar farm with a relatively small capacity (10MW). The company interviewee did not mention whether the project makes a profit or not, or whether they plan to make other future investment plan in solar PV.

To conclude, in the biofuel business a previous experience of making monetary losses does not seem to have an impact on the five companies' biofuel production, as they have to comply with their national government blending mandates. However, in the solar PV business no companies have experienced losses yet. Thus, more time is required to see what will happen to these developments.

6.2.7 View on global climate change

Views on global climate change of O&G companies have been evolving from solely hostile to more accepting and willing to take part in mitigation efforts. In 1989 major O&G companies in the USA formed the 'Global Climate Coalition', a lobbyist organiation aimed at lobbying US Congress not to pass the regulation on greenhouse gas emissions reduction (Kolk and Levy, 2001). The Global Climate Coalition (GCC), together with American Petroleum Institute (API) acted against mandatory climaet change policy at the US and international community by applying two attacking stargeties: "raising questions about and undercutting the prevailling scientific wisdom on climate change in order to cast doubts in the mind of the public and policy-makers on the existence of a problem, and attacking the

policy proposals on economic grounds" (van den Hove et al., 2002, p.5). The GCC started to lose its lobbying power when some of its members decided to leave the group. British Petroleum (BP) was the first company who withdrew from the GCC in 1996, followed by Royal Dutch Shell in 1998; while US-based major oil companies such as ExxonMobil continued to participate until the end of GCC in 2002 (Kolk and Levy, 2001). After the adoption of Kyoto Protocol in 1997, the world has witnessed an increasing divergence of corporate responses to climate change of European and American multinational oil corporations, forming the 'Trans-Atlantic divide', as Rowlands pointed out in his article titled "Beauty and the Beast? BP' and Exxon's position on global climate change" (Rowlands, 2000).

The situation in the 2010s seems to be the same with early 2000s. Harvey (2016) reported that a study of the Carbon Disclosure Project examined eleven O&G companies and concluded that North American companies are less green than European ones. ExxonMobil has maintained its opposing position to climate change (The unrepentant oilman, 2003), as can be seen from the speech of Former CEO Rex Tillerson, who commented that "models predicting effects of global warming aren't very good and that it would be very hard for the world to meet aggressive emission reduction targets. Technologies can help deal with rising sea levels or changing weather patterns that may or may not be induced by climate change. Mankind has this enormous capacity to deal with adversity" (Associated Press, 2015). On the contrary, European-based companies tend to be more accepting of the notions of global climate change. One example is an interview of a head of sustainability at Statoil, "Statoil doesn't debate climate science, we act on it. We recognize that coal, oil and gas are major contributors to the world's total GHG emissions" (Sverdrup, 2015).

The different views on global climate change leads to a difference in business strategies. The hostile view on global climate change leads to reactive corporate responses and vice versa. All five companies studied in the present research were found to agree with climate science and to internalize climate change mitigation activities into their operations,

according to their annual reports and sustainability reports. PTT's annual reports explicit stated that the oil consumption is a cause of global warming:

> *"Investment in this area (oil palm plantation) was made through PTT Green Energy Co., Ltd. (PTTGE), (…) in the production of biodiesel as an alternative energy in line with the government policy on alternative energy and reduction of global warming caused by oil consumption"* (PTT, 2010).

It would be unlikely that ExxonMobil would agree with such a statement, as its CEO Rex Tillerson kept downplaying the threat by global warming:

> *"It's an engineering problem, and it has engineering solutions. The fear factor that people want to throw out there to say we just have to stop this, I do not accept"* (McKibben, 2017).

It is noted that although the companies agree that global climate change is real, their actions are not necessary in line with renewable energy investment. As the IPCC's fifth assessment report 2014 illustrates, there are a wide range of climate change mitigation activities that the energy sector i.e. O&G industry, can pursue. These vary from basic ones such as GHG measuring and reporting, GHG emission reduction targets, energy efficiency, switching to using gas, flaring-venting reduction, as well as reforestation to increase carbon sink. The diversification from fossil fuels to low-carbon energy is more ambitious, and not many O&G companies choose to follow (Chaiyapa et al., 2017). An anonymous interviewee from Malaysia elaborated the complexity of this issue by saying that we have to balance geopolitics, climate change, and poverty reduction. Thus, only agreeing on global climate change is not influential enough for O&G companies to diversify their energy portfolios. In addition, some of the five companies studied viewed that global climate change mitigation agreement will not be as serious as expected. This is going to be discussed in the section of Global Factors.

6.3 National factors

6.3.1 National policies on climate change and renewable energy development

The majority of O&G companies are multinational as they have business operation in many countries. However, as Skjærseth and Skodvin (2009) proposed, multinational oil corporates can be affected by the politics of the host countries, but the most influential factors are to be found in the companies' home countries where they have their historical roots and headquarters, as well as most of their business activities. The national government policies in home countries of O&G companies are thus a key factor in shaping corporate responses to climate change mitigation. A number of scholars studied what caused the divergent climate change strategies of US and EU-based O&G companies and concluded that it was mainly because the European governments implemented more stringent regulations and policies than the US government did (Sethi and Elango,1999; Levy and Newell, 2000; Rondinelli and Berry, 2000; Kolk and Levy, 2001; McCright and Dunlap, 2003; Kolk et al., 2008). James Watson, CEO of SolarPower Europe, commented that it could have been that it was the strong push from the French government what made Total – a French O&G company- engage itself in solar PV business (Macalister, 2016d).

On the other hand, climate change scholars and environmentalists are concerned that American companies will be even more opposing to the climate change mitigation efforts in the future, as the new US President Donald Trump clearly expressed his skepticism in global climate change issues and said he wanted to pull the US out of the Paris agreement (Harvey, 2016). Apart from major western O&G companies, Penha (2011) studied a wider variety of O&G companies, including NOCs from China, Russia and Saudi Arabia. The author concluded that companies whose national governments implemented climate change policy and set renewable energy targets are likely to be more active in renewable energy investment than those whose governments do not have such policies. As for the five O&G companies analyzed in the present thesis, their national governments have both implemented climate change policies and renewable energy development policies. The present study discusses each how each particular policy affects the corporate strategies of those five companies.

6.3.1.1 National climate change policy

The government of Thailand, Malaysia and Indonesia have been active in climate change mitigation efforts both at international and regional organizations. They have recently submitted their Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) declaring their GHG reduction targets and already existing policies to promote clean and renewable energy in their energy mix. Thailand intends to reduce GHG emissions by 20% from the projected business-as-usual (BAU) level by 2030, Indonesia will reduce 26% of its GHG emissions against BAU scenario by 2020 and Malaysia aims to cut down its GHG emissions intensity of GDP by 45% by 2030, relative to the emissions intensity of GDP in 2005 (INDC, 2015, 2016). At the regional level, the three countries are member states of Association of Southeast Asian Nations (ASEAN), which initiated various regional climate change efforts i.e. ASEAN Socio-Cultural Community (ASCC) Blueprint 2009-2015 and ASEAN Action Plan on Joint Response to Climate Change (ASEAN cooperation on environment, 2015).

However, what was said at the international level can actually be different to what is actually done. The interviewees from Malaysia and Indonesia argued that their governments are not so serious as they seem with their commitment in GHG emissions reduction.

> "*Look at our climate change policy, PM said commitment, but then started coal-fired plants and it will increase the energy mix of coal power plants. So you can see how serious of government is about climate change. The main constraint is at government policy*" (anonymous interviewee, Malaysian, male).

Similarly, PERTAMINA interviewees voiced their opinions:

> *"The Indonesian people need more energy and we need to find the supply. The government is pushing to explore more reserves; they do not look at the climate mitigation. The more oil and gas is the better. Because the demand is high"* (PERTAMINA interviewee, male).

PERTAMINA and PETRONAS perceived that their national governments are concerned more about how to achieve national energy security from cheap and available energy sources. Unclear messages from the governments regarding climate change mitigation appears to be a signal for O&G companies to maintain their business as usual behavior relating to fossil fuels production. Interviewees from Thailand O&G companies did not raise any comments regarding national climate change policy, and their main concerns appear to relate to renewable energy development policy and incentives from the government.

6.3.1.2 National renewable energy development policy

Just like climate change policy, Thailand, Malaysia and Indonesia have implemented renewable energy policies and set the targets to increase the uptake of low-carbon energy in their national energy mix. The present study separately discusses the biofuel mandate and policy on renewable energy for electricity generation in order to illustrate the complexity of O&G corporate responses to government policies.

- ***Biofuel mandate***

Thailand, Malaysia and Indonesia have biofuel mandates, which were introduced in different years and include different blending rates. Further information on biofuel mandates for each country are presented in Appendix G. Due to this biofuel mandate, all oil companies (national and foreign) have to comply and commercialize biofuel products at their service stations. However, implementation is not as smooth as could be expected, and interviewees from each of the three countries expressed difficulty in various matters related to policy implementation.

PTT interviewee provided an opinion regarding how biofuel mandates from the government promotion of biofuels became a burden of the company. Regardless of this, the company was forced to comply because this is a government mandate:

"The government prohibits the import of palm oil and ethanol. They want us to use domestic supply to help farmers, although imports are cheaper than domestic products" (PTT interviewee, male).

Thai Oil interviewee explained that the company started biofuel production because of government policy. Also PTT, a main shareholder, assigned Thai Oil to carry out the project. However, at present the company is experiencing limitations in its biofuel business, as explained earlier in the section on the profitability of renewable energy.

Bangchak was the only one company that explained that the company did not invest in biofuels because of government policy. Rather, the company acted ahead of the government's policy and started its biofuel projects voluntarily:

"Other oil companies compulsorily produce biofuels. Bangchak is the opposite. We were the ones who convinced and encouraged the government to promote biofuel. We helped in pilot projects. Once the result was satisfying, the government then implement a mandate. Thai Oil and PTT have to comply with policy. But Bangchak invests in biofuel voluntarily" (Bangchak interviewee, female).

An interviewee who is a former Director General of Department of Alternative Energy Development and Efficiency in Ministry of Energy confirmed the statement of the Bangchak interviewee. In his opinion, Bangchak conducted its business taking into account social and environmental responsibility, and that its renewable energy investment was more advanced than that of other oil companies, as it was conducted on voluntary basis while other companies were forced to do so.

PETRONAS was reported to be reluctant to comply with the biofuel mandate of Malaysia. At the beginning, PETRONAS, together with other oil companies operating in Malaysia, argued that they did not have facilities for blending biodiesel. The government provided funds to construct those facilities, as the Deputy President of Malaysian Biodiesel Association (MBA) explained:

"We have 5 petroleum companies in Malaysia. All oil companies did not want do the biofuels, claiming that they didn't have facilities, so the government have to pay some. Then the oil companies did not have choices, but to follow the mandate. Palm oil companies pay tax to MPOB[12] *which use the money to build the facilities"*(Deputy President of MBA, male).

The difficulty in making PETRONAS comply with biofuel mandate was confirmed by President of APROBI, an association of biofuel producers of Indonesia. In addition, he compared PERTAMINA with the other two NOCs in term of compliance with the biofuel mandate:

"It is really difficult to control PETRONAS. To convince them, Ministry of Plantation brought PETRONAS to see the biodiesel operation in Indonesia, like blending facilities, etc. PERTAMINA is easier to join biodiesel. But PTT is the easiest; I think it is because PTT realized they have to do" (President of ARPOBI, male).

Lastly, the government authority in Biofuel Division, Ministry of Plantation Industries and Commodities Malaysia revealed some insight about PETRONAS's reaction towards the B10 mandate. Apart from low-crude oil price and high palm oil price, PETRONAS's reluctance to comply with the mandate was another reason of the delay in introducing the B10 mandate, which was originally scheduled to start in 2016. However, at the time of writing this thesis (May 2017), Malaysia still cannot put the B10 mandate into practice.

"PETRONAS and other O&G companies signed the letter together telling the government that they needed more time and needed a new facility in order to blend B10. This seems not correct, because the government

[12] Malaysian Palm Oil Board (MPOB)

thought the current blending facilities can use with B10 too. No need to build new plants" (Government authority interviewee, male).

- ***Policy on renewable energy for electricity generation***

The government of Thailand, Malaysia and Indonesia are aware of their high dependence on fossil fuels. To address this, they launched a renewable energy master plan with targets to increase the uptake of renewable energy in their national energy mix. Table 22 presents the main information on renewable energy policy of the three countries (APERC, 2016; interview data from Malaysia and Indonesia).

Table 22 Renewable energy policy of Thailand, Malaysia and Indonesia

Country	Policy name	Targets of RE	Financial scheme	Government office in charge of RE policy
Thailand	• Alternative Energy Development Plan (2015-2036) • Power Development plan (2015-2036)	• 30% of over all RE in final energy consumption • 15-20% of RE in electricity generation	• Adder rates (2007-2014) • FiT(started in 2014)	Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy
Malaysia	• Renewable Energy Act 2011 • 11th Malaysia Plan (2016-2020)	• 3% RE for electricity generation • Target RE (FiT) capacity of 2,080 MW	• 1st Dec 2011 collected 1% levy from electricity bills, changed to 1.6% levy since Jan 2014 • will not affect 75% of electricity consumers (≤ 300 kWh/month will not pay levy)	Sustainable Energy Development Authority of Malaysia (SEDA)
Indonesia	• National Energy Policy (2014)	• New and renewable Energy at least 23% in 2025 and at least 31% in 2050 • Target for RE in power generation is unclear.	• FiT (2016 still in revision to adjust FiT prices) • May use other schemes i.e. reduce tax for IPPs	Directorate General of New, Renewable Energy and Energy Conservation (DGNREEC),Minster of Energy

Table 22 shows that Thailand and Malaysia have set the targets of renewable energy for power generation, though Indonesia does not yet have a clear target. However, company

interviewees and government interviewee in these three countries expressed the limitation of government incentives and quotas to buy power from renewable energy.

An interviewee from GPSC, a subsidiary of PTT running power business, mentioned that the company cannot participate in the Competitive Bidding Method which the government used to select a winner for the power purchase agreement (PPA). This is because the status of company as being a state-owned company. As a result, PTT through GPSC had to conduct a joint venture with another solar PV company, who won the bidding. In addition, the government changed to promote solar rooftop instead of solar farms, due to insufficient transmission line and limited renewable energy funding. GPSC had to cancel the solar farm project in the southern province. Moreover, GPSC set a business target to have 10% of power generation from renewable energy by 2019, yet they may have to revise the target or otherwise start seeking business opportunities abroad to meet the target. GPSC already participated in a joint venture in the 20.8-MW Ichinoseki Power 1 in Japan. Asked why choosing Japan, GPSC interviewee referred to the Japanese energy policy, which promotes renewable power generation after the 2011 Tohoku Earthquake tsunami. The Ichinoseki Power project is enjoying the former Japanese government FiT rate at 42 yen/kWh, which is higher than the current FiT tariff of 26 yen/kWh.

Similarly, Bangchak, even though it has a power purchase agreement for 130 MW under adder rates through its subsidiary-BGPC, is expanding its solar PV business in Japan. According to the company website, a 30MW capacity solar PV project is already in commercial operation and another 164 MW capacity project is under development (BCPG, 2016). Both PTT and Bangchak were encouraged to enter the solar PV business by Thailand national renewable energy policy. However, the two companies have gone beyond the national policy in their home country and utilized the national renewable energy policy of a host country, in this case, Japan.

PERTAMINA interviewees explained the current problem with the FiT scheme and their business strategy to conduct renewable power generation with other partners without relying on FiT. Government authorities from the Directorate General of Gas and Directorate General of New, Renewable Energy and Energy Conservation (DGNREEC),

Minstry of Energy provided explanation on the problems related to the FiT scheme. According to them, PLN, a state-owned utility company, does not agree with current prices in FiT (which was designed by DGNREEC), saying that the price of the electricity generated through it is too expensive. Power generated by coal and gas is cheaper than renewable power generation. The DGNREEC government authority said that the office is considering revising the 2016 FiT rates, which are likely to become lower in the future. However, DGNREEC interviewee herself disagreed with such idea as it will not attract investors. In addition, because the budget to subsidize renewable power generation would come from the Ministry of Finance, DGNREEC is trying to cooperate with Ministry of Finance to find better finance incentives, such as tax reduction for IPPs.

The root cause of this problem, as pointed out by Indonesian government interviewees, appears to lie in an insufficient level cooperation and communication between ministries. Only in the case of FiT for renewable power generation, there are at least three ministries involved: Ministry of State-owned Enterprises in charge of policy of PERTAMINA and PLN, Ministry of Energy and Mineral Resources in charge of national energy policy and FiT scheme, and Ministry of Finance in charge of financial budget for FiT. In addition, geothermal energy development of Indonesia has faced similar difficulties. Despite the country having started upstream geothermal industry since the 1970s, Indonesia is not yet utilizing its huge geothermal potential, which could be as high as 29 GW (see Table 23). A government official from the Directorate General of Geothermal, Ministry of Energy and Mineral Resources, explained the difficulties involved in geothermal development in Indonesia. In his opinion, the lack of good cooperation among ministries has caused a delay in utilizing the huge geothermal potential of the country:

> *"Challenges of renewable energy development in Indonesia, in particular geothermal energy, is that many ministries do not communicate well. Such as the price, the tender and the upstream regulation. We have to talk with Ministry of State owned Enterprises (SOE), so that they will push PLN to buy power from renewable energy, and we have to talk with Ministry of Finance about the price, but so far do not coordinate well, Ministry of*

Forestry and Environment will design the guideline regulation for upstream sector of Geothermal, and we are waiting for this guideline. All these problem are the same with last ten years" (Government interviewee, male).

The situation of the FiT scheme in Malaysia is also challenging. The government official from the Sustainable Energy Development Authority of Malaysia (SEDA) explained that the renewable power generation depends on the renewable energy fund, which comes from a levy in electricity bills. Each month households that consume more than 300 kWh will pay a levy at 1.6% of their electricity bills. This amount is very small because over 75% of household use less than 300 kWh of electricity. SEDA official explained that because of limited funds, the renewable energy targets cannot be increased. Also, the government does not want to raise levy rates in electricity bills for fear of increasing the burden on the public. The FiT scheme for other renewable energy sources is still available until 2018, but for solar PV the quota is finished. SEDA has changed to use net metering mechanism since November 1, 2016 to subsidize solar PV.

PETRONAS installed a 10MW solar farm in Gebeng, receiving FiT from SEDA. However, there are complaints over big companies getting too large shares of the solar PV quota. SEDA allocated 65 MW quota for solar PV power generation; however, if it granted a 5MW or 10MW power purchase agreement to a few big companies, then small and medium companies cannot enter the business (The Green Mechanic, 2014). Currently, the limited quota and funds for renewable energy generation do not seem to be ideal for PETRONAS. However, PETRONAS interviewees omitted giving an opinion on current and future plans in solar PV, and their annual reports also do not provide any other information.

6.3.2 Countries' O&G reserves and renewable energy resources

Existing literature recorded that around 1960s-1970s IOCs started experienced decreasing or shortage of O&G reserves because of a rise of nationalism in oil producing nations (Csomos, 2014; Johnson, 2015). O&G reserves in countries where IOCs operated were taken back by the host countries' governments. NOCs were established to manage

their own national O&G reserves. Such shortages drove IOCs such as ExxonMobil and Shell to diversify their business into the non-oil sector. Since over 90% world O&G reserves are occupied by NOCs, in particular those from OPEC countries, some IOCs from western countries started to explore and produce O&G in highly risky and environmentally fragile areas i.e. Shell's plan to drill for oil in the Arctic (Barrett and Elgin, 2015; Critchlow, 2015). Having bigger O&G reserves can be one factor discouraging NOCs to invest in renewable energy. Penha (2011) observed that NOCs with huge reserves such as Saudi Aramco (Saudi Arabia), NIOC (Iran), PDVSA (Venezuela) and CNPC (China) did not invest or made less investments in renewable energy. However, the low crude oil price in 2015-2016 caused oil producing countries to suffer budget deficits and turn in the direction to low-carbon energy i.e. solar PV and wind (Goldenberg, 2016). In particular, those in Middle East and North Africa (MENA), which has plentiful sunshine and enormous amount of white sand, have a great potential to start up solar PV businesses (Renewable energy, 2015). Having national renewable energy resources is thus another important factor for O&G companies to turn to green energy investment.

Table 23 presents O&G reserves, status in O&G trading and renewable energy potential of Thailand, Malaysia and Indonesia. Among these three countries, Thailand has the least O&G reserves; whereas Malaysia and Indonesia have richer reserves, especially in gas sector, as both of them are world leading Liquefied Natural Gas (LNG) exporters. Lower O&G reserves appears to be a factor that influences O&G companies in Thailand to be more active in searching for alternative and renewable energy than Malaysian and Indonesian companies. PTT and Bangchak started the sale of biofuels at their service stations since 2003, followed by PERTAMINA in 2006 and lastly PETRONAS in 2011. The same story applies to solar PV, PTT installed solar rooftops since 2007; whereas PETRONAS -with funding from Mitsubishi corporation- only installed a solar rooftop of Suria KLCC shopping mall in 2011.

Depleting O&G reserves changed the status of Indonesia, which went from being an oil producing nation to a net importer in 2005. The country used to be only one Southeast Asian country which was a member of OPEC. This held true until 2008, when Indonesia

decided to leave OPEC because it could not meet production quota. Such a change caused the Indonesian government to seriously consider developing alternative and renewable energy in the country. The president of Asosiasi Produsen Biofuel Indonesia (APROBI) recalled that biofuel development started to be considered more seriously since the country became a net oil importer:

> *"Bioenergy was started in 1980s but only in the labs and research centre. In 2005 we started again, because at that time we became a net oil importer. This fact shocked us, because we thought that we were rich in oil reserve. After independence and we got national revenue from oil production, especially get high income during oil shock in 1970s. We used that money to develop schools and clinics. Every village has the clinic using money from the oil revenue. So when 2005, we were so shocked to find that we need to import oil. The government started the idea of using biofuel. And we formed the association"* (President of APROBI, male).

PERTAMINA interviewee affirmed the company's mission to supply energy for the country. The mission is vital as the country experiences decreasing O&G reserves.

> *"The first rationale is our reserves are depleting. The reserves are not balancing: finding new reserve and exploiting reserve is not balance. We already become net importer for oil, soon we will be net importer of gas. We want to increase sustainability of energy in Indonesia. Renewable energy is part of our obligation for our next generation*" (PERTAMINA interviewee, male)

Malaysia's national context appears to be opposite to Thailand and Indonesia. With relatively greater O&G reserves, in particular gas, PETRONAS has the least active investment in renewable energy amongst the five O&G companies studied. PETRONAS

interviewee provided the relation between O&G reserve and renewable energy development.

> *"If your backyard still has a lot of reserves, what will you do? You want to invest RE?"* (PETRONAS interviewee, female).

However, the blessing that Malaysia possesses regarding its O&G reserves can be a double-edged sword. A Malaysian researcher on energy policy at the Asia Pacific Energy Research Centre (APERC) commented that having rich reserves delays the country in searching for alternative energy and that Malaysia people needed to change their mindset about O&G reserves for sustainability of the country.

Table 23 Oil and gas reserves and years of production (from 2014), national status of O&G trading, and renewable energy potential of Malaysia, Indonesia and Thailand

Countries	Gas proven reserves (tcm)	Years of production	Oil proven reserves (billion bbl)	Years of production	Status in O&G trading	Renewable energy resources
Malaysia	1.1	16	3.8	15	• Net gas exporter World second-largest LNG exporter in 2013 • Net oil importer since 2013 (APERC, 2016)	• 39% of world palm oil production (MPC, 2014) • Solar potential radiation 4.5 kWh/m^2 (Bakhtyar et al., 2013)
Indonesia	2.9	39	3.7	12	• Net oil importer since 2005 • Net gas exporter World seventh-largest LNG exporter (IEA, 2013)	• Geothermal 29 GW • Hydro 75 GW • Wind 62 GE of commercial potential • Biomass for electricity 33 GW • Solar potential irradiation between 2.6-5.8 kWh/m^2 **Theoretical potential** • Ocean wave 142 GW • Ocean thermal 4.2 GW (APERC, 2016)
Thailand	0.46	2.8	0.24	5.7	• Net oil importer • Import 20% of gas, 80% domestic production (EPPO,2015).	• Biomass potential 7000 MW • Biogas potential 278 MW • Solar potential irradiation 5.1 kWh/m^2/day • Wind potential (7–8 m/s): 3000 MW (8–9 m/s): 52 MW • Geothermal potential 5.3 MW (Bakhtyar et al., 2013)

6.3.3 Social demand for environmental conservation

Scholars that studied the causes of the difference in corporate responses to climate change mitigation between EU and the US-based O&G companies proposed that the perception of the public is another key factor that can influence O&G companies to take proactive response (Skjærseth & Skodvin, 2009). European people showed great concerns on environmental issues, whereas American are more individualist and concerned on their lifestyle (Levy and Kolk, 2002). It is also expected that pressure on O&G companies to take environmental responsibility would become less under the presidency of Donald Trump and a Republican-dominated Congress. (Harvey, 2016). Although president Trump has –at the time of writing this thesis- not fulfilled his election promise of withdrawing from the Paris agreement, his selection of former ExxonMobil CEO Rex Tillerson to be a secretary of States worried many about his policy toward global climate change agreement (McKibben, 2017) The public perception and social demand for environmental conservation is an important factor for influencing the behavior of corporations. However, in the present study only a few interviewees mentioned about NGOs and public perception. The first one was PTT interviewee. In his opinion, Thai NGOs actively opposed many energy-related projects such as coal-fired plants and dam construction, but they have never criticized the biofuel production:

> *"Usually NGOs will protest when energy prices increase. At present, the government employ oil fund to pay for the gap between high biofuel production costs and retail prices. As long as the retail prices are not expensive and the price-intervention policy is working, NGOs will not do protests"* (PTT interviewee, male).

Similarly, a Malaysian interviewee pointed that the civil society is not a key player in pressuring the government to change policies. This means further that the public cannot have an impact on corporate strategies of PETRONAS since the government, and especially the Prime Minister, has a direct say in PETRONAS's decision and strategies.

"Civil society in Malaysia is not yet established. The awareness on climate change is not so widely. We need to educate people. Environmental concern is growing such as the public disagreement on nuclear. We have some NGOs like CETDEM doing work to raise public awareness" (Anonymous interviewee, male).

The Executive Director, Centre for Environment, Technology & Development Malaysia or CETDEM was also interviewed. According to him, his organization is not supporting the use of palm oil-based biodiesel. This is because when palm oil prices go up, the food prices would increase, affecting consumers' living cost. In addition, the palm oil industry is influential and his organization is concerned on environmental issues caused by the industry.

The viewpoint that the CETDEM interviewee shares with the PTT interviewee is that the price of commodities and food are important for people in Malaysia and Thailand. This reflects the primary social concern of developing countries in Southeast Asia relates to the economic sides of the problem. However, environmental concerns, which are an important factor in steering corporate strategies of O&G companies toward green energy investment, is not yet well- established in the three countries studied.

6.3.4 Business-government relation

The O&G companies examined in existing literature are mostly western IOCs. As a result, the literature investigates business-state relationships as if each of them is a separate entity. Theory on business-state relation proposes two scenarios: either the state actively serves business interests (business can influence government policy) or the state maintains neutrality and independence from business interests (Skjærseth and Skodvin, 2009). However, the case studies in this research are National Oil Companies (NOCs) and associates of NOCs. Thus, O&G companies studied and their respective national governments cannot be viewed as a separate entity. As would be seen in the following section, the governments of Thailand, Malaysia and Indonesia have involved in these five O&G companies' decision-making and strategies to a various degree.

For PTT, Thai Oil and Bangchak, some of the companies' board of directors are high-ranked government officials. However, interviewees currently working at Department of Alternative Energy Development and Efficiency were reluctant to conclude that their affiliation represented a conflict of interest, as such practices are common in Thailand. Rather, they proposed that it could increase companies' compliance with the government's renewable energy development policies. An interviewee who is a former Director General of Department of Alternative Energy Development and Efficiency in Ministry of Energy, recalled the time when he served as a Director in the Board of Bangchak and PTT. According to his interview, he encouraged Bangchak to expand its business in biofuels by increasing the number of service stations offering E85, though he failed to convince PTT as there were many directors in the Board.

An interviewee from PTT raised different concerns, saying that having the regulator be part of the regulated entities could be viewed as unfair by foreign investors, "it is just like you play soccer but the referee is the owner of your competitor". Nevertheless, the PTT interviewee concluded that for Thailand's specific context it seemed good to have Board of Directors from government authority i.e. Ministry of Energy and Ministry of Finance, as they know well PTT's business and provide good governance.

PETRONAS is clearly tied with the government. First of all, it is owned 100% by the government through the Ministry of Finance. Secondly, PETRONAS's CEO and Board of Directors report directly to the Prime Minister of Malaysia according to Petroleum Act 1974 (PETRONAS interviewee, 2016). Although the government officials do not serve as a director of PETRONAS, every board member is appointed by Prime Minister, who has the absolute right to appoint or remove every member of PETRONAS's executive management (Goldstein, 2009). The government, or specifically the Prime Minister, is thus one of the sources of PETRONAS's decisions and strategies. Unfortunately, the government of Malaysia has not yet prioritized environmental issues. An anonymous interviewee from Malaysia highlighted this fact:

> *"IOCs face pressure from shareholders, but NOCs like PETRONAS face government. What government orders, we follow that. Main driver of*

government is economic and politic not environment yet" (Anonymous interviewee, male).

PERTAMINA is also 100% owned by the government. However, the company is not so closely connected to the government as PETRONAS is. A PERTAMINA interviewee explained that they also have Board of Directors, a Board of Commission and shareholder meetings. The Board of Directors decide what the company strategy will be. Unlike PETRONAS, PERTAMINA does not report to the President but to Ministry of State Owned Enterprises (MSOE). While the Malaysian Prime Minister may be viewed as having too much control on PETRONAS, the President of Indonesia is expected to employ more of his power. The high-ranked government official working in the Directorate General of Gas gave an opinion on how to solve the lack of cooperation among ministries, which many have perceived as one of the main causes of why renewable energy is under-development in Indonesia:

"The lacking of clear concreate government policy is the main obstacle, too many bureaucracy, too many licenses, common issues is the communication problem among ministries. For example, Ministry of Finance has different view, they want to make profits, generate money, so they want to put tax on renewable energy too, but to promote the new technology is to provide tax exemption etc. There are two options to solve this problem, either the President himself or coordinating Ministry. If the President has clear view on renewable energy, it will be helpful for renewable energy development, only he can tell the minsters to work together. Under the current President is good, if he is informed well, he will address the problems" (Government interviewee, male).

6.4 Global factors

6.4.1 Volatility of world crude oil prices

World crude oil prices is a major factor influencing O&G corporate business strategies regarding renewable energy investment. However, the relationship between crude oil price and renewable energy investments of O&G companies is very complex. During the oil shocks in 1973 and 1979, oil prices increasingly drove the governments of OECD countries to provide a strong support for R&D in alternative energy in order to lessen their dependence on oil imports from the Middle East (Johnson, 2015). As a result, major western O&G companies invested in renewable energy. However, once the crude oil prices became very low in 1986, O&G companies lost their interest in alternatives to oil and shut down their low-carbon energy projects (Davis, 2006). The recent low crude prices during 2015-2016 provided a different picture. Oil producing countries, such as Middle East countries, Russia, and Jordan, suffered from the low crude oil prices and encouraged a shift to green energy i.e. solar PV and wind (Walker et al., 2015; Renewable energy, 2015; Black and Macalister, 2016; Goldenberg, 2016). Thus, it is argued that the oil prices in 21st century did not affect the renewable energy investment of O&G companies in the same way they did in the past, and that oil prices are not linked with renewable energy investment, especially in the power generation sector (Hering, 2014; Goldenberg, 2016). In addition, the crude oil price is not the sole factor that influence corporate business strategies. ExxonMobil has held a long-term vision that future energy mix composition will be dominated by fossil fuels, and perceived that renewable energy was not economic; thus, the company continues their core business in O&G despite the recent sharp slump in crude oil prices (Associated Press, 2014).

The volatility of world crude oil prices affected the five O&G companies analyzed in the present research in a different way. Other factors such as views on short-term and long-term economic advantages, national context i.e. O&G reserves of the country, have to be taken into account to see how low or high crude oil prices changed O&G corporate strategies. In addition, the study found that the biofuels business was affected by the world

crude oil prices (see Figure 10[13]), while investment in other renewable energy sources such as solar PV appears to be linked with costs and developments in that technology. This section will discuss the relation between crude oil prices and the biofuel investments of five O&G companies from Thailand, Malaysia and Indonesia.

Firstly, based on the review on biofuel investment projects of PTT, Bangchak, Thai Oil, PERTAMINA and PETRONAS (as presented in Chapter 4), the study found that changes in world crude oil price affected the degree of action on biofuels. As Figure 11 shows, during the high crude oil prices in 2007-2008 (the peak was in June 2008, at US$ 156.34 per barrel) there were many biofuel development activities taking place (Macrotrends, 2017). On the other hand, during the crash in crude oil price during 2015-2016 (the lowest point was in January 2016, at US$ 29.38 per barrel), the number of biofuel development decreased, and PTT even experienced losses in their palm oil plantation business, which was shut down (with its R&D on algae-based biodiesel also being shut down).

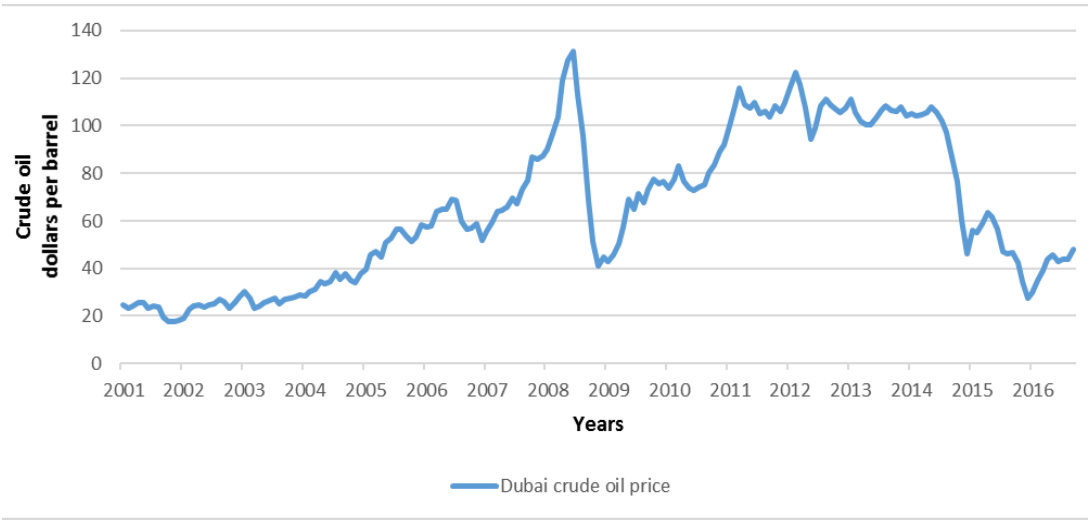


Figure 10 Dubai crude oil prices from 2001-2016 (raw data was obtained from Macrotrends, 2017)

[13] The research applied Dubai crude oil price as Southeast Asian countries import oil from Middle East the most.

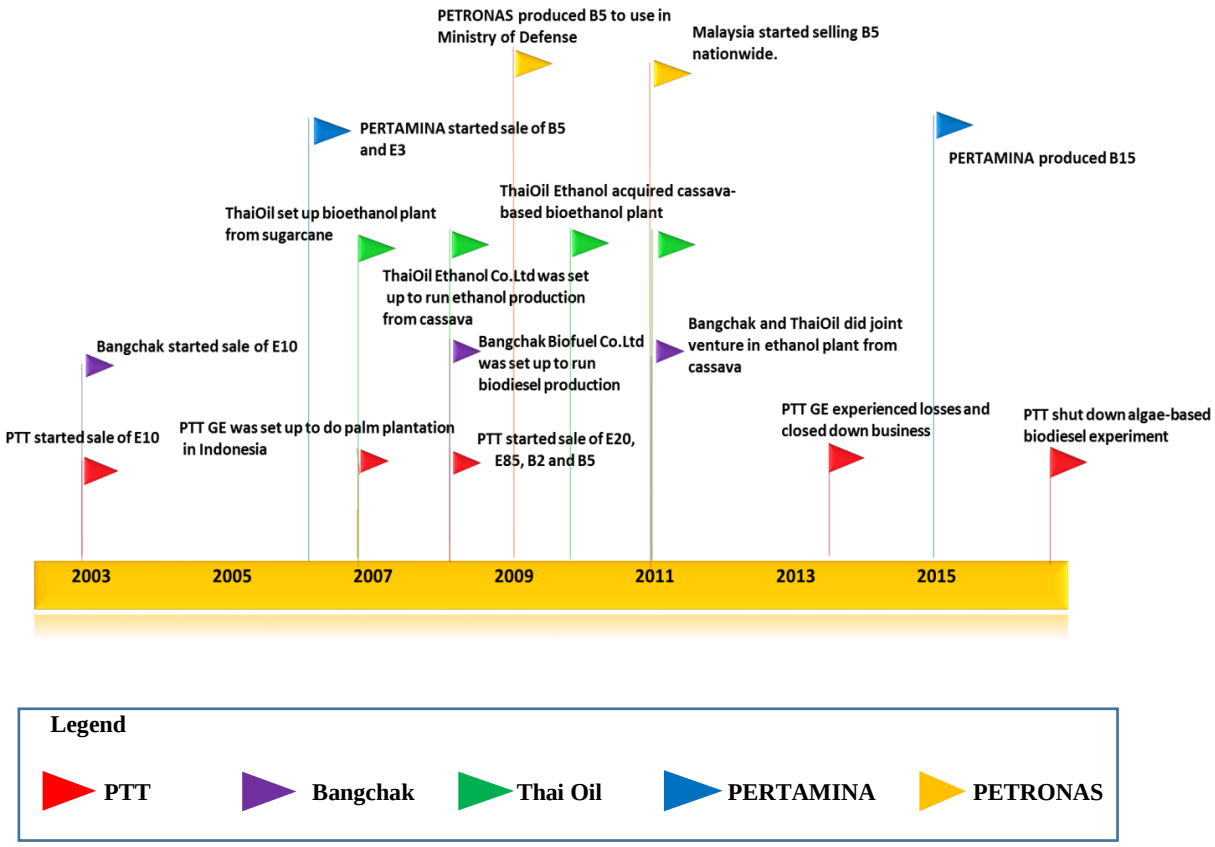


Figure 11 Landmark biofuels investments of PTT, Thai Oil, Bangchak, PERTAMINA and PETRONAS in the first 15 years of 21st century (based on the findings in Chapter 4)

When looking into the details, PTT, Thai Oil and Bancghak are more actively producing and developing biofuels than PERTAMINA and PETRONAS. This is a result of the fact that Thailand typically has to import over 80% of the crude oil it consumes. Thus, the country was suffering from high crude oil prices and government policy prioritized ways to reduce oil imports to enhance national energy security (see discourse analysis of biofuel projects of PTT, Thai Oil and Bangchak in Chapter 5). Indonesia has also experienced depleting in O&G reserves, but much later than Thailand. Finally, Malaysia's PETRONAS was the last one who commercialized biodiesel, due to its relatively higher amount of O&G reserves. However, the most important reason why PETRONAS was the last among the five companies to invest in biofuel is the fact that high crude oil price favored PETRONAS as an oil exporter. As a government authority in Malaysia stated:

"*When crude oil was high PETRONAS got profits and did not think about renewable energy. They just wanted to dig more oil. Now they suffered from the low crude oil prices*" (Government interviewee, male).

As a result, high oil crude oil affected oil exporters and importers differently. When asked about the current low crude oil prices, PETRONAS interviewee accepted that the company was being affected from lower oil revenue. However, they are still able to manage through cutting down unnecessary costs, attempting energy efficiency strategies and running on prudent budgets. More interestingly, the interviewee explained that the company has pursued a strategic business plan to still make profits, although not as big as during the period of high crude oil prices:

"We still export oil and gas. We export crude oil and we import refined products. Our crude oil is sweet, has good quality because of low Sulphur. Then we buy refined products which have lower grade and are cheaper, so we get profits" (PETRONAS interviewee, female).

In conclusion, the volatility of crude oil price appears to affect corporate strategies of five O&G companies differently. A given country's O&G reserves and some other factors also play a role and need to be taken into consideration. The case of PETRONAS revealed that the oil company is capable to come up with a strategic business plan to cope with low crude oil prices. Thus, only taking into account low crude oil prices does not necessarily lead to a diversification of energy portfolio of O&G companies, as claimed by existing literature regarding companies from Middle East or Europe (Goldenberg, 2016; Renewable energy, 2015; Breaking the habit, 2016; On the oil wagon, 2016;). This is an important finding of the present research.

6.4.2 Discovery of shale oil/gas

The discovery of shale oil and gas, which is possible thanks to the horizontal drilling and hydraulic fracturing or fracking technology, has changed the world's energy mix dramatically. Since the late 2000s the shale revolution in the US caused O&G companies to abandon renewable energy and focus on their core business (Perry, 2012; Ferris and Gronewold, 2014; Johnson, 2015). Hersher (2016) reported a study by the U.S. Geological Survey, which announced that a deposit in West Texas was the largest continuous oil and gas deposit ever discovered in the US. The area known as the Wolfcamp shale has proved to have huge reserves, estimated at 20 billion barrels of oil and 16 trillion cubic feet of natural gas. The amount of petroleum discovered is nearly three times more than what was found in North Dakota's Bakken shale in 2013, and is nearly three times the amount of petroleum products used by the US in a year. The discovery of shale gas/oil challenged the idea of peak oil, which predicted the collapse in the supply of oil. Rather, the world experienced the opposite type of crisis, and Monbiot (2016) pointed out that "we are drowning in the stuff". Moreover, as the OPEC increased oil production with the purpose to crash the oil crude price and destroy the shale oil/gas businesses in the US, the world has seen dramatic reduction in world crude oil price, which went below US$ 30 per barrel (the lowest price was US$ 29.38 per barrel in January 2016).

The impact of discovery of shale oil and gas on the five O&G companies analyzed in this study manifested itself as a crash of world crude oil price, which was discussed in section 6.4.1. In addition, the Indonesian government authority from the Directorate General of Gas and Oil provided information that PERTAMINA has invested in the shale gas business in the US, but said that PETRONAS is more aggressive in such business. PETRONAS interviewee thought that shale oil and shale gas affect the climate policy of the US, and that Thailand will change its renewable energy policy if it were to find such reserves:

> *"The US used to be an oil import, but now they have shale gas, so it changes the status on climate change. The US position is changed. If*

Thailand finds shale gas, then I can guarantee that Thailand's renewable energy development will be reduced" (PETRONAS interviewee, female).

Nevertheless, whether Thailand O&G companies would change their renewable energy to focus on their core business of fossil fuels or not requires further investigation. However, so far the study found that PTT, Thai Oil (through a joint venture with PTT) and Bangchak are seeking business opportunity in solar PV abroad, as explained in section 6.2.3. Moreover, PTT is acquiring shares in 24-M Company to produce Lithium Ion battery as a new energy storage technology. Thus, the discovery of shale oil and gas in the US at the present seems not directly change the renewable energy business strategies of PTT, Thai Oil and Bangchak.

6.4.3 Development and costs of renewable energy technology

This factor mainly refers to low-carbon energy sources, aside from biofuels. Penha (2011) highlighted that development and costs of renewable energy influence renewable energy investments, since it leads to economic viability and competitiveness with fossil fuels. This section discusses only PV technology since all of five companies studied have invested in this form of clean energy. The study found that solar PV investment of O&G companies in Thailand and Malaysia are correlated to the costs of silicon PV cells, which have dramatically reduced in recent years thanks to advancement in technology.

In 1954, researchers from Bell Laboratories successfully installed silicon solar cells powering a miniature Ferris wheel. The event was considered the beginning of solar PV development. However, its cost was estimated to be as high as US$ 286 per watt (Baker, 2014). Due to development in technology and the role of Chinese government in strongly promoting its solar PV manufacturing industry, the costs of silicon solar cells have continuously decreased, until they reached a level of less than US$ 1 per watt at the present (Sun et al., 2014; Baker, 2014). Figure 12 shows a list of the landmark solar PV projects of PTT, Thai Oil (through joint venture in GPSC), Bangchak and PETRONAS. Although PTT started installing solar PV on the roof of its service stations for self-consumption since 2007, the commercialization of solar PV of Bangchak (which was then an associated company of PTT) took place in 2011. In the same year, PETRONAS (with cooperation

with Mitsubishi Corp) installed solar panels on the roof of Suria KLCC shopping mall. The project was for experiment purposes, though it can supply some electricity to the shopping mall.

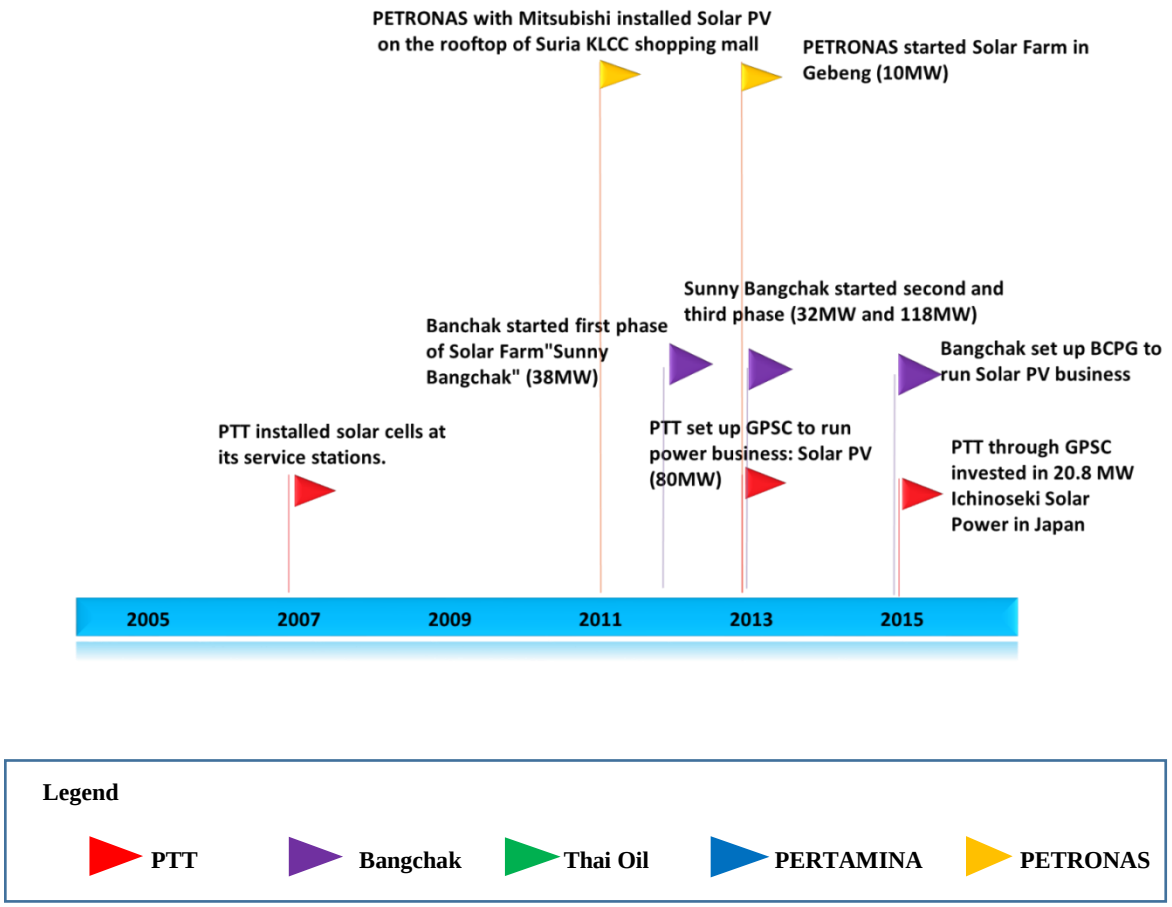


Figure 12 Landmark solar PV investments of PTT, Bangchak, Thai Oil and PETRONAS (based on the findings in Chapter 4)

The timeline of solar PV investment of Thailand and Malaysian O&G companies reflects the correlation with costs of solar cells, which has dramatically decreased in the last 4-5 years. The government of Thailand implemented an adder scheme for solar farm since 2007, but the companies did not take action until 2011, when the costs of PV lowered substantially. GPSC interviewee further elaborated on the issue of the cost of solar cells:

"In the past 5 year, technology has been advanced and cost was very low. The government promoted solar farm since 2007, but no one wanted to do business. When the solar panel costs reduced, together with generous adder rates of 8 baht per kWh from the government, many investors become active" (GPSC interviewee, male).

As for PERTAMINA, the company has a plan to install solar PV for generating electricity and selling to private partners (see Figure 3). The government authority from Directorate General of New, Renewable Energy and Energy Conservation (DGNREEC) gave opinions on the reasons why solar PV development in Indonesia was slower than in other countries. Firstly, it is because Indonesia does not have any PV manufacturing capabilities, and needed to import solar panels. The price is higher than having it produced locally. She also cited India as a model that Indonesia should follow, because it set up a local manufacturing industry. Secondly, the government official pointed to the limited government budget as an obstacle to renewable energy development.

6.4.4 Global movement to divest from fossil fuels companies

This global phenomenon is novel in the study of O&G corporate strategies to climate change mitigation. The movement started in 2012 by NGO called 350.org, attempting to raise public engagement from individuals and institutional investors and join forces to withdraw their money from fossil fuels companies (Howard, 2015). Major pension funds, churches, universities, even Rockefeller Family Fund and the world's biggest sovereign wealth fund owned by Norway are committed to divest from coal, oil and gas companies (Carrington and Howard, 2015; Neate, 2016a). This has provided pressure for O&G companies to keep O&G reserve on the ground as stranded assets in order to prevent the world temperature increase to below 2°C, which is the target of the Paris Climate Change Agreement. The latest progress reported in May 2017 on the Global Divestment Mobilisation (GDM) indicates that thousands of people have participated in over 260 events in 45 countries on six continents. In addition, the volume of divestment is said to amount to over US$5.5 trillion, from 710 institutions across 76 countries.

Despite of this impressive achievement, questions have been posed as whether the divestment will really make changes to fossil fuel companies' behavior. Some analysists point out that the engagement approach could be more effective to induce the firms to undertake climate change mitigation (Fight the power, 2015). In addition, major O&G companies like Shell and Saudi Aramco have expressed their disagreement in the divestment efforts. Shell CEO said that "the divestment was a simplistic solution to a wider problem that could delay adopting more meaningful policy options, I fundamentally do not believe that holds a business rationale" (Macalister and Carrington, 2015). The former chairman of Saudi Aramco argued against the premise of the global divestment movement, indicating that fossil fuels are not the problem, but their harmful emissions. Thus, instead of stopping producing O&G he proposed that technologies are needed to be developed to capture carbon dioxide (Pashley, 2016).

While it has been claimed that this global movement is active in 45 countries, the present study found that such movements does not have impacts on any of the five O&G companies studied. First of all, interviewee from Thai Oil and Bangchak, PTT which have some shares owned by private investors in the Stock Exchange of Thailand, acknowledged the existence of the global divestment movement, but said that the companies are not currently affected. The Thai Oil interviewee said that she found some funding institutions canceled their investments, but the volume was small and did not have impact on Thai Oil. Such global movement has not yet affected Thailand, or maybe it would affect Thailand later than other countries. An anonymous interviewee from Malaysia critically argued about this global movement and the idea of stranded assets. In his view, stranded assets is an idea that NGOs constructed to attack O&G companies. More importantly, he cited the fact that the Malaysian government depends very much on revenue from the O&G business of PETRONAS. Thus, it is out of question that the government would cut down O&G business, as it is the main source of government income:

> *"Government needs money to develop country, to enhance well-beings of people. Will you make your major source of incomes into stranded assets? We need the last drop of oil"* (Anonymous interviewee, male).

6.4.5 Global climate change agreement

At the very beginning, climate change mitigation, which represents efforts to reduce man-made greenhouse gases, was considered as a threat to the oil and gas industry, since its products were one of the direct causes of climate change. Some of major O&G companies formed in 1989 the 'Global Climate Coalition' (GCC), a lobbyist organiation aimed at lobbying US Congress not to pass regulation on greenhouse gas emissions reduction (Kolk and Levy, 2001). The GCC was viewed as a one major reason why the USA did not ratify Kyoto Protocol (McCright and Dunlap, 2003). However, once the idea of climate change gained enough momentum and the parties of the United Nations Framework Convention on Climate Change (UNFCCC) made efforts for more stringent mechanisms to address the global challenges, some O&G companies were influence to change their busienss as usual and to take part in global climate change mitigation efforts. The Kyoto Protocol, implemented in 1997, caused the so-called second wave of renewable energy investment by O&G companies (Switzer, 2014).

The Paris Agreement in 2015, the latest global climate change agreement, also resulted in a push by the O&G industry. On the day the global Paris agreement came into force, the Oil and Gas Climate Initiative (OGCI) -comprising of ten major O&G companies; namely BP, CNPC, Eni, Pemex, Shell, Total, Statoil, Repsol, Saudi Aramco, Reliance Industries- declared that they would create a 1 US$ billon fund for 10 years to mitigate GHG emissions released during their operation (Carrington, 2016a). On the other hand, ExxonMobil has long been opposing the climate change problem. It has been recently revealed that the company's scientists had known since 1981 that fossil fuels combustion caused the global warming and climate change; yet the company allegedly provided about $30million of funds to climate change denial researchers and activists in order to mislead the public about the causes and the dangers of climate change (Goldenberg, 2015; Nuccitelli, 2015; Barrett and Philips, 2016). In the present study, the global climate change agreement appears to affect the five O&G companies through the national climate change commitment. The national governments of Thailand, Malaysia and Indonesia have submitted INDC to UNFCCC and committed to reduce a certain amount of GHG emissions

(see section 6.3.1). The perception of O&G companies themselves toward the global climate change agreement, especially the Paris Agreement, is not as obvious, as most company interviewees did not refer to it during the interview. The exception was PETRONAS, where the interviewee thought that global climate change commitment will not be serious because the US has a new President, who appears to be climate change denier:

> *"Climate change is gonna be changed when Trump is rejecting it. He has stronger voice"* (PETRONAS interviewee, female).

The opinion of PETRONAS interviewee appears to be legitimate considering the appointment of former CEO of ExxonMobil Rex Tillerson to be a Secretary of State under administration of President Donald Trump. Although at the time of writing President Trump has not yet withdrawn from the Paris Agreement, as he promised during the presidency campaign, his selection worries many regarding the future direction of the US regarding global climate change agreement.

6.4.6 Peer influence among companies in the O&G industry

Industrial peers and industrial leaders are considered as influential factor for shaping O&G corporate responses to climate change mitigation (Pulver, 2007). Participating in international O&G industrial associations or other climate change conferences, CEOs and executives have arenas for meeting and talking. The interactions lead to osmosis of ideas and converging strategies among the leaders of O&G companies (Levy and Kolk, 2002; Penha, 2011). In addition, firms are likely to follow the leading company in the industry. For example, Pemex, a national oil company of Mexico, chose to follow BP and Shell's climate strategies in order to become world class companies like them (Pulver, 2007). Regarding renewable energy investment, some commented that Total from France would be the first major O&G company which breaks from the pack and becomes a frontrunner, considering its persistent investment in solar energy (Macalister, 2015a).

The five companies studied provided a rather different picture about peer influence on renewable energy investment. In Thailand's case, PTT, Bangchak and Thai Oil are associate companies. However, their corporate strategies in green energy business are not exactly the same. Bangchak has obviously taken renewable energy investment as a way to build business sustainability. Thai Oil chose to strengthen its core business in oil refinery, while undertaking a joint venture in power business with PTT. This reveals that peer influence on renewable energy investment, even among associate companies, is not so strong.

When comparing the three NOCs, the present study found that PTT, PERTAMINA and PETRONAS, are aware of the business strategies and characteristics of each other. However, they did not choose to follow each other's choices. For PETRONAS, the interviewee made a point that the company chose to follow ExxonMobil regarding renewable energy investments:

> "*We are monitoring everything that are happening, we know what Total, Statoil are doing. They have different strategies; IOCs have different strategies. NOCs are also like IOCs, some are more aggressive like PTT. We are not going very strong in renewable energy; we are like ExxonMobil. And PTT is like Shell"* (PETRONAS interviewee, female).

In addition, the PETRONAS interviewee claimed that renewable energy investment seemed to be the strategy of companies or countries with less O&G reserves, and that PETRONAS would become like PTT in the future once O&G reserves started to deplete.

In the view of PERTAMINA, interviewees seem to relate PERTAMINA with PETRONAS more than with PTT. The interviewees' comments implied that the company looked up to PETRONAS, in the sense that PETRONAS has exclusive rights and powers over Malaysian O&G reserves. This fact enables PETRONAS to maintain its focus on upstream O&G business.

> *"PETRONAS has a strong link to the government. It acts as both regulator in upstream industry and a business company. PERTAMINA is strong too*

> *but private company put pressure to join the business. Because of free trade law, Indonesia opens up for foreign private investors. PERTAMINA used to act as a regulator, but now SKK Migas serves as a regulator. The large portion of O&G reserves are still awarded to PERTAMINA, but some small portion need to be open to foreign / private companies"* (PERTAMINA interviewee, male).

It is allegedly noted that PERTAMINA did not view PTT as a model. President of APROBI, who has worked in the palm oil business for decades and was familiar with the business of PTT, PETRONAS and PERTAMINA, commented that PTT was smart to secure biofuel supply. He criticized PERTAMINA for being reluctant to get involved in the upstream palm oil business. Similarly, PTT itself did not view PERTAMINA as a model. Rather, PTT interviewee perceived PETRONAS as a successful business case.

> *"R&D of Petronas is better than PTT because PETRONAS is richer and gives more importance to R&D more than PTT does"* (PTT interviewee, male).

Although PTT looks up to PETRONAS for its financial performance, PTT has been active in renewable energy because of its own company specific features (i.e. CEO's vision, view on profitability of renewable energy) and national factors (i.e. limited country's O&G reserves, government policy and target in renewable energy development). Similar to PTT, PERTAMINA has become active in finding alternative and renewable energy due to Indonesia's decreasing O&G reserves.

PETRONAS has always been ranked higher than PTT and PERTAMINA in the list of Global Fortune 500[14]. Because of its status as the top of the O&G companies in Southeast Asian region, PETRONAS appears to look at world major O&G companies as a model instead of industrial peers in the same region. However, because ExxonMobil is their

[14] See ranking in previous years in http://fortune.com/global500/

choice of industrial leader, PETRONAS appears to be less enthusiastic to invest in renewable energy.

6.5 Conclusions

The study summarized the main findings in tables to illustrate the differences and similarities of the responses to each factor of the five O&G companies analyzed. Table 24, 25 and 26 present the findings regarding factors relating to company specific features, national factors and global factors, respectively. The present study answers the three research questions in sub-objective 3 below the tables.

Table 24 Company specific features of PTT, Bangchak, Thai Oil, PERTAMINA and PETRONAS

Country	**Thailand**			**Indonesia**	**Malaysia**
Company **Factors**	**PTT**	**Bangchak**	**Thai Oil**	**PERTAMINA**	**PETRONAS**
Ownership structure and role of CEOs and shareholders	• 51.1% of shares owned by government • CEO takes a green vision • Government is a dominant shareholder	• 27.22% of shares owned by PTT • CEOs initiate green business • Not mention private shareholder pressure	• 49.1 % of shares owned by PTT • CEOs follow PTT • Not mention private shareholder pressure	• 100% state owned • No private shareholder pressure	• 100% state owned • CEOs report to PM • No private shareholder pressure
Short-term economic advantages	• Switch to gas	• Not mention switch to gas (do not have upstream business)	• Not mention switch gas (do not have upstream business)	• Switch to Coal Bed Methane (CBM)	• Switch to gas • Apply CCS technology
Long-term economic advantages	• Biofuel is not economic during low crude oil price -RE is profitable but limited opportunity in Thailand	• Biofuel is not economic during low crude oil price • View that RE is profitable and help business sustainability	• Biofuel is not economic during low crude oil price • Strategically choose to maintain oil business, oil industry will not disappear easily	• Biofuel is difficult to run during low crude oil price • RE can be profitable and seek business with private companies	• Biofuel is a burden now • RE is not profitable as O&G business. • Oil and gas will maintain dominance in energy mix

Table 24 Company specific features of PTT, Bangchak, Thai Oil, PERTAMINA and PETRONAS (continued)

Country	**Thailand**			**Indonesia**	**Malaysia**
Company **Factors**	**PTT**	**Bangchak**	**Thai Oil**	**PERTAMINA**	**PETRONAS**
Compatibility of RE to core expertise	• Biofuel is compatible with core expertise • Set up GPSC to run RE generation power business	• Biofuel is compatible with core expertise • Set up BCPG to run RE power generation business • Hire consulting company on RE	• Biofuel is compatible with core expertise • Do not have competitiveness advantage in RE so decided to joint venture in GPSC	• Biofuel is compatible with core expertise but not involve in upstream palm oil business • Set up RE department in 2014	• Reluctant to do biofuels • PERTONAS should not do RE business because of conflict with an electricity company
Corporate social responsibility (CSR)	Not mentioned	Not mentioned	Run CSR projects to install RE for rural communities	Not mentioned	Not mentioned
Lesson learned from past experiences	• Loss in palm oil plantation in Indonesia • Shut down R&D on algae-based biodiesel	No loss experience mentioned	No loss experience mentioned	No loss experience mentioned	No loss experience mentioned
View on global climate change	Agree	Agree	Agree	Agree	Agree but do not think it is going serious as President Trump would deny the problem

Table 25 National factors of PTT, Bangchak, Thai Oil, PERTAMINA and PETRONAS

Country	**Thailand**	**Indonesia**	**Malaysia**
Company **Factors**	**PTT** **Bangchak** **Thai Oil**	**PERTAMINA**	**PETRONAS**
National policy and incentive on RE and climate mitigation policy	• INDCs to reduce 20 % by 2030. • Target to have 30% of overall RE in final energy consumption by 2036 • 15-20% of RE in power generation • Biofuel mandate	• INDCs to cut 26& by 2020 • Increase to 23% share of RE by 2025and 31% in 2050 • Unclear target of RE in power generation • Biofuel mandate	• INDCs to cut GHG emission intensity of GDP by 45% by 2030 • Achieve 17% of RE in 2030 • 3% of RE in power generation • Biofuel mandate
Country O&G reserves and RE resources	• Oil net importer • Import 20% of gas, 80% domestic production • Biomass potential 7000 MW • Biogas potential 278 MW • Solar potential irradiation 5.1 kWh/m^2/day • Wind potential ✧ (7–8 m/s): 3000 MW ✧ (8–9 m/s): 52 MW • Geothermal potential 5.3 MW	• Net gas exporter (world 7th largest LNG exporter) • Net oil importer since 2005 • Geothermal 29 GW • Hydro 75 GW • Wind 62 GE of commercial potential • Biomass for electricity 33 GW • Solar potential irradiation between 2.6-5.8 kWh/m^2 **Theoretical potential** • Ocean wave 142 GW • Ocean thermal 4.2 GW	• Net gas exporter (world 2nd largest of LNG exporter) • Net oil importer since 2013 • 39% of world palm oil production • Solar potential radiation 4.5 kWh/m^2

Table 25 National factors of PTT, Bangchak, Thai Oil, PERTAMINA and PETRONAS (continued)

Country	Thailand			Indonesia	Malaysia
Company **Factors**	**PTT**	**Bangchak**	**Thai Oil**	**PERTAMINA**	**PETRONAS**
Social demand for environmental conservation	NGOs will not protest as long as the energy price is not high.			Not mentioned	Low public awareness on environmental issues and climate change.
Business-government relationship	Some boards of directors are government officials			Reports to various ministers	• CEOs reports directly to Prime Minister • Governments do not prioritize environmental issues

Table 26 Global factors of PTT, Bangchak, Thai Oil, PERTAMINA and PETRONAS

Country	Thailand			Indonesia	Malaysia
Company Factors	**PTT**	**Bangchak**	**Thai Oil**	**PERTAMINA**	**PETRONAS**
World crude oil prices	• Biofuel investment is correlated with changes in crude oil prices • Encouraged to invest in RE when high crude oil prices	• Biofuel investment is correlated with changes in crude oil prices • Encouraged to invest in RE when high crude oil prices	• Biofuel investment is correlated with changes in crude oil prices • Encouraged to invest in RE when high crude oil prices	• Biofuel investment is correlated with changes in crude oil prices	• Biofuel investment is correlated with changes in crude oil prices • Got big revenue when high crude oil price and do not want to invest in RE
Discovery of shale oil/gas	Not mentioned	Not mentioned	Not mentioned	Invest in shale gas in the US	Invest in shale gas in the US but more aggressively than PERTAMINA
Development and cost of RE technology	Invested in solar PV when silicon solar cell cost is decreased	Invested in solar PV when silicon solar cell cost is decreased	Joint venture with PTT	• RE projects are still in R&D and development plan • Except Geothermal which started since 1970s	Invested in solar PV when silicon solar cell cost is decreased

Table 26 Global factors of PTT, Bangchak, Thai Oil, PERTAMINA and PETRONAS (continued)

Country	Thailand			Indonesia	Malaysia
Company Factors	PTT	Bangchak	Thai Oil	PERTAMINA	PETRONAS
Global movement to divest from fossil fuels companies	No impact	No impact	• Observed that some institutional investors cancel investment but the volume as small • The movement can affect Thailand in the future but quite later than other countries	No impact	• No impact • The government will unlikely put O&G reserves into stranded assets because they rely on the O&G revenues
Global climate change agreement	Not mentioned on Paris agreement	Not mentioned on Paris agreement	Not mentioned on Paris agreement)	Not mentioned on Paris agreement	Not as serious since President Trump will reject it
Peer influence among companies in industry	Look up at PETRONAS in term of financial performance	Aim to be a leader in RE itself	Strategically choose to maintain oil business	Look up at PETRONAS for being a regulator in upstream O&G business	Choose to follow ExxonMobil

6.5.1 Factors which influence O&G companies in Thailand, Malaysia and Indonesia to invest in renewable energy

Firstly, global factors are less influential to O&G corporate strategies to conduct renewable energy investment than company specific features and national factors. This can be seen from the fact that company interviewees from PTT, Thai Oil, Bangchak, PERTAMINA and PETRONAS did not raise concerns on some global factors i.e. global movements to divest from fossil fuels companies, the discovery of shale gas/oil or Paris agreement- the latest global climate change agreement. As for the volatility of world crude oil price, PETRONAS was only one company that gained benefits from the high crude oil prices; while the other four companies were driven to find alternative and renewable energy. The national factors i.e. countries' O&G reserves are needed to be taken into account to understand why PETRONAS enjoyed the time when world crude oil prices were high while the four companies suffered and got encouraged to develop renewable energy. Moreover, the peer influence appears to be of little importance, as each company has its own specific features and operates in a different national context. PETRONAS, which is the top O&G company in Southeast Asia, chose to follow ExxonMobil. On the other end of the spectrum, Thai Oil and Bangchak which are associate companies of PTT, seem to have pursued their own business strategies to some degree. Thus, PTT as the mother company, does not much influence Thai Oil and Bangchak as much as could be expected.

Secondly, company specific features were seen to be the most influential to drive O&G companies in Thailand to invest in renewable energy. This can be seen from the fact that PTT, Thai Oil and Bangchak are operating under the same national factors; namely government policy on climate change and renewable energy development, country's O&G reserves and renewable energy resources, social demand for environmental conservation and business-government relations. However, each of them has pursued different business strategies. Bangchak is the most active in both biofuel and solar PV, considering the fact that the company started investment earlier than PTT and Thai Oil. Additionally, Bangchak has more installed capacity in solar PV than PTT and Thai Oil. The present study concluded that the company specific features are the key factors driving O&G companies in

Thailand to enter renewable energy businesses.

Thirdly, national factors, especially country's O&G reserves, were the most influential factors that drive O&G companies in Thailand and Indonesia, which were more active in developing renewable energy sources than O&G company in Malaysia. Because Thailand has the lowest O&G reserves among the three countries, PTT, the NOC of Thailand and its two associate companies, were pushed to look for alternative and renewable energy sources to secure the energy supply of the country. PERTAMINA, an Indonesian NOC, has become increasingly enthusiastic to find more new renewable energy sources due to depleting O&G reserves. This can be clearly seen from the fact that the country changed its status from a net oil exporter to a net oil importer in 2005. On the other hand, PETRONAS controlling all Malaysian hydrocarbon reserves due to the Petroleum Act 1974, still enjoys relatively high O&G reserves especially natural gas. Due to this simple but fundamental fact, O&G companies in three countries have different business strategies in terms of renewable energy investment.

6.5.2 Differences and similarities between factors influencing NOCs and those influencing O&G companies in existing literature (western IOCs and major NOCs)

Given the fact that only world major IOCs from developed countries and NOCs from Middle East, China, and Russia have typically been investigated in literature, the present study tested whether or not and to what extent factors found in the existing literature can be applied with the NOCs and their associate companies from developing countries in Southeast Asia-Thailand, Malaysia and Indonesia.

First of all, it was found that most of factors can be applied to the five O&G companies in the study, and some findings correspond to what happened with major IOCs and NOCs in the literature. In the first group of factors (company specific features), the five O&G companies have been influenced similarly to world IOCs and NOCs by the factors related to 1) ownership structure and the role of CEOs, 2) short-term economic advantages, 3) long-term economic advantages, 4) compatibility of renewable energy to core expertise, 5) Corporate social responsibility, and 6) views on global climate change. The rest of the factors; namely the role of private shareholders and the lesson learned from past experience

in renewable energy business are found to have little influence or no impact on the corporate strategies of the five O&G companies. The reason why the former factor appears to have little of importance is because three of the studied companies are majority or 100% owned by the government- PTT, PERTAMINA and PETRONAS. The private shareholders thus have little or no impact at all on the decision making process of the companies. Given that the majority of Thai Oil's shares are owned by PTT, Thai Oil's business strategy to some degrees aligns with that of PTT. Lastly, 27.22% shares of Bangchak were owned by PTT, while the rest was owned by private investors. However, a Bangchak interviewee did not perceive private shareholders as an influential factor for its decision to enter the renewable energy business. As for the lessons learned from the financial losses in renewable energy business, which was one of many reasons why ExxonMobil does not put money in the green energy business, the study found that only PTT experienced losses in biofuel investment (palm oil plantation in Indonesia). However, PTT continues its sales in biofuel products in Thailand, and what appears to matter for PTT's biofuel investment are rather the changes in world crude oil prices and government biofuel mandate.

In the second group of factors (national factors), the factors which influence five O&G companies are similar to those influencing major IOCs and NOCs except 1) social demand for environmental conservation and 2) business-government relation. In developing countries like Thailand, Malaysia and Indonesia, it is found that the public as well as NGOs are concerned with prices of energy and living costs. The interviewees from Malaysia stated that public awareness on environmental issues and particularly global climate change is not high. In addition, Malaysian Prime Ministers are given absolute power on the decision and strategy of PETRONAS. Hence, civil society in Malaysia appears to have no impact on PETRONAS. In addition, an interviewee from Thailand pointed that local NGOs would not protest against PTT as long as the energy prices are cheap. As for the business-government relation, the five O&G companies seem to behave differently from what the existing literature proposed. This is because the five companies have strong ties with the governments, or act as a regulator in upstream business itself in the case of PETRONAS. Thus, business actors and governments cannot be viewed as a separate entity, as seen in the

existing literature. The cause of such difference is due to existing literature having examined mostly IOCs, which are private owned companies, while the five O&G companies in this study are NOCs or their associates.

Last but not least, only one factor in the third group (global factors) seems applicable to the five O&G companies. The development and costs of technology in solar PV is a key driving factor for PTT, Thai Oil, Bangchak and PETRONAS to start solar farm and solar rooftop projects. The rest of the factors were found to have unclear or different impacts from what the existing literature proposed about world IOCs and NOCs. Details of each factor are provided below.

***The volatility of world crude oil prices*:** High crude oil prices were perceived to encourage O&G companies to invest in renewable energy, as seen in the aftermath of first and second oil shocks in 1973 and 1979. The study found that this factor is true for O&G companies from Thailand and Indonesia, as they have to import crude oil. However, the story was different for a company with rich O&G reserves like PETRONAS. During high crude oil price in 2008-2009, PETRONAS obtained huge profits from O&G business, thus feeling uninterested to invest in any low-carbon energy business. However, during the low crude oil price in 2015-2016 PETRONAS still managed to cope with lower revenue and continue with its core business by cutting unnecessary costs and trading its high-quality crude oil in an exchange with low-quality final oil products.

***Discovery of shale oil/ gas*:** This factor affected five O&G companies indirectly. The discovery of shale oil/gas caused the world crude oil prices to decrease, and change the view on the future energy mix of the planet. However, O&G companies in Thailand and Indonesia's business strategies with regards to renewable energy investment appear unchanged due to the discovery of shale oil/gas. Only PETRONAS seems to be encouraged by the factor, as it is likely to be able to maintain its core business in O&G.

***Global movement to divest from fossil fuels companies*:** This factor has the least impact on all five O&G companies. Although the existing literature, especially news articles in well-known business magazines, would highlight the increasing momentum of the movement, company interviewees in Thailand, Malaysia and Indonesia said they were not affected, mostly because their national governments are the main shareholders. Moreover, in the case of PETRONAS, the government of Malaysia heavily depends on the

O&G revenue from PETRONAS. A Malaysian anonymous interviewee stated clearly that it is impossible that the government would turn their main source of income into stranded assets.

***Global climate change agreement, especially Paris Agreement*:** This factor actually affects the five O&G companies indirectly through the implementation of national climate change policy. However, as PERTAMINA and PETRONAS company interviewees mentioned, the governments seem not to be so serious with regards to their GHG emission reduction commitment. Moreover, the PETRONAS interviewee predicted that compliance with the global climate change agreement would not be serious, because President Trump will refuse to comply with the agreement.

***Peer influence among companies in the O&G industry*:** Existing literature proposed that O&G companies interacted and shared ideas with each other in various arenas, such as the associations of O&G industry or climate change conferences. Thus, converging business and climate change mitigation strategies among them are to be expected. However, the study found that peer influence has little impact on three Thailand O&G companies. Although they are associated, PTT, Thai Oil and Bangchak have maintained some degree of independence in terms of renewable energy investment. Bangchak is the most active in moving towards green energy businesses, but such action was viewed with suspicion by PTT and Thai Oil. Among PTT, PERTAMINA and PETRONAS, there is no evidence that the three NOCs are being influenced by the renewable energy investment strategies of each other. Rather, PETRONAS as the top O&G company in Southeast Asia in term of its financial performance according to Global Fortune 500, chose to follow ExxonMobil's view on the future energy mix, which claims that fossil fuels will maintain a dominant position for the next 40-50 years.

6.5.3 Characteristics of O&G companies which influence the likelihood of renewable energy investment

The findings from Chapter 6 were cross-checked with those from Chapter 4 (regarding actual renewable energy investment projects that the five O&G companies have carried out in the first 15 years of the 21st century). The present study then identified which O&G companies are the most and the least active in diversifying their energy mix and embarking on renewable energy investment as a corporate strategy to climate change mitigation. Bangchak from Thailand appears to be the most active in green energy investment, whereas PETRONAS from Malaysia is the least active company and appears determined to remain within its core O&G business.

The differences between Bangchak and PETRONAS in terms of company specific features, national factors and global factors are illustrated in Table 27. The present study proposes that the following characteristic could be used in predicting whether other O&G companies, both NOCs and private owned companies, are likely to invest in renewable energy or not.

Table 27 Characteristics of Bangchak and PETRONAS

Group	Factors	Bangchak (Most active)	PETRONAS (least active)
Company specific features	• Ownership structure and role of CEOs and shareholders	• 27.22% of shares owned by PTT • CEOs initiate green business • Not mention private shareholder pressure	• 100% state owned • CEOs report to PM • No private shareholder pressure
	• Short-term economic advantages	• Not mention switch to gas (Bangchak does not have upstream business)	• Switch to gas • Apply CCS technology
	• Long-term economic advantages	• Biofuel is not economic during low crude oil price • View that RE is profitable and help business sustainability	• Biofuel is a burden now • RE is not profitable as O&G business. • Oil and gas will maintain dominance in energy mix
	• Compatibility of renewable energy to core expertise	• Biofuel is compatible with core expertise • Set up BCPG to run RE power generation business • Hire consulting company on RE	• Reluctant to do biofuels • PERTONAS should not do RE business because of conflict with an electricity company
	• Corporate social responsibility (CSR)	• Not mentioned	• Not mentioned
	• Lesson learned from past experiences in renewable energy business	• No loss experience mentioned	• No loss experience mentioned
	• View on global climate change	• Agree	• Agree but do not think it is going serious as President Trump would deny the problem

Table 27 Characteristics of Bangchak and PETRONAS (continued)

Group	Factors	Bangchak (Most active)	PETRONAS (least active)
National factors	• National policy and incentive on renewable energy and climate mitigation policy	• INDCs to reduce 20 % by 2030. • Target to have 30% of overall RE in final energy consumption by 2036 • 15-20% of RE in power generation • Comply with biofuel mandate	• INDCs to cut GHG emission intensity of GDP by 45% by 2030 • Achieve 17% of RE in 2030 • 3% of RE in power generation • Comply with biofuel mandate
	• Country O&G reserves and renewable energy resources	• Oil net importer • Import 20% of gas, 80% domestic production • Biomass potential 7000 MW • Biogas potential 278 MW • Solar potential irradiation 5.1 kWh/m^2/day • Wind potential ○ (7–8 m/s): 3000 MW ○ (8–9 m/s): 52 MW • Geothermal potential 5.3 MW	• Net gas exporter (world 2nd largest of LNG exporter) • Net oil importer since 2013 • 39% of world palm oil production • Solar potential radiation 4.5 kWh/m^2
	• Social demand for environmental conservation	• NGOs will not protest as long as the energy price is not high.	• Low public awareness on environmental issues and climate change.
	• Business-government relations	• Some boards of directors are government officials • Government officials encouraged the company to invest in renewable energy	• CEOs reports directly to Prime Minister • Governments do not prioritize environmental issues

Table 27 Characteristics of Bangchak and PETRONAS (continued)

Group	Factors	Bangchak (Most active)	PETRONAS (least active)
Global factors	• Volatility of world crude oil prices	• Biofuel investment is correlated with changes in crude oil prices • Encouraged to invest in RE when high crude oil prices	• Biofuel investment is correlated with changes in crude oil prices • Got big revenue when high crude oil price and do not want to invest in RE
	• Discovery of shale oil and gas	• Not mentioned	• Invest in shale gas in the US but more aggressively than PERTAMINA
	• Development and cost of renewable energy technology	• Invested in solar PV when silicon solar cell cost is decreased	• Invested in solar PV when silicon solar cell cost is decreased
	• Global movement to divest from fossil fuels companies	• No impact	• No impact • The government will unlikely put O&G reserves into stranded assets because they rely on the O&G revenues
	• Global climate change agreement	• Not mentioned on Paris agreement	• Not as serious since President Trump will reject it
	• Peer influence among companies in industry	• Aim to be a leader in RE itself	• Choose to follow ExxonMobil

From the characteristics listed in Table 27, the present study highlights the main distinguishing elements between Bangchak and PETRONAS in blue color frames. What appears to be the characteristic of O&G companies that are enthusiastic to transform themselves to become an energy company are:

- The company is majority owned by private investors.
- CEOs are concerned with the issue of sustainability, and have a vision and see the importance of the green energy business
- The company has little or no O&G reserves especially gas reserve. As a result, the company cannot simply switch to produce gas as the short-term strategy, and instead chooses to move to renewable energy investment.

- The company views renewable energy as being profitable, which can serve to enhance its own business sustainability.
- The company considers biofuels as part of its core expertise. As for renewable power generation, the company sets up a subsidiary to run the business. To address the lack of expertise in renewable energy technology, the company hires a consulting company or outsources.
- The company's home country has less O&G reserves and/or has become a net oil or gas exporter. Moreover, there should be sufficient and diverse renewable energy sources in the country, and the company should be able to utilize these local resources.
- The company has strong link with the government, and government officials are promoting the company to move toward renewable energy investment.
- The company gets affected by the volatility of world crude oil prices, in particular during periods of high prices. The expensive crude oil prices encouraged the company to seek out alternative and renewable energy.
- The company does not invest in shale oil/gas.
- The company takes a leading role in renewable energy investment or follows industrial peers who are frontrunners in green energy business.

On the other hand, the O&G companies that are likely to maintain their business as usual model in O&G industry have the following characteristics.

- The company is 100% owned by the government.
- CEOs of the company have to report directly to the government, or a head of government who is concerned more on economic aspect rather than environmental issues.
- The company has ample O&G reserves, and can switch to gas production as well as install CCS (Carbon Capture and Storage) technology to reduce emissions.
- The company views biofuel production as a burden and is reluctant to comply with the government biofuel mandate. In addition, the company views renewable energy

as being less profitable than O&G business, and projects that O&G sources will remain dominant in future energy mix.

- The company holds the view that renewable energy is not its core expertise, and that it is not the role of O&G companies to carry out investment in them.
- The home country has rich in O&G reserves and is still a net energy exporter.
- The company has strong link to the government, which prioritizes economic development over environmental issues.
- The company obtains big profits when crude oil prices are high. It is thus discouraged to diversify its business portfolio into renewable energy. In addition, the company is capable of finding strategies to cope with lower revenues due to cheap crude oil prices
- The company invests in shale oil/gas.
- The company aligns its business strategy with leading industrial peers who are not keen to invest in renewable energy.

Chapter 7 Conclusions and policy recommendation

The present research examines the corporate responses of the O&G industry to climate change mitigation, placing a special focus on business diversification from fossil fuels to renewable energy. Considering the severe impacts of global climate change and the Paris climate agreement, which put forward a strong global commitment to preventing a 2℃ increase in global temperature above pre-industrial levels and to limit further temperature rise to 1.5℃, the long term phase-out of fossil fuels and the substitution by low-GHG alternative energy resources appears imperative. However, existing literature appears to have limitations in capturing the complexity of O&G corporate strategies to climate change mitigation. Thus, the present study addressed some important gaps in existing literature. Firstly, the majority of existing literature investigated a small group of the world's major O&G companies, mostly on International Oil Companies (IOCs) from the US or the EU and a few National Oil Companies (NOCs) from the Middle East, China and Russia. The present study thus targeted three NOCs from emerging economies in Southeast Asia -PTT from Thailand, PERTAMINA from Indonesia and PETRONAS from Malaysia- as case studies. These three NOCs can serve as a starting point for the study of the wider picture on NOCs, which are typically the main energy suppliers of any given countries. The study also included two associates of PTT- Bangchak and Thai Oil-, in order to provide a more in-depth picture of the specific case of Thailand.

Secondly, the socio-economic phenomenon which are taking place in the 21st century i.e. volatility of crude oil prices, the discovery of shale oil and gas, new global climate change agreements, not to mention the global movement to divest from fossil fuels, have not been well-examined in the existing literature. The present study designed an analytical framework to investigate those aforementioned factors to see how they affect O&G corporate strategies in the development of renewable energy. The last gap which the study addressed is that little analysis was carried out on the discourses that O&G

companies have used to legitimize their business diversification from fossil fuels to renewable energy sources, given the fact that such renewable energy technology is not their core business. The understanding of such discourses is important, as it showcases the communication strategies that O&G companies have used to gain public acceptance on new types of energy sources. To investigate O&G corporate strategies on climate change mitigation and address the aforementioned gaps in the existing literature, the research conducted three studies, each of which attempted to answer one of three sub-objectives of this thesis. The main purpose and findings of each sub-objective are presented below.

7.1 Summary of findings for Sub-objective 1

Sub-objective 1: To examine renewable energy development projects of state-owned oil and gas companies and their associates in Thailand, Indonesia and Malaysia, in the first 15 years of 21st century

Sub-objective 1 was discussed in Chapter 4. The questions asked in this sub-objective are 1) whether major O&G companies in Southeast Asia have conducted renewable energy investment or not, and 2) which energy sources they are putting investment efforts to. These seem to be simple questions; however, the literature suggested that world major O&G companies have an on-off relation with renewable energy. Some major IOCs (such as ExxonMobil) are even opposing renewable energy developments, by stating that they are not profitable and outside the role of O&G companies. Understanding the renewable energy investment activities and changes throughout years of five O&G companies from Thailand, Malaysia and Indonesia is thus important in order to compare the investing behaviors of major world O&G companies.

The study conducted a thorough review on the actual renewable energy investment projects of PTT, Thai Oil, Bangchak, PERTAMINA and PETRONAS during the first 15 years of the 21st century. The results showed that all five companies have invested in renewable energy, but to various degrees and on a range of different technologies. Investment activities can be carried out in the forms of R&D, commercialization, and even CSR activities, as shown in Table 12 in section 4.4. All five companies have produced and commercialized biofuels. Bangchak and PTT appear to be more active in biofuels business

than the other three companies. They entered the upstream biofuel industry through palm oil plantation, whereas Thai Oil, PERTAMINA and PETRONAS did not make any such investments. Moreover, Bangchak and PTT carried out R&D on 2nd and 3rd generation of biofuel, an activity in which PERTAMINA and PETRONAS have less or no investment in. The study also found that biofuel investments appeared to be correlated with the oscillations in global crude oil prices. Nevertheless, the five companies maintain biofuel production and sales even though world crude oil price were cheap, due to existence of government mandates in each of the three countries.

Solar PV only became the focus of the attention of PTT, Bangchak and PETRONAS in recent years, when the cost of solar cells dramatically dropped and their respective governments initiated attractive Feed-in-Tariff policies. The solar PV installation capacity which Bangchak and PTT have attained is much higher than that of PETRONAS, whereas PERTAMINA has not yet installed any solar PV panels at the time of writing this thesis. However, PERTAMINA is the only company involved in the development and exploitation of geothermal energy, thanks to the high geothermal potential of Indonesia.

7.2 Summary of findings for Sub-objective 2

Sub-objective 2: To examine discourses or language-in-use of state-owned oil and gas companies and their associates in justifying renewable energy investment

Chapter 5 examined sub-objective 2. The focus of this chapter was to examine the discourses that O&G companies used to justify their investment in any given renewable energy source. The present study analyzed the discourses written in the annual reports of PTT, Thai Oil, Bangchak, PETRONAS and PERTAMINA, which are all available in the companies' websites until the 2015 annual reports, the latest published at the time of writing. Details of annual reports of five O&G companies were presented in Table 5 in section 3.4. Three questions were asked in the sub-objective, 1) what are discourses each oil and gas company applies to justify a given source of renewable energy?, 2) what sort of discursive legitimation strategies are used to justify a given renewable energy by oil and gas companies in Thailand, Indonesia and Malaysia?, and 3) what are the implications of a discourse study for the diffusion of renewable energy?

To answer the first question, the study identified and recorded discourses in each year for which annual reports were available in order to see the long-term dynamics and changes within the reports. The study presented all discourses that five O&G companies used to explain their reasons for investing in each type of renewable energy shown in Table 13-20 in Chapter 5 and Appendix A, B,C, D and E. Special attention was given to 1) the discourses that the O&G companies used in the first year that they started investing in a given renewable energy source, 2) the discourses which were used the most repeatedly and 3) the discourses which are specific to the socio-economic context of the home countries where the companies are located in.

The results showed that for biofuel investment all five companies referred to discourses on responding to government policy, and four companies except PETRONAS applied discourses on enhancing national energy security and biofuels are good for environment and health. At the time when PTT and Bangchak started the sale of biofuels products, the discourse on following the King's initiate and helping farmer were also found. These are interesting findings because the companies chose to cite these two discourses rather than the discourses on complying with government policy or discourse on environment protection. Not only these two discourses are specific to the socio-economic context of Thailand, the use of such discourses highlights the role of socio-political discourses on renewable energy development and diffusion, in particular at the early stages in their development and commercialisation. The study thus concluded that to promote new energy products in a society, socio-economic discourses could be a key driving factor that would complement technology development, economic incentives or government policy. The discourse study reveals the importance of language factors for renewable energy diffusion. Solar PV discourses were found only in the annual reports of PTT, Bangchak and PETRONAS. Three of them similarly applied discourses on making profits or business sustainability and protecting the environment to explain why they carried out solar PV investment. Since the beginning of solar PV projects, the three companies referred to the discourse of making profits or enhancing business sustainability. The study found that for the case of solar PV investment, the companies did not apply socio-economic rationales

which are specific to their home countries' contexts. The reason of this absence is explained in the second question.

The study answered the second question by categorizing the discourses found in the first question into four different types, based on an analytical framework on discursive legitimacy strategies, namely Authorization, Rationalization, Moral evaluation and Mythopoesis. The results showed that companies manipulated various discourses to legitimize their low-carbon energy projects. Figure 7, 8 and 9 in Chapter 5 showed the discursive legitimation strategies on biofuel, solar PV and geothermal investments, respectively. It should be noted that the companies have invested in other renewable energy sources, such as PTT carrying out investment in wind, biogas and hydropower. However, biofuel, solar PV and geothermal constitute the top three energy sources in which these companies have invested. Thus, the study focused on discourses of these three energy sources.

For solar PV, it is found that the four companies used authorization, rationalization and mythopesis, but not the moral evaluation, as discursive legitimacy strategies. This is because the companies sell power generated from solar PV to the grid, without directly being in touch with end-consumers, in contrast with what happens in their biofuel business. Thus, they do not have to apply moral rationales to gain public acceptance. Lastly, only PERTAMINA invests in geothermal at the moment. The study found that the company mostly applied rationalization and authorization as discursive legitimacy strategies for geothermal investment. However, with findings from only one case, the study cannot make a comparison on geothermal discourses. Thus, further research on discourses used by other O&G companies which invest in geothermal would be required to arrive at a conclusion on this regard.

The third question is on the implications of the discourse study for renewable energy diffusion. The findings from a discourse analysis on the investments in renewable energy of O&G companies provide a potential solution to address 'behavioral challenges', one of three sets of socio-technical barriers for renewable energy diffusion or penetration (Dulal et al., 2013; Jacobsson and Lauber, 2006; Painuly, 2001; Reddy and Painuly, 2004;

Sovacool, 2009; Sovacool et al., 2011). Based on socio-technical approach, there are three sets of intertwined and socio-technical barriers for renewable energy diffusion; namely economic, political and behavioural. According to Sovacool (2009), each type of barrier is understood as "economic barriers include financial impediments, market barriers, and market failures. Political barriers reflect regulatory challenges including weak and inconsistent political incentives, varying standards, competition among utilities, and underfunding of research and development. Behavioral barriers encompass the cultural and social dimensions of power technologies, and include public apathy and misunderstanding, psychological resistance, and the interpretive flexibility surrounding what consumers believe electricity should be" (p.4502).

The discourse analysis and discursive legitimation strategies conducted in this present study revealed how the O&G companies promoted and justified new renewable energy sources to the public given the fact that they are not conventional energy like fossil fuels. The most obvious contribution of the discourse study regards the public awareness and acceptance on biofuels products, as they are directly involved with a large group of consumers. Among the five companies studied, Thai O&G companies (PTT and Bangchak) applied a wide range of discourses and legitimation strategies for biofuel investment. Considering that Thailand's biofuels is the most successful case in Southeast Asia (Chanthawong and Dhakal, 2016), the discourses that the O&G companies in Thailand used can serve as a good example for other O&G companies in other countries to promote their biofuel products. However, further research is needed to see to what extent the discourses of O&G companies can influence public acceptance.

7.3 Summary of findings for Sub-objective 3

Sub-objective 3: To investigate factors that influence state-owned oil and gas companies and their associates to invest in or divest from renewable energy

Chapter 6 discussed sub-objective 3. Developing on the results of sub-objective 1, which pointed out that some companies (in particular those in Thailand) have been relatively active in investing in renewable energy, the study investigated the factors that influence companies to invest in or divest from low-carbon energy. In addition, in the study of discourses in sub-objective 2, the study acknowledged limitations in the methodology on critical discourse analysis. Discourse analysis helps revealing communication strategies, which O&G companies used to promote or justify their new green energy products. However, what the companies said as a reason of their green investment cannot necessarily be claimed to be the actual rationale for them to take action. This limitation is common in existing literature regarding applied discourse analysis on secondary data, such as the sustainability reports of the mining industry (Han Onn and Woodley, 2014).

As a result, the study applied a novel analytical framework to comparatively analyze all five companies from the three countries studied. The framework comprised three sets of factors obtained from a literature review on both academic journals and news articles from well-known business magazines. The three sets of factors were 1) company's specific features i.e. ownership structure and role of the CEOs and shareholders, expectation on short-term and long-term economic advantages, view on global climate change, 2) national factors i.e. home country's renewable energy and climate change policy, country's O&G reserves and renewable energy resources, social demand for environmental conservation and business-government relation, and 3) global factors i.e. volatility of world crude oil prices, discovery of shale oil and gas, development and cost of technology, and peer influences among O&G industry.

Three research questions in sub-objective 3 were addressed. The first question is to investigate the factors which influence O&G companies in Thailand, Malaysia and Indonesia to invest in renewable energy. The study summarized its main findings in Table 24, 25 and 26 in section 6.5 of Chapter 6. Among the three sets of factors, global factors are

less influential for O&G corporate strategies to conduct renewable energy investment than company specific features and national factors. This can be seen from the fact that company interviewees from PTT, Thai Oil, Bangchak, PERTAMINA and PETRONAS did not raise any concerns on some global factors i.e. global movements to divest from fossil fuels companies, the discovery of shale gas/oil or the Paris agreement- the latest global climate change agreement.

Secondly, company specific features were seen to be the most influential to drive O&G companies in Thailand to invest in renewable energy. This can be seen from the fact that PTT, Thai Oil and Bangchak are operating under the same national factors; namely a government policy on climate change and renewable energy development, country's O&G reserves and renewable energy resources, social demand for environmental conservation and business-government relations. However, each of them has pursued different business strategies. Bangchak is the most active in both biofuel and solar PV, considering the fact that the company started investment earlier than PTT and Thai Oil. Additionally, Bangchak has more installed capacity in solar PV than PTT does. The present study concluded that company specific features are the key factors driving O&G companies in Thailand to enter renewable energy businesses.

Thirdly, national factors, such as the country's O&G reserves, were the most influential factors that drive O&G companies in Thailand and Indonesia, which were more active in developing renewable energy sources than the O&G company in Malaysia. Because Thailand has the lowest O&G reserves among the three countries, PTT, the NOC of Thailand and its two associate companies, were pushed to look for alternative and renewable energy sources to secure the energy supply of the country. PERTAMINA, an Indonesian NOC, has become increasingly enthusiastic to find more new renewable energy sources due to depleting O&G reserves. Due to this simple but fundamental fact, O&G companies in each of the three countries have different business strategies in terms of renewable energy investment.

The second question is to examine differences and similarities between factors influencing NOCs and those influencing O&G companies in existing literature (western

IOCs and major NOCs). This is given the fact that only world major IOCs from developed countries and NOCs from Middle East, China, and Russia have been investigated in most of existing literature. The present study tested whether or not and to what extent factors found in the existing literature can be applied with the NOCs and their associate companies from developing countries in Southeast Asia-Thailand, Malaysia and Indonesia.

It was found that most of factors can be applied to the five O&G companies in the study, and some findings correspond to what happened with major IOCs and NOCs in the literature. Factors which appeared to have less influence or different influence on five O&G companies are 1) the role of private shareholders and the lesson learned from past experience in renewable energy business. The reason why the former factor appears to be of little important is because three of the companies studied are majority or 100% owned by the government- PTT, PERTAMINA and PETRONAS. The private shareholders thus have little or no impact at all on the decision making process of the companies. As for the lessons learned from the financial losses in renewable energy businesses, which was one of many reasons why ExxonMobil does not invest in green energy projects, the study found that only PTT experienced losses in biofuel investments (palm oil plantation in Indonesia). However, PTT continues its sales of biofuel products in Thailand, and what appears to matter for PTT's biofuel investments are changes in world crude oil prices and the government's biofuel mandate.

In the second group of factors (national factors), the factors which influence the five O&G companies are similar to major IOCs and NOCs except 1) social demand for environmental conservation and 2) business-government relations. In developing countries like Thailand, Malaysia and Indonesia, it is found that the public as well as NGOs are concerned with the prices of energy and living costs. As for the business-government relation, the five O&G companies seem to behave differently from what the existing literature proposed. This is because the five companies have strong links to their governments, or act as a regulator itself in the case of PETRONAS, which has been granted absolute authority to regulate and give license to upstream O&G business in Malaysia. Thus, business actors and governments cannot be viewed as separate entities, as seen in the

existing literature. The cause of such difference is due to existing literature having examined mostly IOCs, which are private owned companies, while the five O&G companies in this study are NOCs or their associates.

The third question is to highlight characteristics of O&G companies which are the most and the least likely to invest in renewable energy. Based on findings from sub-objective 1 in Chapter 4 and interview data with stakeholders in Thailand, Malaysia and Indonesia, the study concluded that Bangchak from Thailand appears to be the most active in green energy investment; whereas PETRONAS from Malaysia is the least active company and projects to remain in the core O&G business. The different condition between Bangchak and PETRONAS in terms of company specific features, national factors and global factors was illustrated in Table 27 in section 6.5.3. The present study proposes that the characteristics showed in Table 28 could be used in predicting whether O&G companies -both NOCs and private owned companies- are likely to invest in renewable energy.

Table 28 Characteristic of O&G companies which are more and less likely to invest in renewable energy

Factors	MORE likely to invest in renewable energy	LESS likely to invest in renewable energy
Ownership structure	Majority owned by private investors.	100% owned by the government.
CEOS' role	CEOs are concerned about sustainability issues, have a vision and see the importance of the green energy business	CEOs are not concerned about environmental issues, or have to report directly to the government or the head of government, who is concerned more on economic aspects rather than environmental issues.
Short-term economic advantages	The company does not have upstream business. So the company cannot switch to produce more gas to gain short-term advantages.	The company has abundant O&G reserves and has operated in upstream O&G industry. The company can switch to gas production as well as install CCS (Carbon Capture and Storage) technology to reduce emissions
Long-term economic advantages	Hold the view that renewable energy is profitable and can enhance its own business sustainability.	Hold the view that renewable energy is less profitable than O&G business, and projects that O&G will remain dominant in future energy mix.
View on compatibility of renewable energy to core expertise	Considers biofuels as part of its core expertise. As for renewable power generation, the company sets up a subsidiary to run the business. To address the lack of expertise in renewable energy technology, the company hires a consulting company or outsources.	Views that production as a burden and is reluctant to comply with the government biofuel mandate View that renewable energy is not its core expertise, and even that it is not the role of O&G companies to perform such investment
Country's O&G reserves and renewable energy resources	The company's home country has less O&G reserves and become a net oil or gas exporter. Moreover, there should be sufficient and diverse renewable energy sources	The home country has rich in O&G reserves and is still a net energy exporter.

Table 28 Characteristic of O&G companies which make it more and the less likely that they will invest in renewable energy (continued)

Factors	MORE likely to invest in renewable energy	LESS likely to invest in renewable energy
Business-government relation	The company has strong links with the government, and government officials are promoting the company to move towards investing in renewable energy.	The company has strong link with the government but the government prioritizes economic development more than environmental issues.
Volatility of world crude oil prices	The company was affected by the volatility of world crude oil prices, in particular during a period of high prices. The expensive crude oil prices encouraged the company to seek out alternatives and renewable energy.	The company made big profits when the crude oil prices were high and was discouraged to diversify their business portfolio into renewable energy. In addition, the company is capable of finding strategies to cope with lower revenues due to cheap crude oil prices
Discovery of shale oil/gas	The company does not invest in shale oil/gas	The company invests in shale oil/gas.
Peer influence among O&G industry	The company takes a leading role in renewable energy investment or follows the industrial peers, who are frontrunners in the green energy business.	The company align its business strategy with the leading industrial peers, who are not keen to invest in renewable energy

7.4 Policy recommendation

Whether O&G companies will move towards renewable energy or not depends upon a wide range of factors, be them company specific features, the national context of its home country, global socio-economic issues, as well as technology developments in any given renewable energy source. All factors intertwine and play a certain role in encouraging or discouraging O&G corporate strategies to climate change mitigation, especially renewable energy investment. Penha (2009), studying the world major oil companies' approaches to green energy investment, states that understanding the business strategies of oil companies is like playing a live puzzle, as each element is changing over time. The present study agrees with this statement and acknowledges that there is no single factor which can influence O&G companies' climate change strategy, nor one policy can solve all limitations and induce incumbents to steer their resources away from fossil fuels and toward renewable energy. However, the study draws some policy recommendation for the governments of Thailand, Indonesia and Malaysia to address pressing challenges, which were repeatedly raised by interviewees in order to clear a path for the low-carbon energy development of their O&G companies.

7.4.1 Policy recommendation for Thailand

Three of the O&G companies studied have already been quite active in conducting investments in renewable energy. The interviewees from PTT, Thai Oil and Bangchak, government authority and scholars shared the perception that Thailand is ahead of other Southeast Asian countries in renewable energy development. Some Malaysian and Indonesian stakeholders acknowledge that Thai O&G companies are more enthusiastic in developing low-carbon energy than their NOCs, and that their NOCs should follow Thai O&G companies' business strategies. Nevertheless, there are some issues hindering renewable energy development and need government action. Firstly, not only O&G companies but also renewable energy companies are facing the problem of having limited transmission lines, which has resulted in a limited quota to buy the electricity generated from renewable energy i.e. solar PV. PTT and Bangchak have addressed this problem by seeking out business opportunity abroad, such as in Japan and Myanmar. This is helping

the companies to expand their business and achieve investment targets. However, it is unlikely to be beneficial to Thailand in the long run. This is firstly because a large amount of capital is flowing out the country, and secondly the government's targets towards climate change mitigation and diversification of energy mix will be undermined. The present study thus suggests that the government encourages the establishment of partnership between O&G companies and electricity-generating company for these two entities to conduct joint investment in building more transmission lines. This will help lessen the government's burden in finding enough budget to stimulate O&G companies to engage more in renewable energy power generation.

The second policy recommendation regards biofuel development. Thailand has a surplus of bioethanol, while experiencing low productivity of palm oil. Bioethanol in Thailand is the most advance in the region as it has mixed 85% of bioethanol with gasoline. However, biodiesel production is limited due to a scarcity of palm oil. In the short-term, the government of Thailand should encourage or help establish trading between ethanol producers in Thailand and palm oil producers in Malaysia and Indonesia. This would help Thai O&G companies to commercialize a higher rate of biodiesel, and at the same time enable Malaysian and Indonesian companies to produce bioethanol. It is noted that at the present there is no bioethanol sales at service stations in either Malaysia or Indonesia. Nevertheless, biofuels can serve as a transition fuel. For the long-term solution, the government should move gradually move toward electric vehicles as a more sustainable solution for reducing GHG emissions in the transportation sector. O&G companies could contribute to this by transforming their gas stations into power-charging centers.

7.4.2 Policy recommendation for Indonesia

Indonesia is blessed with O&G reserves and diverse renewable energy resources i.e. geothermal and ocean energy. However, as many Indonesian interviewees mentioned, an unclear policy and lack of good cooperation among government offices are the main obstacles for utilizing its great renewable energy resource potential. At the present, PERTAMINA interviewees provided an insight that the company is seeking B2B (business-to-business) partnership with private companies and local government offices located in small islands far away from the grid to sell electricity generated from renewable energy. PERTAMINA initiated this business model to address the problem that PLN (Perusahaan Listrik Negara), a national electricity company, does not want to buy electricity from renewable energy, as it is more expensive than that generated from coal. Although the present study agrees with PERTAMINA's coping strategy, the government should still take action to pave a way for renewable energy development, not only for PERTAMINA, but also for other emerging renewable energy enterprises. As a result, the study suggests that the government establishes an independent organization which has the authority to implement policy and possesses financial resources to provide incentives to renewable energy developers. This new organization would be an all-in-one center, enabling unification of renewable energy development of the country.

Another potential solution to increase the uptake of renewable energy investment in Indonesia could be that the government promotes the investment in the upstream sector of renewable energy technology development. As one Indonesian government official pointed out in the interview, it could have been beneficial to Indonesia if the country had its own solar panels manufacturing industry. This would encourage domestic consumers to turn to solar PV energy for their alternative energy, since the prices of local products would be cheaper and more available than imported ones.

7.4.3 Policy recommendation for Malaysia

The present study found that PETRONAS is the least active in renewable energy investment among the five O&G companies. Many factors account for such a lack of activity, as explained in Chapter 6. However, what appears to be most influential factors are national factors, especially Malaysia's abundant O&G reserves and the government's relative lack of concern on environmental issues. Thus, it is difficult to elaborate a policy recommendation for the Malaysian government, as the government itself seems reluctant to change its dependence on O&G revenues and diversify the energy mix. The study perceives that the public and civil society of Malaysia could put pressure on the government and bring about policy changes. The media, academic institutions and NGOs could raise public awareness on environmental issues and the importance of transitioning towards a low-carbon energy future. Only in this way the government would be induced to change its policy direction, which could eventually affect PETRONAS's business strategies.

In addition, the fact that Malaysia has rich O&G reserves has created the mindset that the country can endlessly utilize the fossil fuels. However, such mentality would also put the country at risk of having to increase GHG emissions and being left alone in the global community, when other countries have been consistently moving forward to the transition to a low-carbon energy future. In this regard, the campaigns by both international and local NGOs could be crucial to raise public awareness on the risk of a high dependence on fossil fuels. The idea of keeping fossil fuel reserves in the ground as stranded assets, which the global movement for fossil fuel divestment is now advocating, should be imbedded into people's mindset, in particular those of the younger generations.

7.5 Rooms for future research

Understanding corporate strategies to climate change mitigation, especially focusing on diversification from fossil fuels to renewable energy, is crucial for policy makers to steer the powerful and resourceful O&G industry towards sustainable energy development. Either a discourse study on companies' annual reports or an empirical study on factors which could influence O&G companies to invest in renewable energy can enhance understanding on the behaviors and business strategies of firms. The present study produced a comprehensive picture regarding the three NOCs of Thailand, Malaysia and Indonesia; while also obtaining insights on two of the associates of Thailand's NOC. However, such research findings represent only the starting point for a study that provides a wider picture on NOCs. The present study hopes that students or scholars would continue work to clarify and produce a more comprehensive and in-depth knowledge on O&G corporate strategies to climate change mitigation.

7.5.1 Further research to cover more case studies

Apart from the three NOCs in Thailand, Malaysia and Indonesia, future research could include NOCs from other developing countries, either in Southeast Asia or other regions. NOCs of Vietnam, Brunei and the Philippines could provide further insights. In addition, Myanmar is another potential interesting case to study, given the fact that the country has very rich gas reserves and recently opened up for foreign investment.

7.5.2 Expanding time period

In the rapid changing world of the 21st century it will be important to continue investigating O&G corporate strategies for many years to come. At present the long-term impacts of the discovery of shale gas/oil, the new US administration under President Donald Trump, low crude oil price, the Paris Agreement and the global movement to divest from fossil fuels companies can still not be clearly seen. As a result, the study recommends continuing examining how these five O&G companies from Thailand, Malaysia and Indonesia will respond to such global phenomena over the next 5 or 10 years.

7.5.3 Discourse analysis on government energy policy

Only company's annual reports were analyzed in the study. However, future research could also run discourse analysis on government energy policy or the statements of Presidents, Prime Ministers or Energy Ministers and compare them with discourses found in companies' documents. This could show how O&G companies, and in particular NOCs, internalizes government discourses into their own languages.

7.5.4 Research on impact of O&G companies' discourses on renewable energy on public acceptance

As explained in the section 7.2, to gain a better understanding on how public acceptance can be influenced by the discourses that O&G companies used, there should be a further study on the relation between these two variables. The future research can start with public acceptance of Thai consumers towards biofuels products, as there is sufficient data on the discourses that PTT, Thai Oil and Bangchak have used in their annual reports. After obtaining the results for the case of Thailand, expanding the study areas to other countries could be very interesting. Vietnam appears to be a good candidate, given the fact that its government and national oil company, PetroVietnam, have tried but failed to stimulate the usage of biofuels. Many biofuels production plants were closed down because of low demand (Sapp**,** 2016a, 2016b).

7.5.5 Improvement on research methodology

To investigate the factors that influence O&G companies to invest in renewable energy, the study applied a qualitative methodology through semi-structured interviews. Future research can improve the research methodology in at least three directions. Firstly, the factors studied should be regularly updated. The study formed a comprehensive analytical framework that includes a wide range of factors that matter for O&G companies in late 20^{th} century and first 15 years of the 21^{st} century. In the next decades, there may be novel factors that start to influence O&G corporate strategies toward climate change mitigation. Secondly, the future study may apply quantitative approach investigating the relation of one or two important factors with corporate strategies. For example, changes

over year of O&G production volumes of O&G companies can be used to determine whether or not the companies are likely to invest in renewable energy business. Thirdly, the questionnaire survey with Likert scales can be applied to weight importance of each factor on decision making of O&G companies toward renewable energy investment. Having quantitative results from the survey can be useful for triangulating the interview data.

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Appendix

Appendix A

Appendix A: Tables of discourses on biofuels, Solar PV, wind, hydropower and biogas investment of PTT

Table 1 Discourses on biofuel investment of PTT

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy								-May 30, 2008: PTT and Toyota Group joined hands in the research and development of a new diesel technology called Bio-Hydrogenated Diesel or BHD, The innovation could respond to the government policy.	-Investment here was made through PTTGE, which consisted in producing crude palm oil for vegetable oil consumption and for biodiesel production as an alternative energy form and petrochemical feedstock, in line with the government policy on alternative energy and global warming caused by oil consumption	-Investment in this area was made through PTT Green Energy Co., Ltd. (PTTGE), and included production of crude palm oil for vegetable oil for consumption, as oleochemical feedstock, and in the production of biodiesel as an alternative energy in line with the government policy on alternative energy and reduction of global warming caused by oil consumption					-Responded to the policy of the Ministry of Energy in aiding suffering oil palm planters who suffered from plunge in prices of palm oil by buying 10 million liters, given its storage capacity, of 100% biodiesel or B100.

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of PTT (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Environmental reasons				-PTT has continued the research and development of environmentally friendly products and services; In 2004, various environmental programs were implemented such as the research and development of alternative fuels e.g. Natural Gas for Vehicles (NGV) and gasohol	-The company developed and expanded the markets for alternative fuels to reduce air pollution including NGV, Gasohol and biodiesel	-As a leader in the supply of alternative energy forms for a better environment and an active promoter of research and development of products and technologies for the environment, in 2006 PTT expanded its market of alternative energy to lower petroleum imports and air pollution	-PTT Gasohol 91 Plus, a new product, made its debut in response to His Majesty the King's initiative. This product contains an excellent engine cleaning agent of the US Top Tier Gasoline standard as well as a friction modifier for cleaner engines for improved combustion, higher driving efficiency, full power, fuel saving, reduced polluted emission	-PTT and Toyota Group joined hands in the research and development of a new diesel technology called Bio-Hydrogenated Diesel or BHD.. The innovation could respond to the government policy and, more importantly, is environment friendly through reduction of global warming		- PTT will invest more in the power business as well as other eco-friendly energy operations to counter global warming impacts, such as bio-fuels, both gasohol and biodiesel, and oleochemical products made from natural raw materials -…the palm oil business, which is an environmentally friendly energy source	-A notable example is bio-jet fuels, which lower aviation emissions under the Emission Trading Scheme (ETS) enacted in European countries				

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of PTT (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Help farmers			-…and **help provide more income for Thai farmers**; PTT offered gasohol at 12 locations in Bangkok. PTT first offered gasohol at its Head Office station. It was the first oil company to do so in Thailand										-…biodiesel by BMTA (Bangkok Mass Transit Authority) buses **in support of Thai farmers** by lowering the palm oil glut		-PTT invested in R&D of green energy and bioplastic while **supplementing value to agricultural products of community**

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of PTT (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Help alleviate consumers' burden esp. during high crude oil prices			-To provide **a less expensive alternative** for users of 95-octane gasoline, support His Majesty the King's efforts in promoting alternative energy, and help provide more income for Thai farmers; PTT offered gasohol at 12 locations in Bangkok.				-PTT Gasohol 91 Plus, … and – above all – **Baht 2/liter lower price than 91-octane gasoline**	- In addition to **helping alleviate consumers' burden during a time of high oil prices**, PTT led others in the procurement of alternative energy. During 2008, PTT has launched E20 & E85 Gasohol while developing B5 biodiesel.							

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of PTT (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Be a leader in RE business and active R&D and establish viable sustainable business					-Over the years, PTT has played a key role in supporting research and development of environment-friendly petroleum products and environmental technology. In 2005, the Company developed and expanded the markets for the alternative fuels to reduce air pollution including NGV, gasohol, and biodiesel	-As a leader in the supply of alternative energy forms for a better environment -An active promoter of research and development of products and technologies for the environment, in 2006 PTT expanded its market of alternative energy to lower petroleum imports and air pollution.					-As a commitment to business-driven technical expertise through environmentally friendly technology, we are sparing no resource to explore other alternative-energy products that can be further developed to establish viable sustainable-energy businesses in the future. A notable example is bio-jet fuels				- Signed a cooperative agreement on exploitation of the land and public utility systems in the WEcoZi. The business unit secured palm kernel shells to make biofuels in response to PTT's Green Roadmap and the optimal application of alternative energy

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of PTT (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Build self-reliance and national energy security from lowering oil imports					-Committed to finding and developing alternative energy products to reduce the national burden of long term oil imports, we have expanded our gasohol sales outlets to over 1,000	- in 2006 PTT expanded its market of alternative energy to lower petroleum imports and air pollution.	-Promoting alternative energy like Gasohol, Bio-diesel, and NGV for greater self-reliance	- Gasohol and biodiesel were the publics' other choices in the collective efforts for greater self-reliance - E85 gasohol, with a higher ethanol content, will lead to less dependence on imported fuels.		-PTT distributed over13,925 million liters and constantly promoted bio-fuels-gasohol to replace gasoline, and biodiesel to replace diesel	-PTT continued to promote biofuel energy as an alternative option, with gasohol to replace gasoline and biodiesel to replace diesel.	-PTT continued to promote biofuel energy as an automotive option, with gasohol to replace gasoline and biodiesel to replace diesel.	-PTT continued to promote biofuel energy as an automotive option, with gasohol to replace gasoline	-PTT also constantly promotes biofuels—namely gasohol to replace gasoline, and biodiesel to replace diesel.	

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of PTT (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Follow HM the King's initiative			-…To provide a less expensive alternative for users of 95-octane gasoline, support His Majesty the King's efforts in promoting alternative energy, and help provide more income for Thai farmers; PTT offered gasohol at 12 locations in Bangkok.				-PTT Gasohol 91 Plus, a new product, made its debut in response to His Majesty the King's initiative.								

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of PTT (continued)

Discourse strands \ Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Reduce risk of raw material shortage from using agricultural products								- PTT and Toyota Group joined hands in the research and development of a new diesel technology called Bio-Hydrogenated Diesel or BHD, the first of its kind in Thailand. This was an innovation of biomass fuels created from various raw materials, such as jatropha and algae, which can reduce the risk of raw-material shortage from using agricultural products.							

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on solar PV investment of PTT

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Business benefits to company										-PTT is committed to development of novel alternative energy forms amendable to value addition					
Environmental reasons										-Equally important, PTT is committed to the development of novel alternative energy forms amenable to value addition or regarded as friendly to the environment, including power generation from wind energy, solar energy, and compressed biogas for vehicles in place of NGV. T - Bangchak's suuny project.. as well as to promote electricity generation from clean energy to reduce health and pollution impacts					
Enhance national energy security										-August • Bangchak's foundation laying ceremony and the launch of electricity from the solar-cell project "Sunny Bangchak" with an installed capacity of 38 MW. Electricity from the project will be sold to EGAT and the Provincial Electricity Authority (PEA) in the fourth quarter of 2011. The project aims to enhance national energy security and increase electricity reserves to meet the demand of the business sector and private households, as well as to promote electricity generation from clean energy to reduce health and pollution impacts.					
Respond to consumers' demand										-Bangchak's sunny project… increase electricity reserves to meet the demand of business sector and private households					

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on wind energy investment of PTT

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Positive benefit for business										-PTT is committed to development of novel alternative energy forms amendable to value addition					
Environmental reasons										-…regarded as friendly to the environment					

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on hydropower investment of PTT

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Positive benefit for business													-add value to PTT Group		
Energy security of Thailand													-enhance energy security		
Economic benefit for Thailand													-generate revenue for Thailand		

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on biogas investment of PTT

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Alternative to normal fossil fuels										-Agree to buy 6 tons/ day of biogas to substitute to diesel -Buy biogas from company producing CBG and sell it as an alternative to NGV for car fuel in areas far from NGV stations in the northeast	-…substitute for NGV in remote areas		-To cut demand energy for truck or vans by some 320,000 liters or some baht 9.6 million baht per year		
Environmental reasons											-Research on global warming mitigation: production of biogas from the resulting biomass				

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Appendix B: Tables of discourses on biofuels, Solar PV investment of Bangchak

Table 1 Discourses on biofuel investment of Bangchak

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy			- Expansion of sales of "Bangchak Gasohol 95" at 99 service stations in Bangkok Metropolitan to honour His Majesty the King for the royal initiative on gasohol promotion project in Thailand, to support the "Clean Oil Policy" of the Government and to promote more utilization of Gasohol 95 especially in big cities with heavy traffic.	-in response to the policy to replace total utilization of normal unleaded Gasoline by Gasohol -cooperated with Department of Alternative energy Development and Efficiency (DEDE) in a project to research the biodiesel production and utilization -in compliance with the National Agenda -support to development of biofuel…in line with Ministry of Energy's strategy of sustainable development of alternative energy	-in consistence with the government policy to emphasizing utilization of alternative energy -biodiesel utilization would also be encouraged in accordance with the government policy	-with the expansion, the Company helps support the government policy of promoting production and distribution of biodiesel -due to government policy to promote the production and use of biodiesel replacing diesel at 8.5 million liters per day, the company supports by expanding the number of service station which sell B5 to 200 stations.	-under the government's alternative energy promotion policy for energy security and lower energy imports	Corresponding with the government's policies and measure to promote RE, for economic and energy security of the country	this move is in line with the government policy to promote RE to strengthen the national energy security and economy	in cooperation with the Ministry of Agriculture and Cooperatives, Ministry of energy and Bank for Agriculture …will initiate a conversion of abandoned orange farm to palm plantations		Bangchak Biofuel Co.Ltd was set up In support of the public policy on alternative-energy promotion …	Bangchak Biofuel Co.Ltd was set up In support of the public policy on alternative-energy promotion …	Palm plantation … in line with the public sector's alternative/RE promotion plan	

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Bangchak (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Environmental and health reasons			-to promote more utilization of Gasohol 95 esp. in big cities with heavy traffic				-used vegetable cooking oil as its main raw material… this can help address the health problem of Thai people caused by the consumption of the used cooking oil and tackle the environmental problem stemming from the disposal of the used cooking oil in the public sewage system				-aware that refining business consumes a large amount of energy and emits considerable carbon dioxcide, the company has set a target to be Carbon Neutral Company	-aware that refining business consumes a large amount of energy and emits considerable carbon dioxcide, the company has set a target to be Carbon Neutral Company	-aware that refining business consumes a large amount of energy and emits considerable carbon dioxcide, the company has set a target to be Carbon Neutral Company	-aware that refining business consumes a large amount of energy and emits considerable carbon dioxcide, the company has set a target to be Carbon Neutral Company	-Pursue the status of a low-carbon company : Set a goal of posting a minimal volume of carbon dioxide emission by relentlessly operating a project to improve energy and refinery resource efficiency, while investigating investment in renewable/alternative energy. -E20S gasohol features outstanding properties due to the S Purifier and S Modifier, which complete fuel combustion in the engine, thus providing power and environmental protection. With less combustion pollutants because of lower sulfer content (10 ppm), E20S is superior to the Euro 5 standard. -Bangchak is also the first in Asia to produce gasohol E20 of the Euro 5 standard. The product is environmentally friendly with a sulfur content of lower than 10 ppm -Bangchak developed and launched new products with “Green S” technology, namely “E20S” gasohol and “Hi Diesel S” diesel, blended with an additive that enhances efficient combustion while giving more power to the engine and reducing emissions from combustion, thus conserving the environment. -The Company launched the “Bangchak E20 S, The new “E20 S” also contains lower sulfur than EURO 5 requirement, make it more environmental friendly

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Bangchak (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Enhance national energy security by lowering oil imports					Biofuel was concerned as alternative energy to replace total utilization of diesel		-Research on biodiesel production at Bang Pa-In … aside from strengthening the country's energy security and saving foreign currency income -…has realized the importance of alternative energies, particularly those derived from vegetables which contributes to enhancement of energy security and reduction of country's foreign exchange losses from the considerable oil import	-the company is aware of importance of the alternative energy, especially ethanol and biodiesel which contributes to the country's energy security and reduction of foreign currency losses from oil imports	-contributes to the country's energy security, reduction of foreign currency losses from oil imports			Recognizing the significance of alternative energy, which benefits national energy security and lowers trade imbalances resulting from fuel imports	Recognizing the significance of alternative energy, which benefits national energy security and lowers trade imbalances resulting from fuel imports	Recognizing the significance of alternative energy, which benefits national energy security and lowers trade imbalances resulting from fuel imports	Recognizing that renewable-energy is imperative for national energy security by reducing trade deficits from oil imports, Bangchak promotes ethanol and biodiesel for blending in gasoline and diesel. Its products in this category include Gasohol 91, Gasohol 95, Gasohol E20, Gasohol E85, and Hi-diesel.

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Bangchak (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
For business sustainability, diversify income risk, and be a leader in RE					… the leading role concerning alternative energy would be emphasized by expanding the number of service stations for sale of gasohol 95 and 91.	-the Company in 2006 continued its 2005 policy of being the leader of RE by consistently expanding sales of Gasohol 95 ,91 and biodiesel. -After the Company achieved its goal of becoming the leader in distributing Gasohol95, other oil traders have followed in the Company's footsteps…	…as a leader in alternative energy, joined hands with the Office of Basic Education Commission in organizing the contest …			-for sustainable business value creation, the company will restructure its current revenue stream of 70%:30% which is vulnerable to the volatility of oil prices, within 2015, the targeted revenue structure will be 50%:20%:30% for refining, marketing and new businesses. emphasis on new business will be on clean energy and alternative with steady income and low dependence on external factors -thanks to its vision to forge environment-friendly energy business for sustainable development, the company values investment n downstream ventures for the sake of its own sustainability	-clean energy is Bangchak's tool for sustainable development, a goal that is being achieved through our solar farm, biodiesel and ethanol plants -emphasis on new business will be on clean energy with steady income and low dependence on external factors…it will steadily add value to the business and diverse the risks of income sources in the future -Thanks to its Greenergy vision which entails sustainable development and to lower risks of engaging solely in the oil business, …	within 2016, the targeted revenue structure will be 60%:20%:20% for refining, marketing and new business, with steady income and low dependence on external factors.. diverse the risks of income sources in the future	-to diversify income risks… in harmony with the Greenergy Excellence vision - recognizing high volatility facing reefing business as well as volatile oil prices… Bangchak set its goal in 2020 for refining income at 50% versus 50% for emerging businesses.. designed to ass secure value to Bangchak's business while effectively diversifying risk to future income	-to diversify income risks… in harmony with the Greenergy Excellence vision -committed to leadership in alternative and renewable energy -recognizing high volatility facing the refining business as well as volatile oil prices… Bangchak set its goal in 2020 for reefing income50%:50% for emerging business	-It has also spread its wings to other businesses, including power production from solar energy (solar farm) - a clean source of energy from nature, biomass energy, petroleum exploration and production, and innovation-oriented businesses. Bangchak's mission is to enhance national energy security, while investing in new businesses to keep the organization moving forward and ensure sustainability. -Long-term managementof risks caused by world oil price fluctuation.New investments that can generate steady revenue have become more and more significant. Bangchak has expanded its investment to power production and energy crop (plant) businesses.

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Bangchak (continued)

Discourse strands \ Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Be a responsible company, run business model with benefit to environment and social development					-As a responsible Thai petroleum company					-this business model (change orange farm to palm plantation) benefits the environment and provides higher income to support social development in agricultural communities	-these (alternative energy projects) represent business development approaches that align with environmental changes, reduce global resource consumption and thus least impacts the environment -aware that business operations that lack social and environmental activities are unsustainable, the company is determined to do business in such a way that not only can it sustain continuous growth but also simultaneously generate positive impacts on society and the environment		-palm production…this business model benefits the environment and provides higher income to support social development in agricultural communities -committed to undertaking its energy business in an environmentally friendly way for sustainable development…		

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Bangchak (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Help alleviate consumers' burden esp. during high crude oil prices					…willingly aimed to alleviate impacts of rising oil prices to the public	…provide the public with quality oil at a time when oil prices are rising									
Thailand has potential as an agricultural country						For Thailand, an agricultural country, the most appropriate RE is biofuels									
Follow HM the King's initiative on biofuels project and self-sufficient philosophy			…expand of sales Bangchak gasohol95 to honor HM the King for Royal initiative on gasohol promotion project in Thailand			-with our gratitude to His Majesty grace and wisdom of RE, the Bangchak Petroleum Plc. has adopted the royal initiative on alternative energy to develop gasohol and bio-diesel for sale at our service stations -To celebrate on the auspicious occasion of the 60th Anniversary of HM Accession to the Throne in 2006 and HM the King's 80th birthday Anniversary in 2007, the company has launched many projects and activities to mark and to publicize HM works on RE. -HM the King recognized the benefits of biofuel… -For more than 20 years, HM the King has been embarking Thailand on the experimentations with bio-based fuels under the Royal Chitralada Project	-the Bangchak has integrated the philosophy into business operations and we have produced and marketed crops-based gasohol and biodiesel upon the initiate research at HM's Chitralada Palace -…to promote HM's ideas and to honor on his 80th birthday anniversary		…apply the initiatives on RE of HM the King, in line with HM the King's Sufficiency Economy philosophy						

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Bangchak (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Enhance Thailand to step forward in the era of RE					-…enhance Thailand to step forward into the era of development and utilization of alternative energy sources as in counties in EU and USA										
Respond to demand from consumers					-…provide convenience for customers and the public in using gasohol instead of benzene -…in order that customer can find gasohol more easily	- …to ensure that there will be enough bio-diesel for sale consistently, the company invested in installing a bio-diesel production unit which uses palm oil, soap, or used cooking oil.									

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Bangchak (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Help farmers							-The Research Centre at Bang Pa-In initiated its biodiesel production development project which will lift the living quality of farmer -the other benefit… is it can help shore up the falling farm product prices, create jobs and generate more incomes to farmers	-…helps increase the price of agricultural products, create jobs and generate more incomes for farmers	-…supports of local agricultural sectors in terms of local employment and improve their quality of living			-…while generating income for farmers	-…while generating income for farmers	-…turning deserted orange groves into palm oil plantation to generate income for Rangsit farmers	-A deserted orange plantation was turned into a palm oil planting area to attract farmers to palm oil planting,which gives higher financial benefit than other plants in such an area with acidic soil.

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on Solar PV investment of Bangchak

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Enhance national energy security by lowering oil imports										- Recognizing the significance of alternative energy, which benefits national energy security and lowers trade imbalances resulting from fuel imports, the Company has launched the Sunny Bangchak solar power plant project at Amphoe Bang Pa-in of Ayutthaya province					
Be a responsible company, run business model with benefit to environment and social development											-These represent business development approaches that align with environmental changes, reduce global resource consumption and thus least impacts the environment		-…committed to undertaking its energy businesses in an environmentally friendly way for sustainable development		

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on Solar PV investment of Bangchak (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
For business sustainability, diversify income risk, and be a leader in RE										-investment…have been made to strengthen the Company -for sustainable business value creation, the company will restructure its current stream of 70%:30% between refining and marketing which is vulnerable to volatility of oil prices…within 2015,the targeted revenue structure will be50%:20%:30%...Emphasis on new business will be on clean energy with steady income and low dependence on external factors… -thanks to its vision to forge environment-friendly energy business for sustainable development, the company values investment in downstream ventures for the sake of its own sustainability	-clean energy is Bangchak's tool for sustainable development - Emphasis on new business will be on clean energy with steady income and low dependence on external factors… -it will steadily add value to business and diverse risks of income sources in the future -Thanks to its Greenergy vision which entails sustainable development and to lower risks of engaging solely in oil business	-this year, our solar power plant-one of our flagship RE business ventures-began accrual income which has grown our income base and lowered risks associated with the refinery and marketing, our traditional core business -Within 2016, the targeted revenue structure will be 60%:20%:20% for refining, marketing and new businesses	-to diversify income risks, Bangchak has constantly grown its alternative-energy businesses. -recognizing high volatility facing the refining business as well as volatile oil prices and…Bangchak set its goal in 2020 for the refining income 50% versus 50% for emerging businesses - committed in alternative energy leadership	-to diversify income risks, Bangchak has constantly grown its alternative-energy businesses…in harmony with the Greenergy Excellence vision -recognizing high volatility facing the refining business as well as volatile oil prices and…Bangchak set its goal in 2020 for the refining income 50% versus 50% for emerging businesses, commanding steady income and low risks posed by external factors	- Strive for financial stability by diversifying income risks through investment in renewable-energy businesses, marked by income certainty and regularity, including solar power plants and geothermal power plants. - For corporate sustainability, Bangchak has diversified and expanded investment to related businesses, namely the renewable energy, power from renewable energy, … - It has also spread its wings to other businesses, including power production from solar energy (solar farm) - a clean source of energy from nature, biomass energy, petroleum exploration and production, and innovation-oriented businesses. Bangchak's mission is to enhance national energy security, while investing in new businesses to keep the organization moving forward and ensure sustainability. - Strive for business growth and diversify risks toward businesses with secure revenue : Set growth goals by supplementing sustainable value to businesses through growing the proportion of revenue from new businesses of clean energy and other energy businesses, marked by constant revenue stream and low risks due to external factors. - New investments that can generate steady revenue have become more and more significant. Bangchak has expanded its investment to power production and energy crop (plant) businesses. Its solar energy business has a current production capacity of 118 MW

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on Solar PV investment of Bangchak (continued)

Discourse strands \ Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Environmental and health reasons											-aware that refining business consumes a large amount of energy and emits considerable carbon dioxcide, the company has set a target to be Carbon Neutral Company	-aware that refining business consumes a large amount of energy and emits considerable carbon dioxcide, the company has set a target to be Carbon Neutral Company	-aware that refining business consumes a large amount of energy and emits considerable carbon dioxcide, the company has set a target to be Carbon Neutral Company	-aware that refining business consumes a large amount of energy and emits considerable carbon dioxcide, the company has set a target to be Carbon Neutral Company	- Pursue the status of a low-carbon company : Set a goal of posting a minimal volume of carbon dioxide emission by relentlessly operating a project to improve Energy and refinery resource efficiency, while investigating investment in renewable/alternative energy. - It has also spread its wings to other businesses, including power production from solar energy (solar farm) - a clean source of energy from nature, biomass energy, petroleum exploration and production, and innovation-oriented businesses.

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Appendix C: Tables of discourses on biofuels of Thai Oil

Table 1 Discourses on biofuel investment of Thai Oil

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy					-Thaioil and our subsidiaries operate under laws, rules and regulations, changes to which may affect the operational and business performance of Thaioil Group as a whole. For instance, the government's campaign for energy conservation,for the use of gasohol as an alternative to gasoline, and other drives may require future investments in or modifications to the production processes of Thaioil Group. -Our policy on business development and strategic planning involves studying new business opportunities and challenges that align with government policies while promoting programs of public merit. Our preliminary study on the production of high quality ethanol fuel from cassava indicated a satisfactory return on investment	-This project-(Ethanol production) is being study to cope with new business opportunity arising from the national energy policy on the promotion of biofuels.	-This decision was made in light of the domestic supply-demand situation which is contingent on the government's energy policy in providing support to the blending of ethanol in gasohol. The regional ethanol market indicates a demand growth in the future and requires further study	-Thaioil further aims to invest in additional projects to produce ethanol from cassava and sugar cane juice. This is in response to the anticipated high growth in ethanol demand resulting from the energy policy of the government to promote gasohol usage.	-Ethanol production business support the government's policy in developing clean fuels and alternative energy -the ethanol business through joint venture projects… in support of the country's gasohol project which will serve the government policy with respect of gasohol usage -Alternative Energy To address the government's alternative energy policy, Thaioil has studied the viability of investing in a number of alternative energy sources, such as biomass, solar and wind power plants.		-As for alternative energy, Thaioil Group plans to develop its ethanol business by following the government-sector approach of alternative-energy application.				

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Thai Oil (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Environmental reasons								-Ethanol from sugar cane juice is another clean energy option that will help the environment and reduce global warming. The project balances our business objectives with environmental and social responsibility.	-(ethanol production business) support the government's policy in developing clean fuels and alternative energy to reduce pollution and enhance the quality of life of the Thai society		-The fact that Thaioil successfully produced gasohol, gasoline, and diesel under EURO 4 standard ahead of nationwide enforcement in 2012 enabled it to sell these products to domestic customers for environmentally friendly consumption faster		-Through an affiliate, it also invested in the production of ethanol, a form of alternative energy popularly blended with gasoline to form gasohol. When comparing gasohol to other fuel, gasohol yields less greenhouse gas emissions and leads to less global warming in view of the product lifecycle.		

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Thai Oil (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Help farmer						-Besides reducing imported fuel products, the project will improve earnings of agricultural growers, create jobs and generate revenue in reduced labor movement areas, and add value to domestic agricultural products. -This project is being study to cope with new business opportunity arising from the national energy policy on the promotion of biofuels. The use of ethanol in gasoline will not only strengthen the country's energy security but also reduce MTBE imports. In addition, the ethanol project will also help stabilizing revenue for agriculture sector as a whole.										
Enhance national energy security by lowering oil imports						-In response to corporate social responsibility, we undertook a study to produce ethanol from agricultural products as an alternative fuel source -Besides reducing imported fuel products, the project will improve earnings of agricultural growers, create jobs… -The use of ethanol in gasoline will not only strengthen the country's energy security but also reduce MTBE imports.										

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Thai Oil (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
See business opportunity and become a leader						-Ethanol Production Projects. This project is being study to cope with new business opportunity arising from the national energy policy on the promotion of biofuels.				-As for alternative energy, Thai Oil Group is keen on developing its ethanol business from agricultural supplies since Thailand commands the potential to become an ethanol hub to meet regional needs. -In addition, Thai Oil is investigating more investment in the power and alternative-energy businesses to support its move toward leadership of the energy group in Asia Pacific.	-…aligns with Thai Oil's long-term strategic plans for alternative energy and ethanol market development for future export Thai Oil Ethanol Co., Ltd. and Bangchak Petroleum Plc signed a share acquisition agreement with Ubon Bio Ethanol Co., Ltd. (UBE), under which each was to hold 21.28%.UBE produces ethanol from fresh cassava and cassava chips with a capacity of 400,000 liters per day, which aligns with Tha i Oil's long-term strategic plans for alternative energy and ethanol market development for future export. -This in turn indicates an opportunity for other potential exporters of ethanol to capture some of Brazil's former markets. Thai Oil Ethanol has therefore planned to secure suitable warehouses to support its ethanol export to the Philippines, whose government is set (gasohol) to enforce a rise in the ethanol-blending content in gasoline from 5% to 10% by February 2012.				

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Thai Oil (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Adhere to business objectives with environmental and social responsibility						-In response to corporate social responsibility, we undertook a study to produce ethanol from agricultural products as an alternative fuel source.		-Ethanol from sugar cane juice is another clean energy option that will help the environment and reduce global warming. The project balances our business objectives with environmental and social responsibility							-Aiming for relentless improvement in all work processes, the Company executed its 2014-2018 Sustainable Development Master Plan, resulting in its support to greenhouse gas (GHG) emission reduction of 26,827 tons of carbon dioxide through the more than 19 projects that increase the efficiency of energy; increase the production capacity and sale of biodiesel;

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on biofuel investment of Thai Oil (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Enhance quality of life of Thai people									-(ethanol production business) support the government's policy in developing clean fuels and alternative energy to reduce pollution and enhance the quality of life of the Thai society						

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Appendix D

Appendix D: Tables of discourses on geothermal and biofuels investment of PERTAMINA

Table 1 Discourses on geothermal of PERTAMINA

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy									-support the second phase of the government program to supply 10,000 MW of electricity		-PERTAMINA Geothermal exploration and production activities are conducted entirely within the country and are intended to support government programs providing a second stage 10,000 MW of electricity - Geothermal is currently being actively developed in Indonesia for power generation purposes	-intended to support government program providing a second stage 10,000 MW -actively developed in Indonesia for power generation purposes. In PLN's program for accelerated development of power plant (fast track) 10,000 MW Phase II, around 3,900 MW is planned to be obtained from geotehrmal	-intended to support government programs providing a second stage 10,000 MW of electricity	-the government is expected to prioritize the use of geothermal energy considering that it will be lost if not used.	-Government has rolled out a development acceleration program of 10,000 MW power plant, in which 49% is sourced from geothermal. National energy policy is targeting power supply of 9,500 MW in 2025 from geothermal power plant.

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on geothermal of PERTAMINA (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Enhance national energy resilience										-The activity of developing RE and alternative energy is part of PERTAMINA's effort in supporting national energy resilience		-…become the back bone of national energy security	-the development of geothermal remains a strategic priority of PERTMINA in support of the national energy resiliency , especially the proportion of geothermal in the national energy mix		
Geothermal is upstream business of PERTAMINA						-The upstream business sector comprises exploration and production of oil, gas and geothermal energy	-The upstream business sector comprises exploration and production of oil, gas and geothermal energy	-The upstream business sector comprises exploration and production of oil, gas and geothermal energy							-PERTAMINA also places geothermal energy management in the upstream sector.

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on geothermal of PERTAMINA (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
GHG emission reduction and obtaining CER climate credits									-PERTAMINA will obtain CER climate credits		-Geothermal is one of the environmental friendly RE	- Geothermal is one of the environmental friendly RE			Emission reduction is carried out through engineering efficiency/adjustment on emission sources from PERTAMINA operations, which are internal and external combustion, flaring, thermal oxidizer and incinerator, Sulfur recovery unit, fugitive emission, storage tank, Fuel loading and unloading activities, catalytic cracking unit, CO2 removal unit, geothermal power plant, and waste water treatment plant.
Growth and profits for company									-PERTAMINA has invested and developed business in both upstream and downstream sectors to accelerate growth and increase profits.	-PERTAMINA carries out investments and business development in upstream and downstream sectors as a strategy to spur growth and improve profitability					

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on geothermal of PERTAMINA (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mitigate the risk of decreasing oil and gas reserve									-The risk of the irreplaceable Oil and Gas Reserves. The company mitigates this risk by looking for new reserves.. do alternative energy mining such as geothermal resources and coal bed methane	-conducts risk mitigation to anticipate depleting oil and gas reserves by exploring new reserves, acquiring domestic and oversea blocks, developing alternative energy such as geothermal	-Risk of non-renewable Oil and Gas Reserves, the company's main income depended to oil and gas reserve	-non-renewable oil and gas reserve: Income deficiency due to the company's dependence on oil and gas reserves	- non-renewable oil and gas reserve: Income deficiency due to the company's dependence on oil and gas reserves		
Economic prosperous and enhance well-being of Indonesia people						-play strategic role in national stability and economic growth - improvement of the economic activity for the purpose of the welfare and prosperity of the people	-improve growth and revenue by increasing oil, gas and geothermal energy reserves and production	-to contribute in growing the economy in pursuance of people's well-being and prosperity	-The company's objectives are to generate profit based on effective and efficient corporate management and to contribute to the achievement of economic growth in pursuance of the people's well-being and prosperity.	-PERTAMINA manages the company effectively and efficiently to contribute to the improvement of economic activities for the welfare and prosperity of the people. -the company's objective is to generate income and contribute to the improvement of the economy for the benefit of the Indonesian public		-become a driving force of the Indonesian economy now and in the future			

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 1 Discourses on geothermal of PERTAMINA (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Company vision											-PERTAMINA's vision to become a world class energy company is also reflected in the consistency of the Company in the development of new and RE sources. Currently, focuses on geothermal and Coal Bed Methane -PERTAMINA's involvement in the geothermal is in accordance with its vision as an energy company	-its vision of becoming a World Class Energy Company and Asia Energy Champion by 2025 -PERTAMINA is committed to turn itself into an integrated energy company (CBM, geothermal ,new and RE) -Entrusted with the New Energy, utilization of new and RE as a means toward a position as a key player in the regional as well as global energy business -PERTAMINA's involvement in the geothermal is in accordance with its vision as an energy company			
Potential geothermal in Indonesia													-Indonesia is the country with the greatest geothermal energy potentials in the world. Therefore the development of geothermal energy has excellent prospect, especially for generating power. -Indonesia has a huge potential for utilizing geothermal energy for the purpose of generating powers.	-the use of geothermal gives a very promising hope in the future. Availability of geothermal in Indonesia is a valuable resource that should be utilized. -Indonesia is the third largest country producing geothermal energy with a production capacity of 1,339 MW. This indicates a good prospect for geothermal energy development especially for electricity generation.	-Indonesia has one of the largest potential geothermal energies in the world with power source of 29 GW, and recorded as the third largest country in the world producing geothermal energy with production capacity of 1,339 MW. This indicates that there is still open broad opportunity of geothermal energy development in Indonesia, particularly for power plan

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
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Table 2 Discourses on biofuels investment of PERTAMINA

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Respond to government policy						-in compliance with the Instruction of the President of the Republic of Indonesia No.1 Year2006 regarding Supply and Use of Biofuel as Alternative Fuels and Presidential Decree of the Republic of Indonesia No.5 Year 2006 regarding National Energy Policy	-in compliance with the Instruction of the President of the Republic of Indonesia No.1 Year2006 regarding Supply and Use of Biofuel as Alternative Fuels and Presidential Decree of the Republic of Indonesia No.5 Year 2006 regarding National Energy Policy -the government program (mentioned above) encouraged SOEs(State-owned enterprises) to develop and use bio fuel	-to date, the Company supports Government policy in increasing biofuel usage enhanced oil fuel products such as Bio Premium and Bio Pertamax… and Bio Solar						-Since the issuance of the Presidential Regulation No.5 fo 2006, the development of new and renewable energy potentials in Indonesia is growing. At present, PERTAMINA fulfills its responsibility in biodiesel utilization with 10% mix -the government also issued a Regulation from the MoEMR No.20/2014 that supports the acceleration of biofuel use for transportation and power plants, PERTAMINA responded with a positive NRE (new and RE) contribution target for 2025 which was 5% from biofuel, 5% geothermal 2% liquefied coal, and 5% combination of biomass, nuclear, water, solar power and wind power.	-In order to comply with Government policy regarding mixture of Biofuels (BBN) of 15% in this year and as much as 20% in the next year, PT Pertamina (Persero) cooperates with 11 companies of BBN producer in Indonesia. Procurement of mixture Oil Fuel with this biofuels will supply 63 TBBM belong to Pertamina to fulfill the period needs of November 2015 up to April 2016 with total volume of 1.84 million kiloliters (KL). -Government commitment towards biofuel (BBN) development was increasingly visible by the issuance of a number of regulations at Minister level… The regulation requires all enterprises of Fuel business license holders to deliver Fuel that was mixed with 15% Biofuel, effective from 1 April 2015.

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on biofuels investment of PERTAMINA (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Company mission							-the year of 2007 is the initial period of PT PERTAMINA (PERSERO) Transformation Program…the perfection of the company's vision from To be a leading,advanced and respected company to "To be a world class national oil company with the mission "to carry out an integrated core business in oil,gas and biofuel,based on strong commercial principles"	-Mission: integratedly performing core business of oil,gas and biofuel, based on strong commercial principles	-Mission:To conduct the core business of oil, gas and biofuels in an integrated fashion based on sound commercial principles	-Mission:To conduct the core businesses of oil,gas and biofuels in an integrated fashion based on sound commercial principles	-The Company's Mission focuses on running the Company's core business in oil, gas and biofuels in an integrated way, based on strong commercial principles.				

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on biofuels investment of PERTAMINA (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mitigate the risk of decreasing oil and gas reserve							-reduce the use of non-renewable fossil fuel		-The risk of the Irreplaceable Oil and Gas Reserves… the company mitigates the risk by looking for new reserves, block acquisition inside and outside country, do alternative energy	-oil and gas are non- renewable natural resources. PERTAMINA conducts risk mitigation to anticipate depleting oil and gas reserves.	-Risk of Non-renewable Oil and Gas Reserves	-development of biofuel to replace diesel fuel -Non-renewable Oil and Gas Reserve Risk: income deficiency due to the Company's dependence on oil and gas reserves	- Non-renewable Oil and Gas Reserve Risk: income deficiency due to the Company's dependence on oil and gas reserves		

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Table 2 Discourses on biofuels investment of PERTAMINA (continued)

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Economic prosperous and enhance well-being of Indonesia people							-the company's objective is to generate income and contribute to theimprovement of the economy for the benefit of the Indonesian population			-the company's objective is to generate income and contribute to the improvement of the economy for the benefit of the Indonesian population	-the company's objective is to generate income and contribute to the improvement of the economy for the benefit of the Indonesian population				
GHG emission reduction and obtaining CER climate credits									-PERTAMINA will obtain Certified Emission Reduction (CER) climate credits because there is a significant opportunity for the company to reduce GHG emissions through RE projects						
Business opportunity for company														-PERTAMINA sees good beneficial business prospects from the new and RE sector. The demands for biofuel in 2025 will be sizable due to government policy to use 30% biodiesel, 20% of bioethanol and 5% of bioavtur	

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Appendix E: Tables of discourses on solar PV investment of PETRONAS

Table 1 Discourses on Solar PV investment of PETRONAS

Year / Discourse strands	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Positive results for business										-Sign MOU with Mitsubishi Corporation to jointly develop a solar photovoltaic Demonstration project in Malaysia. The signing of the MOU marked an important milestone for PETRONAS in harnessing renewable energy for future growth	-Signing MOU with Mitsubishi on October 2010, it also acts as a catalyst for PETRONAS to explore further opportunity in RE that offers synergy with PETRONAS's existing core business				
Reduce GHG emissions												-the clean energy generated can reduce our GHG footprint by 500,000 kg of CO2 annually	-Solar Independent Power Producer Plant at Gebeng, Pahang was completely in 2013. The project is in line with national commitment to pursue RE sources and reduce carbon emissions		
Respond to Government policy													-Solar Independent Power Producer Plant at Gebeng, Pahang was completely in 2013. The project is in line with national commitment to pursue RE sources		
Sustainability commitment											-in line with our commitment to operate in a sustainable manner, PETRONAS has taken steps to explore the application of Solar	-in line with our sustainability agenda, PETRONAS successfully installed Solar PV -signifying the Company's commitment to sustainable development	- in pursuing this sustainability agenda, PETRONAS successfully install several solar PV		

Frequency	O time	1 time	2-3 times	4 times or more	No annual reports
Color legend					

Appendix F: History of renewable energy investment of world major O&G companies

Company	Solar	Wind	Biofuels	Geothermal	Hydrogen	Battery	Tidal	Fossil fuels
ExxonMobil	-1977 Exxon reported that its solar investment were meant to greatly expand the usefulness of solar energy and that the investment were beginning to show favorable economics		-Spent $600 million on a 10-year effort to turn algae into oil (Csomos, 2014) -Exxon' algae project is a partnership with Synthetic Genomics, a La Jolla (Calif.) Company co-founded by human genome pioneer J. Craig Venter. (Ken Well, Bloomberg 11 May 2012)			Exxon has more than 1000 Esso-branded service stations in the UK, sent slides to Department for Transport Officials saying the government should avoid policies that support electric cars because cutting carbon emissions from power stations was cheaper.		
Chevron	-use solar to enhance oil production (Csomos, 2014) -shut down its solar i.e. cancel a pair of giant solar farms in Hawaii (Davis Ferris 2014))in 2014			-Indonesia in Darajat and Salak. Hold 40% of the Philippines Geothermal Production Company (Csomos, 2014)				
StatOil		2015 announce the truly innovative floating wind-park off the coast of Scotland to begin in 2016. The offshore windfarm will soon supply more than 600,000 UK homes with energy. (Sverdrup Guardian 27 Nov 2015) -2016 it outlined plans to spend 1.2 billion Euro in partnership with E.On on the German Arkona windfarm in the Baltic sea.						

Company	Solar	Wind	Biofuels	Geothermal	Hydrogen	Battery	Tidal	Fossil fuels
Shell	-Started in 1980s with an investment in a solar company called R&S Solar based in Holland -1997, Shell announced to make RE the 5th core division, and invested 500 million USD over 5 years , R&S Solar was absorbed and renamed as Shell Solar (Miller, 2013) -2002 integrate Shell Solar with Siemens Solar creating a vertically integrated company from silicon production to downstream sales of solar system, -1999-2006 spent 1.25 billion US to wind, solar and hydrogen , until 2009 stopped (Csomos, 2014) -2004Shell opened the world's largest grid connected solar park (Guardian Fred Pearce 2009) -2006 Shell had problem with shortage of silicon and did not dare to take up the poly-Si producers' offers to secure the supply. So producers cut Shell Solar off. In the same year, it sold Shell Solar to Solar World from a Germany. -in 2009 Shell exited all Solar business, and said clearly that focus going forward is on biofuels in the RE sphere. (Miller 2013) - 2009, Shell was reported by guardian and other newspaper that it would no longer invest in RE technologies such as wind, solar, hydropower because they are not economic (Guardian Fred Pearce 2009	Wind farms 550 MW installed capacity around the world In 2016, Shell established a spate division, New Energies, to invest in RE and low-carbon power, such as hydrogen, biofuels and electrical activities but will also be used as a base for new drive into wind power (Macalister Guardian 15 May 2016), Shell announced it was bidding in a partnership to build two windfarms off the Dutch coast that will be big enough to power 825,000 households.	-Partnership with Codexis uses enzymes to turn grass, stalks and sugar cane waste into biofuels. It has put about $60 million a year into the project, aiming to produce renewable fuels without displacing food crops. (Ken Wells, Bloomberg 11 May 2012) -Spent 12 billion USD to do joint venture with a Brazilian sugar producer and ethanol producer-Cosan -Shell decided in 2009 to focus on biofuels in the RE industry and in 2010 set up the Raizen ethanol venture with Cosan SA Industria&Comercio. In 2010, it saw the share of RE in transport fuel doubling this decade, and since then has focused its research on biofuels made from sugar cane0farm waste after ending an algae project in Hawaii in 2011 (Bloomberg Eduard Gismatullin and Sally Bakewell, Mar1 2013)		-Head of Shell hydrogen, a new division of Royal Dutch/ Shell is convinced that Fuel cell will soon begin replacing power stations and cars burn coal, oil and gas. (economist 24 July 1999) -Like BP, its primary thrusts are solar and wind energy .Shell though casting a slightly wider net is also concentrating on biofuel derived from agricultural fibers, geothermal energy and hydrogen (Heesun 2002 Bloomberg)	-Electric car charging points could appear alongside petrol pumps at Shell's UK service stations as soon as next year,. The diversification into infrastructure for battery-powered cars would mark a new departure for the company, which has largely backed biofuels as a greener alternative to petrol and diesel in the past. (Adam Vaughan Guardian 13 Sep 2016)		Over 670billion USD was spent in 2013 exploring new fossil fuel reserves. Shell is spending billions on Arctic exploration and Canadian tar sands projects Shell this year completed a $54bn acquisition of BG, a British producer of natural gas and oil, bring gas close to half of its energy mix.

Company	Solar	Wind	Biofuels	Geothermal	Hydrogen	Battery	Tidal	Fossil fuels
Total	-Since 1980s Held a half share in two solar firms:Photovoltech and Tenesol. Most important focus. Not only solar farm in Abu Dhabi (Shams concentrating solar power station, 100 MW capacity installed) but also manufactures high efficiency solar panels -2011 acquired a 66% share of SunPower Corporation for 1.37 billions USD -2013 got a 86 MWp solar farm project with South Africa's Department of Energy -in 2012 SunPower with Mid American Solar began development of soalr plant, with 579 MW generation capacity in Califonia, the largest (Csomos, 2014) -In 2016 it planned to spend nearly 1 billion Euro on buying 100-year old battery manufacturer Saft. CEO said the deal would allow us to complement our portfolio with electricity storage solutions, a key component of the future growth of RE. (Macalister Guardian 21 May 2016)	One of four arms in RE(Csomos, 2014) -in Company's 2008 registration document Total wrote, Total has decide to dispose of certain of its wind farm projects (Guardian McCarthy,2009)					One of four arms in RE	

Company	Solar	Wind	Biofuels	Geothermal	Hydrogen	Battery	Tidal	Fossil fuels
BP	-established its solar division in 1981 and acquired Lucas Energy System (Johnson,2015),late 1990s merge with Amoco which got a 50% of shares in Solarex, then the largest solar manufacturers. In 1999 BP acquired the rest 50% of Solarex from Enron. Abandon solar in2011 after 40 years of business, saying that it could not make money from solar and point to low-cost solar panel produced in China which competed with its products (Miller, 2013nt) -in 2009, BP shut down its alternative energy headquarters in London, accepted the regination of its clean energy boss and imposed budget cuts from 1.4billion USD last year to between 500million USD-1 Billion this year(Guardian, Macalister, 2009) -In 2011 Tony Hayward , a successor of John Browne, closed down BP Solar in 2011, on the ground that it did not make money (Macalister 16 April 2015 Guardian)	BP, 2013 said it owned 16 wind farms in the US And Sold Indian wind energy business in 2009(Csomos, 2014) -The company is selling some of its RE assets including three wind farms in India and has cut its solar-cell manufacturing capacity in Span and America. The investment will fall from 1.4 billion in 2008 to around 500million to 1 billion in 2009 (The Economist 5 Dec 2009) BP, is gingerly considering investing more in wind for the first time in five years. (Economist 26 Nov 2016)	-Mid2010 BP spent nearly 100million USD for the cellulosic biofuel business of a listed US company (Verenum) -2011 spent 680USD to buy 83% share in CNAA, a Brazilian ethanol producer (Miller,2013) -BP, 2013 said it owned three sugarcane ethanol mills in Brazil(Csomos, 2014)		BP is developing hydrogen-related energy technology (around 2000s) Heesun Wee, Bloomberg 25 Sep 2002			Swap assets with Husky Oil, giving it an entrance ticket to the Alberta tar sands, in Canada (Macalister Guardian 11 Dec 2007)

Appendix G: Development of biofuel mandate of Thailand, Indonesia and Malaysia

I. Thailand biofuel mandate

At the present, Thailand ranks the largest ethanol producer and third biodiesel producers (after Indonesia and Malaysia) in Southeast Asia (Chanthawong and Dhakal, 2016). It is perceived that the rapid growth of biofuels in Thailand is a result of government policies which according to Chanthawong and Dhakal (2016) are comprised of more comprehensive set of polices than other Southeast Asian countries. The Thailand policies has targeted both supply and demand side including ambitious national biofuels targets supported by fixing the price-floor for buying raw materials from farmers, blending rate mandates, fuel subsidies, not to mention tax waivers for importing biofuel production technology. It is noted that there is no blending rate mandate for gasohol or bioethanol. However, at the present gas stations of PTT and Bangchak commercialize Gasohol E10, E20 and E85. As for biodiesel, the blending rate varies on the supply for palm oil.

Table 1 biodiesel blending mandate

Date	Mandatory biodiesel blending rates
June 2007	B2 and voluntary use of B5
June 2010	B3 and voluntary use of B5
March 2011	B2 and voluntary use of B5
May 2011	B3-B5
July 2011	B4
January 2012	B5
July 19, 2012	B3.5
November 1, 2012	B5
January 2014	B7
February 17, 2014	Adjust from B7 to B3.5
May 14, 2014	Return to B7
January 22, 2015	Adjust from B7 to B3.5
April 17, 2015	Return to B7

Table 2 Targets on renewable energy and biofuels (DEDE, 2015; GAIN, 2015)

Policy	Renewable Energy Development Plan 15years (2008-2022)	Alternative Energy Development Plan 10years (2012-2021)	Alternative Energy Development Plan (2015-2036)
RE in total energy consumption	20.3% by 2022	25% by 2021	30% by 2036
Ethanol production target (million liter/day)	9	9	11.30
Biodiesel production target (million liter/day)	4.5	7.2	14

II. Indonesia biofuel mandate

Oppositely, to Thailand, the government of Indonesia focused on biodiesel development than ethanol production thanks to its vast amount of palm oil plantations, main raw material for biodiesel. Ethanol development program was ended in 2010 and fuel producers claimed that it was a result from PERTAMINA's insufficient purchase pricing scheme (GAIN, 2015). Table 3 presents the both biodiesel and bioethanol blending mandate which was adjusted several times. The latest adjustment was Regulation of Ministry of Energy and Mineral Resources No.12 issued in March 2015. Indonesia has more than 50 sugar cane mills providing plenty supply of molasses. However, since 2010 Indonesia stopped the fuel grade ethanol (FGE) production program due to the price conflict between Ministry of Energy and Mineral Resources and ethanol producers. As the result, Indonesia' ethanol is used only in non-fuel products such as perfumes, cosmetics and pharmaceutical goods (GAIN, 2016). In addition, although there is mandate on bioethanol, the interview with government authority in Indonesia during December 2016 confirmed that there was no bioethanol available in the gas stations.

Table 3 Biodiesel and bioethanol mandate of Indonesia

Type of fuel	2014	2015	2016	2025
Biodiesel	10%	15%	20%	30%
Bioethanol	1%	2%	5%	20%

III. Malaysia biofuel mandate

Malaysia did not have bioethanol. Although being a world top palm oil producers, Malaysia's biodiesel blending rate appears less than expected. The interviewees from government authority and Malaysian Biofuel Association mentioned the reluctance of oil companies including PETRONAS in producing biodiesel. Additionally, due to huge gap between low crude oil price and expensive palm oil price, the biodiesel B10 mandate got delayed. Table 4 presents a mandate which the actual roll out dates are usually later than the original schedule.

Table 4 Biodiesel mandate of Malaysia (Biofuels Annual, 2016)

	Transportation sector		**Industrial sector**	
	Planned Government Roll-out	**Actual Roll-out**	**Planned Government Roll-out**	**Actual Roll-out**
B5	2008	2011 (Central region) 2014 Nationwide	None	
B7	January 1, 2015	January 1, 2015	October 1, 2016	October 1, 2016
B10	October 1, 2015	End of 2016 as reported but 1st quarter 2017-realistically	No plans	
B15	2020		No plans	

Appendix H: Photos from fieldwork in Thailand, Indonesia and Malaysia


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ห้องน้ำสะอาด
ห้องให้นมบุตร
GREEN serve
ไฮดีเซล S 26.84
แก๊สโซฮอล์ E85 S 20.39
แก๊สโซฮอล์ E20 S 25.29
แก๊สโซฮอล์ 91 S 27.53
แก๊สโซฮอล์ 9 S 27.80
ATM
ออก


Esso
TESCO
Lotus
express
ดีเซล 26
30.33
25.29
27.53
27.80
เก็บภาษีหุ้นต่ำเพิ่ม
จากหิเตอร์หัวจ่าย
เงิน
คืน 3

Figure 2 Service stations of oil companies in Malaysia (from up, PETRONAS, PETRON and BHP)

Figure 3 Visiting a stakeholder for interviews (from up, PETRONAS headquarter, SEDA, and Biofuel Division, Ministry Of Plantation Industries and Commodities Malaysia)


Sime Darby
Plantation
Sime Darby
Biodiesel Sdn Bhd
Carey Island Plant


Sime Darby
BIO ENERGY
Markets for Biodiesel
Biodiesel Blending Limits - 2005
>20%
5 - 20%
<5%
None or N/A
EU Biodiesel Demand ('000MT)
926
3,184
11,500
2001
2005
2010F
2005 Biodiesel Production Worldwide
3.75 mill. tonnes p.a.


1.5%
PALM BIODIESEL B100
BIODIESEL (B100)

Figure 5 PERTAMINA service station in Jakarta, Indonesia

Figure 6 PERTAMINA Energy Forum 2016 held on 13-14 December 2016 at Ritz Carton Pacific Place Hotel, Jakarta, Indonesia