BIOMASS TO ENERGY IN THAILAND: AN INSTITUTIONAL PERSPECTIVE ON THE CHALLENGES OF VERY SMALL SCALE PROJECTS IN CHIANG RAI PROVINCE

NATTAPAN KONGBUAMAI

MASTER OF SCIENCE

IN

NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT

SCHOOL OF SCIENCE

MAE FAH LUANG UNIVERSITY

2012

BIOMASS TO ENERGY IN THAILAND: AN INSTITUTIONAL PERSPECTIVE ON THE CHALLENGES OF VERY SMALL SCALE PROJECTS IN CHIANG RAI PROVINCE

NATTAPAN KONGBUAMAI

THIS THESIS IS A PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE
IN
NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT

SCHOOL OF SCIENCE
MAE FAH LUANG UNIVERSITY
2012

BIOMASS TO ENERGY IN THAILAND: AN INSTITUTIONAL PERSPECTIVE ON THE CHALLENGES OF VERY SMALL SCALE PROJECTS IN CHIANG RAI PROVINCE

NATTAPAN KONGBUAMAI

THIS THESIS HAS BEEN APPROVED
TO BE A PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF SCIENCE
IN
NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT
2012

THESIS COMMITTEE

.....CHAIRPERSON
(Dr. Apisom Intralawan)

.....ADVISOR
(Dr. Panate Manomaivibool)

.....CO-ADVISOR
(Prof. Dr. Arne Remmen)

.....EXAMINER
(Dr. Suthep Nimsai)

.....EXTERNAL EXAMINER
(Asst. Prof. Dr. Pawinee Iamtrakul)

ACKNOWLEDGEMENTS

First and foremost, I would like to express my sincere gratitude to the Asia Development Bank (ABD) for its financial support through the Mae Fah Luang University (MFU)-ADB/EOC project on "Capacity Building for Natural Resources Management and Socio-economic Benchmarking in the GMS and to MFU for my partial scholarship.

I am very grateful to Dr.Panate Manomaivibool and Prof. Dr.Arne Remmen for giving me their exceptional guidance, inspiration, and encouragement while carrying out this thesis through their assistance and support. Their sincerity and helpfulness gave me strength to complete this thesis. The authors would also like to thank Assoc. Prof. Dr. Hansa Saguannoi, the director of the Institute for the Study of Natural Resources and Environmental Management (ISNREM), for her constructive inputs and her professional comments throughout the study.

This study could not have been carried out, without the support of village header at Ban Jam Pong Moo 5, Lai Ngao Sub-district, Wiang Kean District and Ban Tri Keaw Moo 8, Wang Nue Sub-district, Wiang Chai District, in Chiang Rai province and all interviewees for their kindness, sincerity and helpful during my field visit. Additionally, I would like to acknowledge the contribution to all the respondents and interviewees for their valuable input to this study.

My acknowledgments are also directed to all the members of the ISNREM for their kind academic and administrative support throughout my course at MFU.

Nattapan Kongbuamai

Thesis Title	Biomass to Energy in Thailand: An Institutional Perspective on the Challenges of Very Small Scale Projects in Chiang Rai Province
Author	Nattapan Kongbuamai
Degree	Master of Science (Natural Resources and Environmental Management)
Advisor	Dr. Panate Manomaivibool
Co-Advisor	Prof. Dr. Arne Remmen

ABSTRACT

Biomass is one of the major renewable energy sources worldwide and is expected to play a greater role in future energy scenarios. Thailand like many other countries has set targets to increase the share of biomass in its energy mix from 841 ktoe for electricity and 2,781 ktoe for heat in 2010 to 1,890 ktoe for electricity and 8,200 ktoe for heat by 2021. Chiang Rai has the largest biomass potential among the nine provinces in the North of Thailand. However, despite the interest and the proposals of several other private investors, hitherto only one biomass-to-energy (BtE) power plant has been built in Chiang Rai with a mere capacity of 0.13MW. The rest of the 550 ktoe biomass potential was not converted into modern forms of energy and was likely to be burnt in open air as part of the preparation of land for the next crop cycle. This burning was believed to be one of the main factors contributing to the smoke haze crisis, which severely polluted the air in Chiang Rai in the summer of 2012.

In order to understand the challenges of very small scale biomass projects in Chiang Rai, this study examines the institutional factors influencing the adoption of BtE by contrasting two BtE projects to become very small power producers (VSPP). The institutional perspective is chosen because the low uptake of BtE in Chiang Rai cannot be explained with simply financial, technological, policy or legal factors – all of which seemed to favor very small scale BtE projects. The multiple-case design allows this study to contrast two proposed projects. The project in Ban Jam Pong Moo 5, Wiang Kean, was successfully established and has been in operation since 2008 while the other in Ban Trikeaw Moo 8, Wiang Chai failed to materialize the plan that had been drawn up since 2010.

To guide the analysis, the 5Ps framework that focuses on the Partnerships between Public, Private, People and Professional sectors is constructed to guide the investigation. Data from documentary study, field observations, and qualitative interviews were triangulated to reconstruct the implementation procedures of BtE projects and to understand perceptions, resources and roles of stakeholders in the two cases. Furthermore, a questionnaire survey was conducted with the successful very small scale BtE projects in Thailand in order to triangulate the finding of the case study. The analysis reveals gaps in the formal institution and outlines the partnerships between the four sectors that can be critical to the success of very small BtE projects. 5Ps framework indicates formal rules are necessary but not sufficient requirements, community understanding and participation is indispensable, and the involvement of professionals can strengthen the project but not a panacea. The results from this study can be used as guideline in Thailand to promote the BtE projects.

Keywords: Biomass/Renewable energy/Partnership model/Project implementation

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

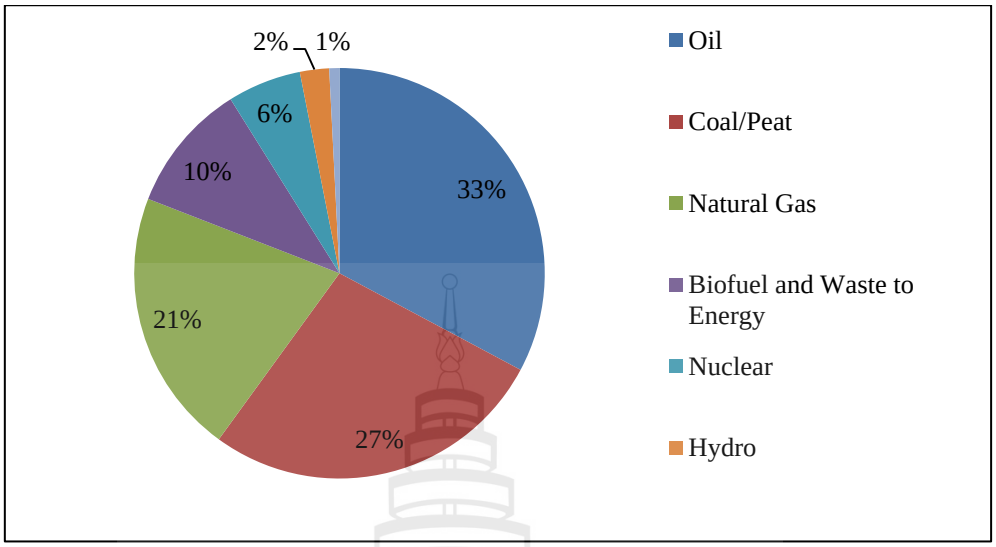
LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background

United Nations General Assembly declared 2012 the International Year of Sustainable Energy for All. This initiative encourages the engagement of governments, the private sector and civil society sector globally in order to increase the awareness of the importance of addressing energy issues and to promote action at the local, national, regional and international levels. Doubling the share of renewable energy in the global energy mix is one of the objectives to be achieved by 2030 (United Nation, 2012). As Biomass is now perceived as one of the cheapest available renewable energy sources for power generation (Mahapatra, Chanakya & Dasappa, 2009, pp.271-279; Energy Sector Management Assistant Program (ESMAP), 2007), exploring biomass opportunities for the provision of energy has increased rapidly worldwide. Biomass energy resource was approximately 1,452,000 ktoe (1,452.55 Mtoe) in 2010 and had the largest share of renewable energy in world's total primary energy, as shown in Figure 1.1 (International Environmental Agency, 2011, p.6). Karekezi and Kithyoma (2006) estimated that almost 50% of the world's population relied on biomass for energy.



From International Energy Agency (IEA). (2011). **2011 Key world energy statistics.** Paris, France: SOREGRAPH. Retrieved March 30, 2012, from http://www.iea.org/publications/freepublications/publication/key_world_energy_stats-1.pdf

Figure 1.1 The World's Total Primary Energy Supply in 2010 by Energy Sources

It is expected that biomass will play a greater role in future energy scenarios. The Shell International BV (2009, p.46), for example, forecasted that biomass would supply around 3,128,881 ktoe (131 EJ) in 2050. Many countries have also found biomass as a crucial role of renewable energy scenario. An example is the Danish government that set the goal to be independent from fossil fuels by 2050. In order to achieve this goal the share of renewable energy, mainly wind power and biomass, will be increased to 30% of final energy consumption by 2020 (Danish government, 2011, pp.6-7).

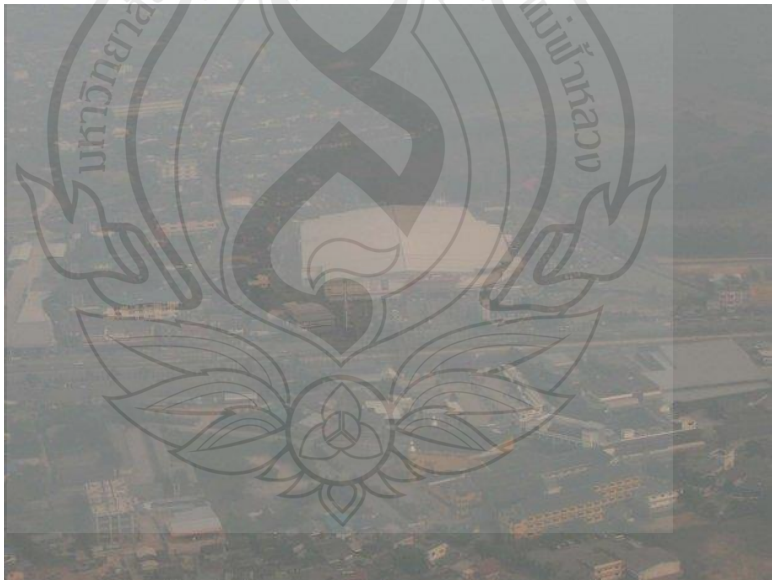
Thailand like many other countries is trying to lower its dependence on imported oil to promote energy security. The Thai government has been providing incentives both fiscal and non-fiscal towards the development of alternative energy since the 7th National Economic and Social Development Plan (NESDP) 1992-1996.

After the Ministry of Energy (MOE) was formed in October 2002, the energy policy considered biomass a significant source of alternative energy. The Department of Alternative Energy Development and Efficiency (DEDE) has estimated that Thailand has around 33,000 ktoe of biomass potential about 13,000 ktoe of which were utilized in 2010 (Department of Alternative Energy Development and Efficiency [DEDE], 2010, p.1). However, most of the utilization was in traditional forms of direct burning of firewood and charcoal that produced air pollutants. Only 26% of biomass utilization in Thailand was converted to cleaner forms of energy such as electricity, heat, methane, and liquid biofuels. This is expected to change in the future. The new Alternative Energy Development Plan 2012-2021 (AEDP 2012-2021) set the targets of 1,896 ktoe of electricity and 8,200 ktoe of heat to be generated from biomass by 2021 (DEDE, 2012, p.5). If the plan is met, biomass will contribute to 66% of electricity and 91% of the heat from renewable energy. It will also account for 25% of alternative energy of the final energy consumption (DEDE, 2012, p.5).

In respond to the policy stimuli, the biomass-to-energy (BtE) sector in Thailand has evolved but rather at an uneven pace. Thailand currently has several research units focusing on research and development (R&D) of BtE technologies and systems. Notable examples are the Nakornping Energy Research and Development Institute at Chiang Mai University (CMU) in the North, the Center of Excellence in Biomass at Suranaree University of Technology (SUT) in the Northeast and the Energy Research Institute at Chulalongkron University (CU) in Bangkok. According to the Energy Policy and Planning Office (Energy Policy and Planning Office [EPPO], 2012a), the sum of 2,125 million baht was allocated to BtE projects via the Energy Conservation (ENCON) Fund during 1995-2004. The fund was however concentrated in a few large projects. In order to encourage the development of smaller projects, the National Energy Policy Council (NEPC) has drawn up the regulations and plans for purchasing electricity from very small power producers (VSPPs) who generate lower than 10 MW by giving them “adders” including the bonus for offsetting diesel-fired generation. Since the introduction of this adder program in 2006, around 375 enterprises have expressed their interest in biomass and in becoming VSPPs and registered with Provincial Electricity Authority (PEA) and

Metropolitan Electricity Authority (MEA). However, only 63 projects had been implemented and connected to the grid in 2011.

Chiang Rai is an example of biomass being underutilized. On one hand, it has the largest biomass potential among the nine provinces in the North of Thailand. DEDE (2010, p.7) estimated that more than 550 Ktoe was available in Chiang Rai alone in 2010. This was about 28% of their combined potential. On the other hand, there has only been one VSPP in Wiang Kaen District, Chiang Rai with a capacity of 0.13 MW. Other endeavors to establish BtE plants in Chiang Rai such as the one in Wiang Chai failed to materialize. While the development of new plants sluggish, biomass in Chiang Rai in particular agricultural residue is burnt in open areas. This has contributed to the smog crisis which was worsened in the summer of 2012, as shown in Figure 1.2. On 10 March, 2012 the PM10 level of 437.6 µg/m3 measured in Mae Sai, Chiang Rai was highest in the Northern provinces, far exceeded the air quality standard of 120 µg/m3 (Pollution Control Department [PCD], 2012a).



From Smoke crisis in Chiang Rai. (2012, March 20). **Daily News**. Retrieved March 30, 2012, from http://www.dailynews.co.th/thailand/18141

Figure 1.2 Smog Crisis in Chiang Rai

In order to understand the challenges of very small scale BtE projects in Chiang Rai, this study examines the institutional factors influencing the adoption of BtE by contrasting two BtE projects to become VSPP. The Public-Private-People-Professional Partnership (5Ps) framework will be constructed in Section 2.2 based on Majamaa's Public-Private-People Partnership (4Ps) framework to investigate the perceptions, resources, roles and relationships of Public, Private, People and Professional actors which were embedded in this project developments.

1.2 Objective

This research aims to achieve the following three main objectives;

1.2.1 To analyze institutional factors critical to the establishment of very small scale power plants in Chiang Rai Province, Thailand.

1.2.2 To analyze the mechanism of partnership in developmental project.

1.2.3 To recommend pragmatic policies in order to promote renewable energy systems to Thailand.

1.3 Research Question

To achieve the objectives of this research, the research question was developed to address this research study of BtE in Thailand. There is one main research question and four sub questions.

The main research question is:

Why did very small scale BtE projects succeed or fail in Chiang Rai Province?

The four sub questions are formulated to support the investigation. The main question is broken down into more manageable questions to focus on the institutional aspect of the BtE system as follows:

Table 1.1 Sub Questions

Sub questions	Methodology
1. Who were the stakeholders?	1.1 Documentary Study 1.2 Interviews
2. What were their resources and perceptions to the BtE projects?	2.1 Field Observation 2.2 Interviews
3. What were the role of each stakeholders and their participation in the partnership?	3.1 Documentary Study 3.2 Field Observation 3.3 Interviews 3.4 Questionnaire
4. What are the formal and informal partnerships governing BtE projects in Thailand?	4.1 Documentary Study 4.2 Field Observation 4.3 Interviews

1.4 Conceptual Framework

The conceptual framework is the 5Ps framework which constructs to understand the institutional factors influencing the adoption of BtE projects. They consist of 4 sectors namely public sector, private sector, people sector, and professional sector. This study looks into the role, resources, perception and interaction of the 4 keys stakeholders (Section 2.3).

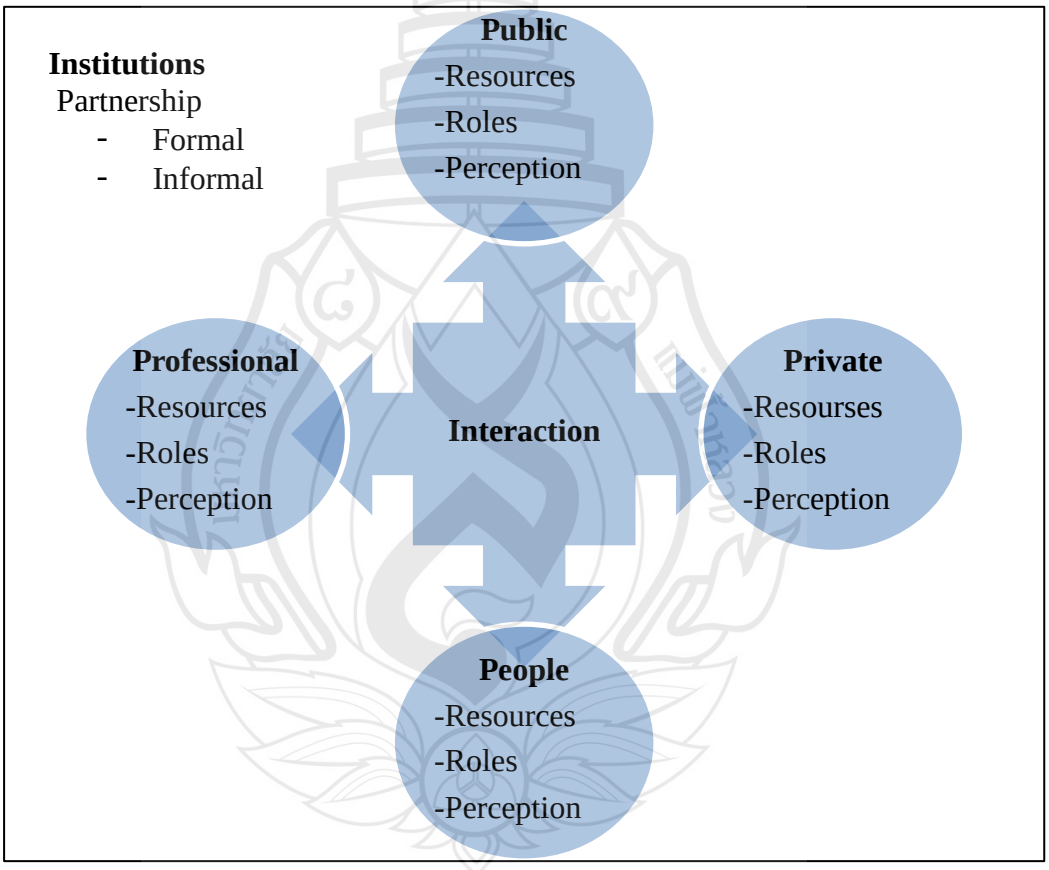


Figure 1.3 Conceptual Framework

1.5 Scope and Limitation

The production of electricity from biomass was the focus of this study. Regarding the biomass materials which will be further described in Section 2.1, agricultural and forestry residues are the main interest. They are attractive sources because of a co-benefit in reducing the smog problem in Thailand. In addition, producing energy from residues avoids the controversies over the competition between food and fuel, as in the case of virgin biomass.

This project also focus only on the VSPP who, according to the definition of EPPO (2012b, p.1), sell no more than 10 MW of power to the distribution units (PEA, MEA). Projects of this size are relevant to the local amount of targeted biomass materials.

This study is focused on Chiang Rai, Thailand during year 2005-2010. Eventually, some findings may not be generalizable within the entire nation, or to other geographic areas on matters such as institutional set-up, agriculture practices, culture and their life style.

There are also limitations on data. Some data and information were not available, nor accessible due to, for example, business confidentiality. In addition, some information is available only in Thai with no official translation, in this way, it is the main limitations of this study.

1.6 Definitions

1.6.1 Biomass

Biomass is a mass of dead organic matter from plants which include agriculture crop and forestry residues. While agriculture crop residues refer to the residues from crops e.g. corn, rice, cassava, etc and forestry residues are the residues from forestry e.g. bark, leaves, floor residues.

1.6.2 Biomass to Energy

Biomass to energy refers to electricity which is produced by agriculture crop and forestry residues.

1.6.3 Institution

An institution is a complex of positions, roles, norms and values lodged in particular types of social structures and organizing with respect to very small scale BtE project.

1.6.4 Partnership

A partnership is a kind of cooperation between actors who share their resources in order to achieve a very small scale BtE project. A formal partnership is an agreement or a contract under Thai Civil and Commercial Law to cooperate while cooperation in the form of non-legal working relationships is considered an informal partnership.

1.6.5 People Sector

The people sector is local communities who would be affected by the impacts of the project, end users who would benefit from the project, and their allies such as non-governmental organizations (NGOs) and the media.

1.6.6 Private Sector

The private sector is a profit making organization including a private person and the private investors e.g. material supplier, BtE power plant and loan company, etc.

1.6.7 Professional Sector

The professional sector means academic organizations that provide the knowledge for society in both nation and international scale which includes universities, research institutes or academic institutes.

1.6.8 Project

A project is defined as a related set of activities undertaken to create a very small scale BtE project. A successful project is defined as the project which has established, operated and utilized biomass to produce electricity as an energy power plant, and it is currently connect to the grid of PEA or MEA. However, a failed project is the project that lacks some of established, operated and utilized biomass to produce energy which is to be materialized.

1.6.9 Public Sector

The public sector is the government organizations that facilitate, regulate, control and make policies. It can be both local and national level.

1.6.10 Very Small Power Producer (VSPP)

This is an electricity producer from renewable energy that connect to the grid of PEA and/or MEA which the capacity is up to 10MW.

.

1.7 Structure of Thesis

The report is designed into 5 Chapters–Chapter 1 Introduction, Chapter 2 Literature Review, Chapter 3 Research Design and Methodology, Chapter 4 Results and Discussion, and Chapter 5 Conclusion and Recommendation.

Chapter 1 presents the background of this study in order to define its objectives, research questions and set the scope of study. It starts with biomass in the energy context before describing the gap between expectations of the energy policies in Thailand and the reality of BtE projects in Chiang Rai. The topic of the study is then defined and pronounced.

Chapter 2 reviews literature about the energy aspects of biomass and the partnership models. Section 2.1 provides the basic information of biomass and its energy. Section 2.2 describes the history and different models of partnerships before, the 5P is constructed in Section 2.3 to be the guiding framework for this study.

Chapter 3 presents the design of this study and the methods on how data was collected and analyzed. This chapter is divided into 3.2 sections. The first part explains how the multiple case study was designed and cases selected. This section also describes the two cases. Section 2 provides an overview of the tools, data collections and data analysis.

Chapter 4 analyzes key institutional factors contributing to the success and the failure of the projects. It is divided into 3 sections: stakeholder mapping (Section 4.1) partnership models (Section 4.2), and discussion (Section 4.3)

Chapter 5 concludes this study and also provides the policy and practical recommendation. Moreover, chapter 5 also provides the suggestions for further research.

There are three different levels; every chapter starts with one serial number, while section has two serial numbers respectively. Further, sub-sections are marked as bold instead of having a number. All tables were referred as “Table” and graphs and pictures were referred as “Figure” respectively, and have two numbers according to the chapter. All the references in the report are organized according to the American Psychological Association Style (APA Style).

CHAPTER 2

LITERATURE REVIEW

2.1 Biomass and its Energy

This section provides some basic understanding about the biomass and its energy. It is divided into three sub-sections; biomass feedstock, conversion routes and end products. Biomass feedstock describes types, availability, applicability and accessibility of materials. At this juncture, the ways biomass can be converted into energy and be recorded. The last subsection explores the products, markets and end users. Apparently, key environmental concerns related to securing feedstock, biomass conversion and energy products are also discussed in these segments.

2.1.1 Biomass Feedstock

Biomass is defined as mass of living or dead organic matter from plants, animals and micro-organisms. This shall include products, by-products, residues and waste. It is a mixture of organic molecules containing carbon, hydrogen, oxygen, nitrogen and also small quantities of other atoms, including alkali, alkaline earth and heavy metals. Biomass takes carbon out of the atmosphere while it is growing, and returns it as it is burned or decomposed (Food Agriculture Organization [FAO], 2009, p.2; Biomass Energy Center; UNFCCC, 2005, p.1).

There is wide range of biomass feedstock that can be converted to energy. While there is no standardized categorization, they can be divided roughly into two groups (Basu, 2010, pp.27-63): (1) virgin biomass includes wood, plants, leaves (ligno-cellulose), crops and vegetables (carbohydrates); and, (2) waste includes municipal solid waste (MSW), sewage, animal, and human waste, gases derived from landfilling (mainly methane) and agricultural wastes (Figure 2.1).

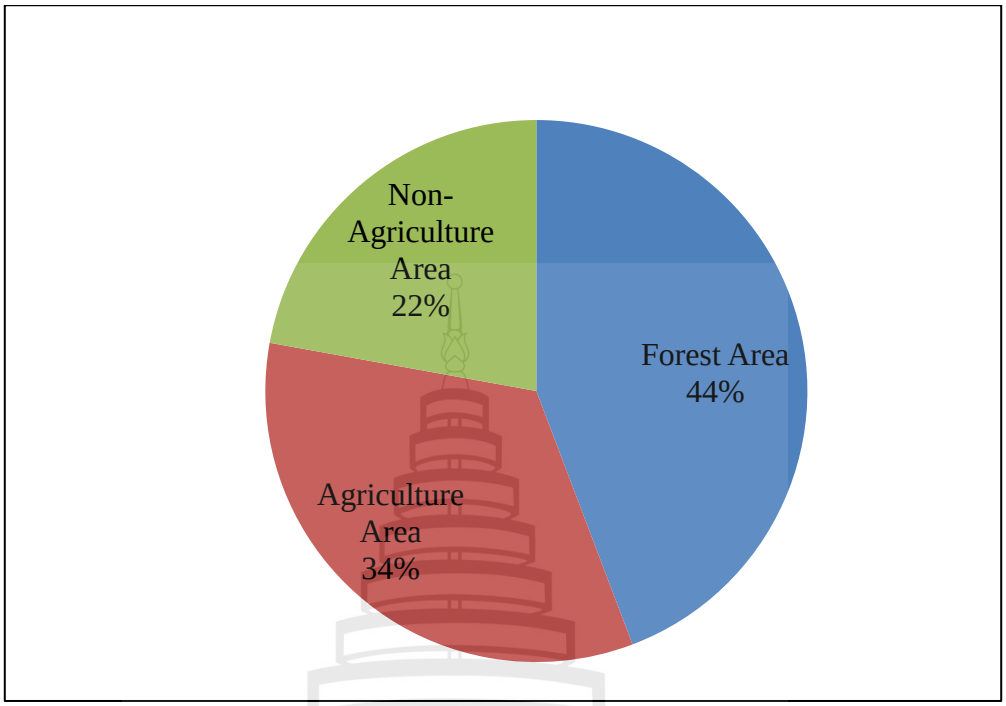
Virgin	Terrestrial Biomass	Forest Biomass Grasses Energy Crops Cultivated crops
	Aquatic biomass	Algae Water plant
Waste	Municipal waste	Municipal solid waste Biosolid, sewage Landfill gas
	Agriculture solid waste	Livestock and manures **Agriculture crop residues**
	Forestry residues	**Bark, leaves, floor residues**
	Industrial waste	Demolition wood, sawdust Waste of oil or fat

From Basu, P. (2010). **Biomass-characteristic**. Biomass gasification and pyrolysis, practical design. Retrieved April 20, 2012 from http://www.sciencedirect.com/science/article/pii/B9780123749888000027

Figure 2.1 Two Major Groups of Biomass and Their Sub-classifications

This study is aware of the different kinds of biomass. Some sources of biomass such as virgin biomass, may conflict with food demand and/or other land uses. So, it only focuses on agriculture and forestry residues. Following the same definition of solid biomass by DEDE, it refers to biomass which is generated energy by direct combustion such as agricultural wastes, forestry residues (DEDE, 2010, p.1) as the blue highlight in figure 2.1.

Thailand is one of the agricultural countries with reference to 2010 data. It was noticed that 47.37% of total area are agriculture land, and 33.44% are forest area, with total of 24.47 million populations in the agricultural sector. In Chiang Rai there were 7.2 million rai of which 44%, were forest areas and the other 34% was agricultural land in the same year, as shown in figure 2.2 (Department of Agriculture Extension, 2012).



From Department of Agriculture Extension. (2012). **Land used data**. Bangkok: Ministry of Agriculture and Cooperatives. Retrieved May 5, 2012 from, http://www.agriinfo.doae.go.th/year55/general/ land/land53.1.pdf

Figure 2.2 Area of Land Used of Chiang Rai in 2010

Due to the land activities of Chiang Rai, the factors that influenced the solid biomass potential of Chiang Rai are being presented in table 2.1. Rice is the main crop in the province that accounts for more than 50% of total agricultural area. The residue of rice contributes almost 80% of total agricultural residues. Maize is also one of the potential crops in Chiang Rai covering 20% of total agricultural areas, and its residues rank number two at 18% of the total agricultural residues.

Table 2.1 Solid Biomass Situation in Chiang Rai, Thailand in 2010

Crops	Planted Area (Rai)	Production (Ton/year)	Residues Type	Residues (Ton/year)	Energy Potential (Ktoe)
Rice	1,657,251	930,866	Paddy Husk	210,376	72
			Straw	1,107,731	362
Maize	451,020	273,919	Stalk, Top, Leaves	244,336	93
			Cob maize	51,771	21
Cassava	14,108	44,504	Stalk	5,385	2
			Root	4,050	2
Oil palm	3,642	2,484	Frond	676	0
			Fiber	370	0
			Shell	320	0
			Empty Bunches	534	0
Groundnuts	4,844	1,259	Shell	407	0
Soybeans	31,242	6,863	Stalk, Leaves, Shell	8,078	3
Para Rubber	35,563	9,033	Charcoal	2,683	2
			Fuel wood	2,240	0
			Frond, Leaves	912	0
			Saw dust	307	5
Pineapple	6,154	21,268	Stalk	12,506	5
Total	**2,203,824**	**1,290,196**		**1,652,682**	**566**

From DEDE. (2010). **Thailand alternative energy situation 2010**. Bangkok: Ministry of Energy.

DEDE (2011, p.7) has mentioned that there are varieties of agricultural activities, geography, climate in each region and each month which is effect to the

supply of biomass raw material, the project developers should study the biomass availability since beginning, and implement good procurement and storage management in order to manage the supply side of project. Chiang Rai has the variety of solid biomass residues and available whole year. Table 2.2 summarizes the calendar of solid biomass available in Chiang Rai by crop, the black block represents cultivation period, during the cultivation period, the residues are being available. In Chiang Rai, rice is the biomass potential, there are two rice cultivation periods in a year, so there are two times of residue available each year. Even the corn and other crops cultivate only one time a year, but natural processes for residue digestion and recycling take much longer than one year period of crop cycle. Requirement to intensify production by increasing annual crop cycle, farmers make a choice to burn their residue which is easy and cost saving management for multiple plantations. In addition, their local believe of black soil is more fertile and a source of rich nutrient for the next crop.

Table 2.2 Calendar of Solid Biomass Available in Chiang Rai

Crop	Month											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
In-season Rice										■	■	■
Dry-season Rice				■	■							
Corn								■	■	■		
Rubber						■	■	■	■	■	■	■
Longen							■	■	■			
Coffee	■	■									■	■
Cassava	■	■	■	■								
Lichee					■	■						
Soybean				■	■							
Tangerine											■	■
Pomelo								■	■	■		
Ginger										■	■	■
Onion			■	■								
Garlic			■	■								

From Chiang Rai Provincial Agriculture Extension Office. (2012). **Annual crop data in 2011 report**. Chiang Rai: Chiang Rai Provincial Agriculture Extension Office.

DEDE also recommended the amount of raw material for 1 MW BtE power plant annually, as shown in table 2.3. Each type of biomass material supply for BtE power plant is different. There are varieties, such as rice husk is required as lowest as 9,600 tones per year per MW, and 13,200 tons per year per MW for maize stalk. As Chiang Rai has high biomass potential of these two crops, it seems that Chiang Rai be the BtE promotional area. However, the water is also as important factor for operating BtE power plant that may require 120 sq.m^2 per MW per day (DEDE, 2011, pp.49-50).

Table 2.3 Biomass Feedstock for 1MW Power Plant

No.	Biomass	Tones/Year/MW
1	Rice husk	9,600
2	Rice straw	10,500
3	Maize stalk	13,200
4	Maize cob	13,500
5	Sugarcane trashier	17,600
6	Para wood (Residues)	19,700
7	Cassava rhizome	23,600

From DEDE. (2011). **Tools for development and investment of alternative energy: Biomass energy**. Bangkok: Ministry of Energy.

The other factors that are important for the choices of feedstock are the travel distance and the travel time (Rentizelas, Tolis & Tatsiopoulos, 2009, p.13). The travel distance mostly affects the fuel consumption, whereas, the travel time affects the depreciation, maintenance, insurance and the labor allocated to a specific tour. So, small BtE projects should find local feedstock. DEDE (2011, p.44) has highlighted the considerations for power establishment, it included availability, quality and accessibility of biomass where the delivery radius is below 100 km in order to avoid the procurement problem during the operation power plant. Storage of biomass is also an important factor, storage of input is benefit for securing the supply side of running the BtE power plant. It depends on the plantation period of each crop that can supply continually. The storage should also have a controlled warehouse to avoid the degradation from e.g. moisture problem where is appropriate biomass moisture may not exceed 10-20% for gasification technology (Biomass Energy Center, n.d).

2.1.2 Biomass Conversion

There are wide ranges of technological options to convert different types of biomass into renewable energy. Conversion technologies may release the energy directly, in the forms of heat, electricity, liquid biofuel or combustible biogas. Conversion of BtE is undertaken using two main process technologies: thermo-chemical and bio-chemical/biological. For the thermo-chemical conversion four main options are available: combustion, pyrolysis, gasification and liquefaction. Bio-chemical conversion encompasses two options: digestion and fermentation. (McKendy, 2002, pp.47-54). Table 2.4 summarizes the technological types and options.

Table 2.4 Biomass Flow

Input	Technology Conversion	Output
	Thermal conversion	
Solid Biomass	Combustion	Energy and Power (Electricity, Heat)
Solid Biomass	Gasification	Energy and Power (Electricity, Heat)
Solid Biomass	Pyrolysis	Energy and Power (Electricity, Heat)
High moisture content biomass	hydrothermal upgrading (HTU) and hydroprocessing	Liquid fuel (high energy density)
	Bio-chemical conversion	
Vegetable oil, Oil crop, alge	Fermentation	Liquid fuel
Straight and waste vegetable oils	Anaerobic digestion	Liquid fuel
Seeds of various crop	Mechanical extraction	Liquid fuel

From McKendry, P. (2002). **Energy production for biomass (part 2): Conversion technology** (pp.47-54). Colchester, UK: Applied Environmental Research Center Ltd.

Because this study is focusing only on agricultural crop residues and forestry residues and currently the AEDP 2012-2021 supports to utilize these solid biomass residues for electricity purpose, the thermal conversion technology is the main conversion technology interested in this study. Table 2.5 provides some more details of the three sub-options.

Table 2.5 Biomass Technology and Definitions

Technology	Descriptions
Combustion	Combustion is the burning of flammable biomass in air, i.e. combustion. It is used over wide range of output to convert the chemical energy stored in biomass into heat, mechanical power, or electricity using various items of process equipment, e.g. stoves, furnaces, boilers, stream turbines, turbo-generator, etc. Combustion of biomass produces hot gases at temperatures around 800-1000 °C. It is possible to burn any type of biomass but in practice combustion is feasible only for biomass with moisture content lower than 50%, unless the biomass is pre-dried.
Gasification	It is a partial oxidation process where a carbon source (biomass) is broken down into carbon monoxide (CO) and hydrogen (H_2), plus carbon dioxide (CO_2) and possibly hydrocarbon molecules such as methane (CH_4). Gasification is the conversion of biomass into a combustible gas mixture by the partial oxidation of biomass at high temperature, typically in the range 800-900 °C.
Pyrolysis	Pyrolysis is the precursor to gasification, and takes place as part of both gasification and combustion. It consists of thermal decomposition in the absence of oxygen. It is essentially based on a long established process, being the basis of charcoal burning. Pyrolysis is the conversion of biomass to liquid (termed bio-oil or bio-crude), solid and gaseous fractions, by heating the biomass in the absence of air to around 500 °C.

From McKendry, P. (2002). **Energy production for biomass (part 2): Conversion technology** (pp.47-54). Colchester, UK: Applied Environmental Research Center Ltd.

Presently, the VSPP in Thailand are implementing the thermal technology conversion mainly combustion technology to convert biomass for electricity and heat purposes. These technologies are mostly imported. DEDE (2011, p.46) also commented that if there is no constant supply of a single type of biomass feedstock, the investor should choose the technology which is suitable for multi feedstock, and suitable technology in order to save the cost of technology maintenance and management that can also secure the supply shortage.

At the BtE power plant site, there are various pollutions going on or taking place such as air, water, soil, etc. Pollutants from biomass power plant mainly are smog, nitrogen oxide, CO2 etc. it is controlled by the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (Pollution Controlled Department, 2012b) covering aspect of air (both smog and noise), water, and soil pollution. Some stakeholders are (local community, civil sector) against the BtE power project in Thailand, because they are concerned about the human and environmental impact while the company has selected the technology for their power plant due to their economic reason (Table 2.6). This can be a cause of conflict. DEDE, (2011, p.48) has called for more public participation in order to ensure the success of BtE projects and to resolve local conflicts.

Table 2.6 Investment Cost of the Power Producer

Power Producers by raw material	Purser (Bar)	Investment cost (million baht/MW)
Rice husk	40	50-70
Rice husk	65	62
Para Wood Residue	62	70
Sugarcane	70	33-40
Oil palm	40	60-90

From DEDE. (2011). **Tools for development and investment of alternative energy: Biomass energy** (p.61). Bangkok: Ministry of Energy.

Due to the location of VSPP in the community, the sustainable and good environment practices have been concerned as Thai government has set the regulation for registration. Each power producer must conduct and submit the project suitable report before requesting for authorization to establish a factory (Factory in Category 3).

However, the Local community can collect the biomass residue for selling to the power plan which can be their income. Nevertheless, the power plant also employs the local people to work in their factory as job creation, and provide the tax for local community. Biomass seems to contribute positively to the rural development.

2.1.3 End Products and Utilization

As the Biomass Energy Center (n.d.) mentioned biomass as a renewable fuel that can deliver a significant reduction in net carbon emissions when compared with fossil fuels. It can reduce the several tones of greenhouse gases (GHG) per year by good practice. Many countries try to substitute fossil fuel with renewable energy e.g. biomass, wind, solar in order to reduce the GHG. Thai government has also promoted energy from biomass as one of key renewable energy to flight with GHG.

Biomass can be converted into useful forms of energy (power/heat generation, and transportation fuels). Each VSPP of biomass in Thailand presently generated both heat and electricity, but electricity is currently only in market and its market is limited to PEA and MEA by making the sell contact following the processes and regulations. Currently, 63 VSPP sell total amount 394.51 MW to PEA while no VSPP exists in the responsible areas of MEA (Bangkok, Nonthaburi, and Samut Prakan). According to this, the VSPP cannot see the various modes of products, it is not attached the investors. Furthermore, the products of VSPP biomass power project are not satisfying the community consumers who required biomass for heat of cooking mainly. As rural areas are often close to biomass resources, then the biomass small-scale power project could provide the local need, be benefit to local community, and encourage the local participation for good understanding and corporation.

One of the major economic implications of energy from biomass is their relative cost-competitiveness with conventional practices. In many cases, modern energy from biomass remains more expensive than the conventional fuels and it requires additional policy incentive and economic support (Johanson, 2000; Sander & Skott, 2007; World Business Council for Sustainable Development (WBCSD), 2007; UN Energy 2007; Voytenko, 2010, p. 31). DEDE (2011, p.64) expressed that biomass knowledge in Thailand is still in the novice stage, the energy production from biomass per unit is still expensive compared to conventional practice. Government therefore should provide the incentive in order to promote the utilization of biomass. Thailand currently has the “Adder” program for the VSPP, biomass for maximum 7 years period, and the adder variously depends on the capacity of the power plant. In addition, the area also has a favorable adder as shown in table 2.7.

Table 2.7 Adder Program for Biomass in Thailand

	Adder (Baht/kwh)	**Extra Adder[1] (Baht/kwh)**	**Extra Adder in the Zone[2] (Baht/kwh)**	**Period (Year)**
Biomass				
Capacity<=1MW	0.50	1.00	1.00	7
Capacity>1 MW	0.30	1.00	1.00	7

Note. [1]For the BtE power plant in the area of diesel production

[2]For the BtE power plant in the area of Narathiwat Province, Pattani Province, Yala Province and Chana District, Nathawi District, Sabayoi District and Thepha District in Song Kla Province

From DEDE. (2011). **Tools for development and investment of alternative energy: Biomass energy** (p.64). Bangkok: Ministry of Energy.

For the aspect of sustainability use of biomass, the European Union (EU) is the leading group of countries that promote the utilization of biomass and concern the sustainability use of this kind of energy. European Commission (EC) introduced a report on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating, and cooling in 2010. This report recommended the sustainability use of solid biomass (forest, agriculture and waste) in order to ensure greenhouse emission reductions and production of biomass in social and environmentally sustainable way for the member countries (European Commission, 2010). This includes the criteria of production of biomass, GHG performance across the whole life cycle, conversion of biomass to energy. So, the sustainability use of biomass was taken into account, and it guarantees a sustainable use of biomass for energy purposes.

2.2 Partnership Model

The description of the BtE system in Section 2.1 shows that it is not just a technical system that makes it successful but also partnership of various actors. This section explains the development of partnership models. It starts with Public-Private Partnership (3Ps) the concept of which emerged in the 1980s. It then introduces Majamaa's 4P Model (2008, p.5) that stresses the importance of public participation in projects. These partnership models serve as building blocks for the construction of the analytical framework of this study which will be described in Section 2.3.

2.2.1 Public-Private Partnership (3Ps)

After the World War II, most of the governments took primary responsibility in building and maintaining their state. The policy making and planning were mainly top-down and centralized approach. However, a substantial number of government policies in the 1960s and 1970s failed to meet their original targets. These failures exposed government limitation. Governments realized that it must partner with other actors, notably the private sector, in order to have effective and efficient policies. This led to a wave of privatization and 3Ps in the late 1980s and 1990s (Kickert et al., 1997, pp.1-5).

In a situation that many governments had budgetary pressures with cuts in government spending during the economic recession in the early 1990s, the private sector was in the better position to invest in the project. The 3Ps were introduced as a synergistic way to reach a "win-win-win" situation. It would benefit all participants - public sector, private sector as well as the general public who would receive better services (Wong, 2006; McQuaid 2000; Kernaghan, 1993, pp.57-76; Kouwenhoven, 1993; Majamaa, 2008, p.3).

It was shown that the uses of 3Ps were justified in many cases when compared their benefits to the traditional public spending (Nisar, 2007, pp.1-19; Zhang, 2006, pp.956-965; Zhang, 2005, p.19; Earl & Reagan, 2003; Institute of Public Policy Research (IPPR), 2001; Majamaa, 2008, p.3). According to World Bank (2007), there are four main areas of benefits from 3Ps:

1. Increasing efficiency in the execution of projects;
2. Enhancing implementation capacity;
3. Reducing risk for the public sector; and
4. Mobilizing financial resources by freeing scarce public funds for other uses.

These benefits came from the strengths of the private sector. However, the private sector gains the benefit from this partnership also. The private sector gain the benefit while the support of government as partnership both in fiscal and non-fiscal incentive grant, low tax rate, low interest rate fund, and deducted some policy barrier. In other hand, Build-own-operate (BOO), a private party or consortium agrees to finance, construct, operate, and maintain a facility previously owned and/or operated by a public authority. The concessionaire retains ownership of the facility. However, the concessionaire bears the commercial risk of operating the facility.

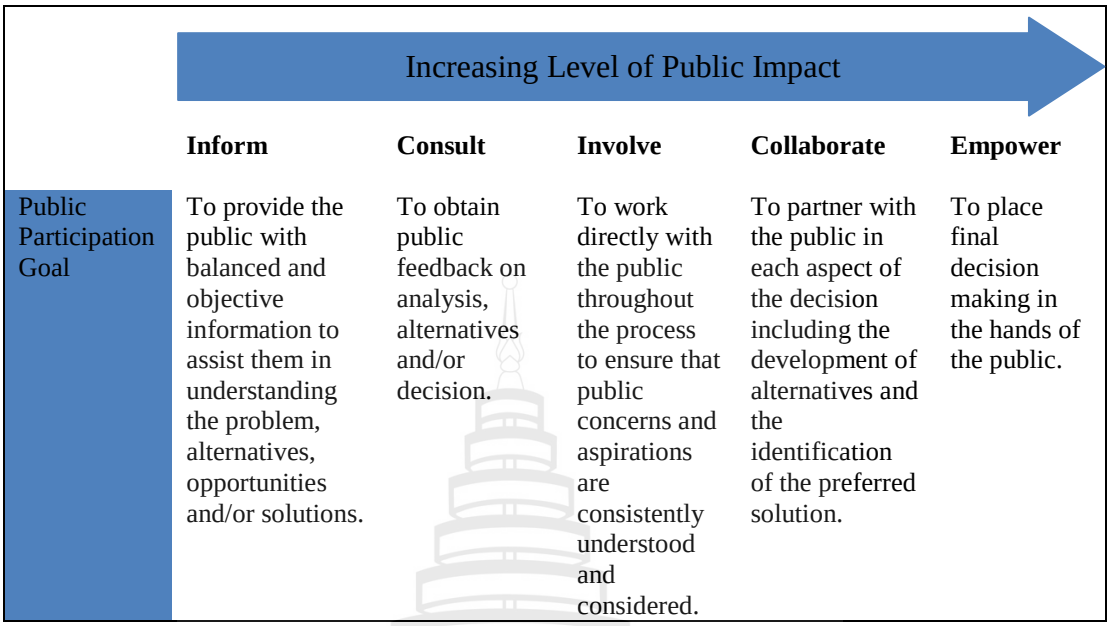
In Thailand, several 3Ps projects have been implemented in various sectors including power/electricity, telecom, ports, water and sanitation and transportation sector since the early 1990s. Traditionally government projects were predominantly financed through government budget. However, it became difficult for the Thai government to deliver infrastructures without increasing the public debt beyond acceptable level. Therefore, the Thai government increased the role of the private sector by introducing 3P in government's procurement (Susangarn, 2007, p.2).

Despite its merits, the 3Ps model was not without criticisms. The extents of benefits from private sector participation, and public authorities' uncertainty about the quality of the 3P services have also been under critical discussion (Shaoul, 2005, pp.441-471; Kuntaliitto, 2003; Kanniainen & Määttä, 2001; Majamaa, 2008. p.4). Due to the development project, the people have interacted with the development project as local community who have shared benefit and resource with the development project and as also end user. In this context, 3Ps did not offer what the local community needs. Due to a lack of public participation, 3Ps might lead the conflict between the development projects with the local community.

2.2.2 Public-Private-People Partnership (4Ps)

The extension from 3Ps to 4Ps model has its root in the rise of participatory democracy in the 1990s. The necessity of public participation for successful environmental

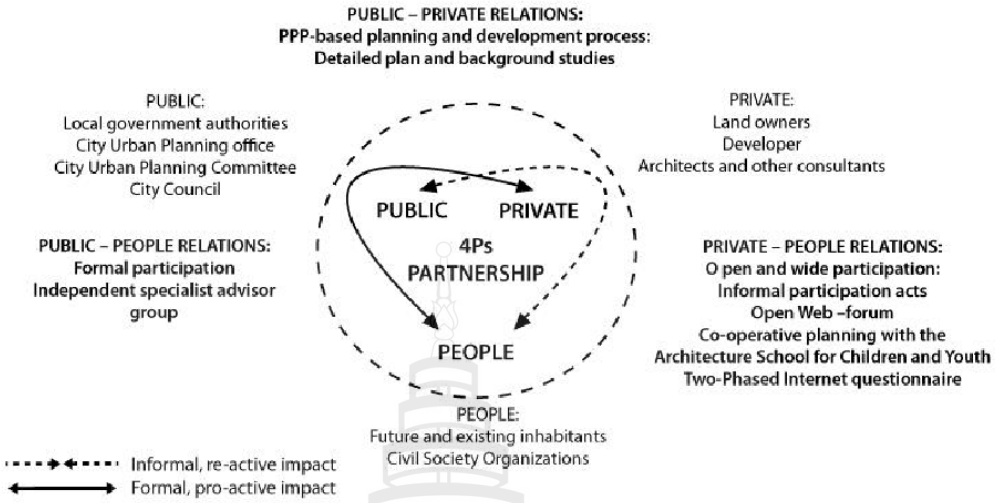
policy had been recognized for some years. At the documentation generated by the United Nations Conference on Environment and Development in Rio in 1992 (UNCED known as the 'Earth Summit'), the need for public involvement in the design and implementation of all sorts of environmental policy was emphasized in a set of 27 principles as "States and people shall co-operate in good faith and in a spirit of partnership in the fulfillment of the principles embodied in this Declaration and in the further development of international law in the field of sustainable development" (UNESCO, 1992). The Declaration recognizes public participation, which according to the spectrum of the International Association for Public Participation (2007) classifies public participation into 5 levels (inform, consult, involve, collaborate, and empower). The level of public participation is increasing when it move to the right of spectrum as show in figure 2.3.



From International Association for Public Participation. (2007). **IAP2 Spectrum IAP2 Spectrum**. Retrieved November 1, 2012, from http://www.iap2.org/associations/4748/files/spectrum.pdf

Figure 2.3 Spectrum of Public Participation

Also, Majamaa (2008, pp.9-10) makes the observation that direct customer contact is missing from Public-Private Partnership (3Ps). People was often overlook in the service deliver framework, although they could play an active role in improving accountability and service quality in both public and service sector (Ahmed & Ali, 2006, p.782). Majamaa's 4P model, in particular, includes private, public, and people as partnership. There are both informal and formal relationships (Figure 2.4), and it indicated the relation between each stakeholders. A figure showing the interrelations between the three groups of actors- private, public and people.



From Majamaa, W. (2008). **The 4th P - People- in urban development based on Public-Private-People Partnership**. Doctoral Dissertation. Helsinki University of Technology. Retrieved March 3, 2012, from https://aaltodoc.aalto.fi/bitstream/handle/123456789/4559/isbn9789512295852.pdf?sequence=1

Figure 2.4 Stakeholders' Participation in Relation to the 4P-based Urban Development Processes

Majamaa study has shown the 4Ps-based urban development process has created possibilities for engaging pro-active participation methods and solutions, not only improving the accountability and quality of the services by delivery cost effective way the same services as it previously used to produce by public sector. The 4Ps have addressed the community need, and has reduced the conflict with the local community who live nearby the project side.

Thailand has tried to increase the practical public participation since the construction of the Constitution of the Kingdom of Thai in 2007. According to the section 67 in this laws as "Persons so assembling as to be a traditional community shall have the right to conserve or restore their customs, local knowledge, arts or good

culture of their community and of the nation and participate in the management, maintenance, preservation and exploitation of natural resources and the environment in a balanced fashion and persistently as provided by law." (Thai Parliament, 2007). It translates the spirit of participation in the constitution into practice that gave the right to the citizen to conserve their resources and environment. It encourages accountability, transparency of the government sector, and public acceptance of the administrative operations.

Furthermore, Section 67 in The Constitution of the Kingdom of Thailand 2007 also states "...Any project or activity which may seriously affect the quality of the environment shall not be permitted, unless its impacts on the quality of the environment have been studied and evaluated and opinions of an independent organization, consisting of representatives from private environmental organizations and from higher education institutions providing studies in the environmental field, have been obtained prior to the operation of such project or activity, as provided by law..."(Thai Parliament, 2007). According to this, the BtE project required Environmental Impact Assessment (EIA), but EIA may not expected for the lower 10MW BtE project following the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (Environmental Impact Evaluation Bureau, 2010). Therefore, it may cause the conflict between the project developer and the community due to the knowledge of the BtE project which is new technology for Thailand community, it may require the expert, so the 4Ps are not enough in practice. Hereby, it needs to be addressing the professional sector for the development project as the 5Ps framework. Then, the role of the Professional should be included.

2.3 Analytical Framework: Public-Private-People-Professional Partnership in BtE

Despite a step forward made by the 4Ps model, the role of professional sector has not been explicitly articulated. This may cause failures in project implementation, especially when the expertise within the public, the private, and the people was not sufficient. World Bank, for example, was identified the lack of technological and institutional capacity as barriers in the partnership between the public sector and NGOs/ Community Based Organization (CBO) (World Bank, 2000). Ahmed and Ali (2006, p.782) find that the specialized facilitating agencies may play a critical role in the formation of the public-private-community partnership. Heclo (1978, pp.87-124); Kingdon (1984) and Kickert (et al., 1997) also recognize the importance of such facilitators, for example, suggests that "the set of policy participation includes not only the traditional "iron triangle" of legislators, agency officials, and interest group leaders, but also researchers and journalists who specialize in that policy area". Moreover, Sabatien (2007, p.192) indicates that scientific and technical knowledge plays an important role in order to modify the beliefs of policy participants, in respond to this, the researchers (university scientists, policy analysts, consultants, etc.) can be active players in the policy making process. Sabatien also highlighted the importance of professional fora for concerning the design of institutions for negotiating and implementing agreement. This professional sector is the key actors to who solve the problems through negotiations in the beginning of the project. According to Sabatien (2007, pp.206-207), the professional sector who is a key player in solving problems through negotiations, requires neutral facilitators and platforms in order to avoid future conflicts which may arise after a decision. This sector brings together the contending factions on a negotiation table before the commencement of a project.

In addition, excellent communication and frequent exchange of information is a way to bridge the gap between partners, it leads to stable relationships and to coordinate of their mutual relationship (Sabatien, 2007, p.192).

Public-Private-People-Professional Partnership (5Ps) is a new framework of partnership for technology-driven projects. Figure 2.5 shows the 5Ps framework which depicts interactions between all the actors. These four sectors have interacted among each other both in formal and informal form of partnership. These four sectors is the stakeholders relevant to BtE project which are those individuals or organizations who have a key interest in the project's outcome because it is going to impact, or be impacted by, their day-to-day operation. Various stakeholders may be internal or external to the organization executing the project: the impacts may be positive, negative, or a combination of the two.

Stakeholders are people and organization that are actively involved in the project, or whose interests may be positively or negatively affected by the project. The sheer breadth and complexity of stakeholder relationships distinguish project management from regular management. To be effective, the project manager must understand how stakeholder can affect the project and develop method for managing the dependency (Gray & Larson, 2006, p.341). Each actor depends on each other because they strongly influenced by interorganization which means they need each other's resources to achieve their goal (Thompson 1967; Benson 1978, pp.69-102; Scharpf, Reissert & Schnable, 1978, pp.345-370; Aldrich, 1979; Kickert et al., 1997).

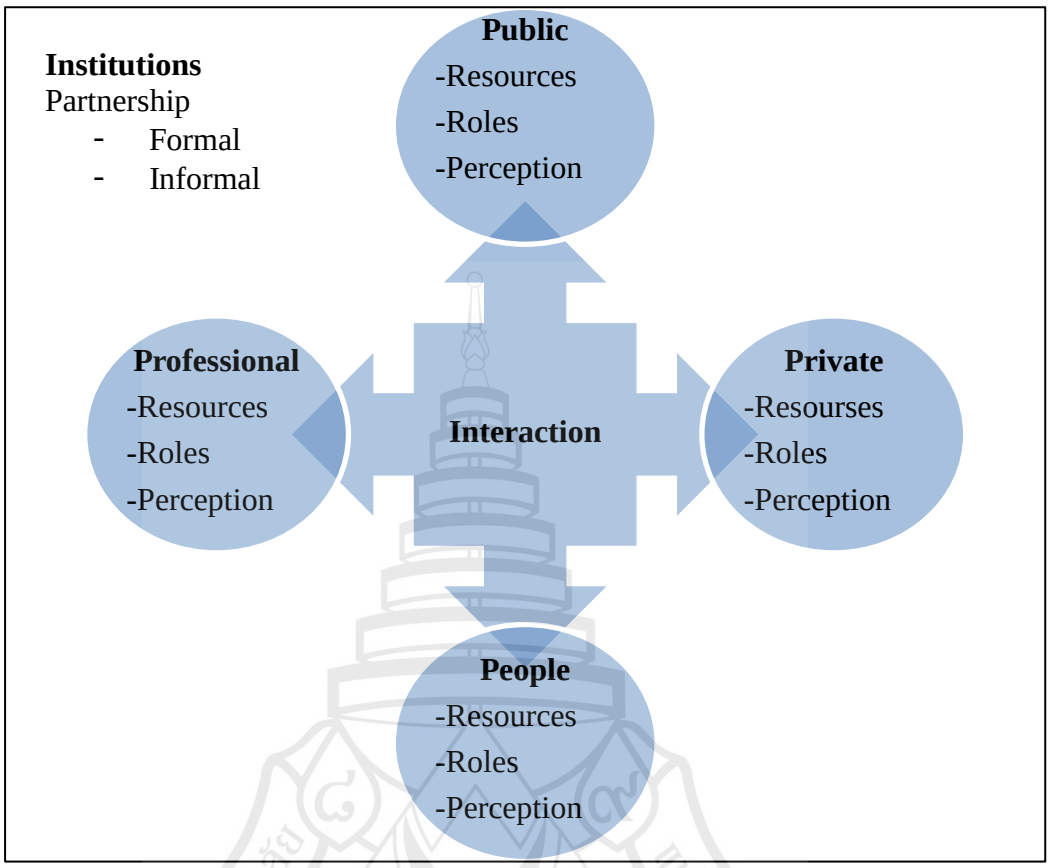


Figure 2.5 Public-Private-People-Professional Partnership Framework

According to the 5Ps framework, there are four main sectors, namely public sector, private sector, people sector, and professional sector. The definitions and expected roles of each sector are given in table 2.8;

Table 2.8 The Definitions and Roles of the Stakeholders.

Stakeholders	Definitions	Roles
Public Sector	Public sector is the government organizations that facilitate, regulate control and make policies. It can be both local and national level.	The main role for this sector is to facilitate the laws and regulation relevant to the development project.
Private Sector	Private sector is a profit organization including a private person and the private investors e.g. material supplier, BtE power plant and loan company, etc.	Private sector is provided a capital sources as project investors, load companies.
People Sector	People are local communities who would be affected by the impacts of the project, end users who would benefit from the project, and their allies such as NGOs and the media.	End users who share benefit with the development project. Customers and End users include the group (or group) of people who either asked for the project or will be directly impacted by the outcome of the project. They will use the end product create by the project.
Professional Sector	Professional sector is academic organizations that provide the knowledge for society in both nation and international scale. It can be included university, research institute or academic institute.	Professional sector plays the role as knowledge provider to society without influencing by other sectors.

With references to the 5Ps, it is apparent that various actors have been identified as being involved in the BtE projects. The roles and interactions are

therefore considered by their understanding and interpretations of the formal and informal rules.

In the context of governance, the dawn of change in bureaucracy has stepped in to nullify the process of establishing any BtE project nation-wide. This however, affects the market rule that gave companies the right to benefit from direct entry. Presently, to obtain the authority to establish any BtE project, the party concerned must pass through the investigative sectors that comprise of the 5P.

As an institutional perspective, emphasis is placed on the role of institutions and institutionalization which shapes the strategies and intentions of actors. In its approach to the processes of partnerships, it envisages the role of rules and organizational frameworks, which set the stage for strategy formulation and interaction. (Kickert et al., 1997, p.185). From the institutional perspective, there is a need to structure the right incentives and find amicable set of rules to build partnerships.

Following Toole et al (Kickert et al., 1997, p.172) state that effectiveness and efficiency used as sole criteria for success network management, network interactions are then viewed as an opportunity to avoid or break the resistance of other actors to policy proposals by putting them aside or by mobilizing proponents of the measure under discussion. This means goal attainment is the criterion used to determine the success of failure of interaction within partnership.

Toward an effective evaluation criterion, Teisman (1992) and Klijn and Teisman (1991, pp.99-112) state that goal attainment is not an appropriate criterion for evaluating interactions. Instead they suggest the introduction of an ex post satisficing criterion: the extend to which participants consider the interaction and its results satisfactory. An ex post satisficing is related to the well know criterion of “win-win situation” which is sometime proposed for judging the outcomes of networks. They are not legality or profit maximization but rather satisficing, win-win and procedural values. Win-win situations are concentrating on one actor achieving their objective, but this does not means that everyone involved will achieve their objectives to the same extent (Kickert et al., 1997, p.175). In this respect, successful of policy/project required corporation form various actors who are interdependence to obtain the win-win situation among the actors in partnership.

As various kinds of biomass sources, this study is focusing on biomass which is the waste from agriculture and forestry matters in order to avoid the conflict of land use and food issue. Local potential materials are also concerned in this study which is in Chiang Rai province. And, it is also mainly rely on thermal conversion technology which is transform solid biomass (agriculture and forestry residues) to energy (electricity). Due to the practical government support, there are many investor who show their interested to become the VSPP. It is also supports from professional sector e.g. biomass research and development center. According to this, the utilization of biomass in Thailand would contribute the great proportion. But, the utilization of biomass in modern form is still low. So this study is developed 5Ps to analysis the partnership of 4 stakeholders about how they interact during the project development to guide about the success very small scale biomass power project due to the Constitution of Kingdom of Thailand gives the priority to the People sector to protect the local environment. Therefore, this is how to construct the overview of biomass and its energy and study's framework. Next chapter, it is the research design and methodology to get through the study with the specific objectives (Section 1.2) that present in Chapter 3.

CHAPTER 3

RESEARCH DESIGN AND METHDOLOGY

3.1 Research Design

Rubin and Babbie (2005) state that the four most common and useful purpose in social research are exploration, description, explanation, and evaluation. Exploratory research is to explore new topic or to examine new interests. While descriptive research seeks to describe situations and events. In explanation research is to explain and report on "why" rather than just explain a situation. Lastly, in evaluation research encompasses all three of the preceding purpose.

Due to an exploratory study is approach when there is poor knowledge about the topic that should be studied and therefore its goals is to gain new knowledge and come up with some explanation in order to answer the research question (Dudley, 2011, p.106).

Furthermore, Neumen (2006) suggests that the aim of exploratory research tends to serve the researcher's need to discover new areas of study; to become familiar with the basic facts, setting, and concerns related to that area; and to create a general picture of condition as well as to serve the researcher to achieve a better understanding of the topic overall.

Since the institutional perspective study on BtE in Thailand is limited and few studies in this area. Therefore, this study employed an exploratory research approach which is appropriate to help the researcher to be able to identify the about the factors and the roles of partnership in the success of very small scale BtE project in Chiang Rai, Thailand. The findings of this study can be a starting point for further descriptive, explanatory, and evaluation study in the future.

In doing this, it employed a multiple case-study design as research strategy. The cases were nested in Chiang Rai which had the largest biomass potential in the

North of Thailand but with lower than 1 MW of electricity harnessed from this potential. Chiang Rai was also chosen because it was one of the provinces most suffering from the worsened summer smog with the highest level of particulate matters smaller than 10 micrometers (PM10) in the region.

A comparison was made between two BtE projects to understand the institutional factors influencing the success of such projects. The project at Ban Jam Pong, Moo 5, Wiang Kean District was successfully erected and had fed electricity to the grid since 2008 while the project at Ban Tri Keaw Moo 8, Wiang Chai District had yet to be materialized since its conception in 2010 (for more information of the cases, please see Chapter 4). The description of the cases and the development of the projects will be provided in sub section multiples-case design.

The study employed multiple methods (documentary study, field observation, interview, and questionnaire) to collect data about the two BtE projects. The documentary study conducted on sources such as project proposals and project reports secondary materials such as policy paper and scholarly articles, to understand the details and the developments of the two projects. The information was also double checked with field observations. The field visit took place in Wiang Kean and Wiang Chai three times during June–August 2012. The observations were directed toward the local reality in terms of biomass and other resources, and how actors in the field participated in the projects.

Ten semi-structure interviews were also carried out with key actors including representatives from the public, private, people and professional sector. The analysis triangulated the data derived from these sources and methods to reconstruct the institutions both formal and informal that governed the adoption of BtE projects and the efficacy of management strategies. Regarding the latter, this study had the hypothesis that under the changing context of governance (Kickert et al., 1997, pp.168-191) a network management strategy that is different from the free market and the top-down bureaucracy was needed for the successful implementation of BtE projects. To aid the analysis, a framework was constructed to categorize partnership models. The point of departure was the work of Majamaa (2008) which expanded the concept of Public-Private Partnership (3Ps) by adding the fourth P, People defined as local communities who would be affected by the impacts of the project, end users

who would benefit from the project, and their allies such as NGOs and the media. Because a BtE project requires considerable technical knowledge that might not be internalized within the three sectors, this study hypothesized that the role of the Professional sector should be potent and added a fifth P. The professionals included but not limited to universities, and research institutes (Figure 2.5 Public-Private-People-Professional-Partnership Framework).

3.1.1 Multiple-case Design

The case study is one of several way of doing research. According to Yin (2003, pp.39-54) the case study identify into two different approaches, single case study is analogous to a single experiment, and many of the same conditions that justify a single experiment, while a multiple-case study deals with two or more cases that are believed to produce similar results (a literalities replication) or contrasting results (a theoretical replication).

And following the suggestion of Yin (2003, pp.39-54) that findings of a multiple-case study are likely to be stronger than those of a single-case design. So, this study employed a multiple-case design as a research strategy with the contrasting result is the case.

Holistic multiple-case design has been considered in order to analyze a different context of partnership framework (stakeholders) in this study. This study also follow the theoretical replication and try to contrast the results of the cases by selecting one successful project and another that failed to establish a very small-scale BtE power plant. Due to objective of this study as an exploratory study, an exploratory study tends to be small and sampling approaches are not concerned with representativeness and generalizing to a large group (Dudley 2011, p.107).

3.1.2 Case Selection

The case studies (Wiang Kean and Wiang Chai) were purposively selected in order to gather the new information for further study as exploratory study. The two cases will be investigated in this study: the biomass project at Ban Jam Pong, Moo 5, Lai Ngao Sub-district, Wiang Kean District, Chiang Rai, and Ban Tri Keaw Moo 8, Wiang Nue Sub-district, Wiang Chai District, Chiang Rai. These two cases were

considered as comparable. Both were agriculture-based communities where the agricultural areas contribute the highest land proportion and agriculturist is majority of local occupational. However, despite their similar agrarian background, the status of the two projects differed greatly. A Bangkok-based company, Supreme Renewable Energy Co., Ltd., has been successfully installed the BtE plant with the capacity of 0.13 MW in Wiang Kean District and the plant has been in operation since 2008. On the other hand, the BtE plant with a planned capacity of 9.4 MW at Ban Tri Keaw Moo 8, Wiang Nue Sub-district, Wiang Chai District, has not yet been constructed since the project was proposed by the Clean Energy 2 Co., Ltd. owned by a rice-mill tycoon in Chiang Rai. The descriptions of the two cases are provided below;

3.1.2.1 Case I: BtE project at Ban Jam Pong, Moo 5, Lai Ngao Sub-district, Wiang Kaen District, Chiang Rai Province, Thailand

Lai Ngao Sub-district is located in Wiang Kaen District, Chiang Rai Province, there are 725 households among sub-district. The total population is 2,833 in 2011, the male population is around 1,382, and 1,451 is for female population. The average income is 68,825.53 THB per person per year and the average expenditure 43,002.36 THB per person per year in 2011 (Community Development Department, 2011a). Famer is the main occupation. These district has access to public services e.g. electricity, water supply and road. The primary crop is this sub-district is rice, longan, corn, cassava, pomelo and rubber, it is 10,646 rai of agriculture area as show in below table. Rice production is cover almost 5,200 rai per year.

Table 3.1 Agriculture Production and Area in Lai Ngao Sub-district 2011

Crop	Production (Tons)	Area (Rai)	Plantation Period
In-season Rice	2,823.38	5,006	May-November
Dry-season Rice	121.00	165	February-May
Longan	23.50	134	May-July
Corn	865.21	1,479	May-September
Cassava	410.80	124	July-February
Pomelo	5,039.00	2,191	November-July
Rubber		1,547	Whole year
Total Area		**10,646**	

From Wiang Kean District Agriculture Extension Office. (2012). **Land use in Lai Ngao**. Chiang Rai. Wiang Kean District Agriculture Extension Office.

Ban Jam Pong Moo 5 located in Lai Ngao Sub-district, Wiang Kean District, Chiang Rai Province. There are 223 households in 2011, the 874 total population is combining with 443 male and 431 female populations. The main occupation is mainly farmer (38% of total population). The average income is 54,628.22 THB per person per year and 24,313.82 THB is the average expenditure per person per year in 2011. The total area is 8,200 Rai, out of this 3,255 is the area for agriculture (Community Development Department, 2011b) in figure 3.1.

Figure 3.1 Farm Land at Ban Jam Pong Moo 5

There is one BtE power plant in this village, this BtE power plant was invested by the private company namely the Supreme Renewable Energy Co., Ltd. It was established in April 2007 at 101 Moo 5, Ban Jam Pong, while the head office is located in Bangplad, Bangkok. The biomass gasification technology has been implemented in this power plant using the agriculture wastes (maize cob, and wood chip). For the energy production, its capacity is about 0.16 MW but the sell contact with PEA is 0.13 MW. This BtE power plant used mainly the local residues, and local workers. It started to sell electricity since August 18, 2011. This BtE project is under adder program. They also have some technical supports from the Energy Research and Development Institute-Nakornping (ERDI), CMU, and Prince of Songkla University, etc.

Figure 3.2 Biomass Power Plant at Ban Jam Pong Moo 5

The company received the ASEAN Energy Award 2010 (Second best) on 22 September 2010, and the Thailand Energy Award 2010 (Winner) on 30 August in the same year.

3.1.2.2 Case II: BtE project at Ban Tri Keaw Moo 8, Wiang Nue Sub-district , Wiang Chai District, Chiang Rai Province, Thailand

Wiang Nue Sub-district is located in Wiang Chai District, Chiang Rai Province. There are 1,675 households among sub-district. The total population is 5,137 in 2011, the male population is around 2,534, and 2,603 is for female population. The average income is 72,2245.78 THB per person per year and the average expenditure 35,795.88 THB per person per year in 2011 (Community Development Department, 2011a). Famer is the main occupation. These district has access to public services e.g. electricity, water supply and road. The primary crop is this sub-district is rice, corn, pumpkin, papaya, etc, it is 4,434 rai of agriculture area as show in table 3.2.

Table 3.2 Agriculture Production and Area in Wiang Nue Sub-district 2011

Crop	Production (Tons)	Area (Rai)	Plantation Period
In-season Rice	-	3,314	May-November
Dry-season Rice	-	-	February-May
Corn	-	623	May-September
Pumpkin	-	320	-
Papaya	-	123	-
Chili	-	42	-
Cassava	-	9	-
Maize	-	3	-
Total Area		**4,434**	

From Wiang Chai District Agriculture Extension Office. (2012). **Land use in Wiang Nue**. Chiang Rai. Wiang Chai District Agriculture Extension Office.

Ban Tri Keaw Moo 8, Wiang Nue Sub-district, Wiang Chai District, Chiang Rai Province has 210 households. The total populations are about 570 people which combined with 285 male and 285 female. A Famer is main occupation (52%). The average income is about 84,571.75 THB per person per year (Community Development Department, 2011b). Rice is the main agriculture activities in this community (Figure 3.3).

Figure 3.3 Farm Land at Ban Tri Keaw Moo 8

The power plant was planned to be built at Ban Tri Keaw Moo 8, Wiang Nue Sub-district, Wiang Chai District, Chiang Rai Province, Thailand. The proposal had been drawn up since 2011 by Clean Energy 2 Co., Ltd owned by a rice-mill tycoon in Chiang Rai. It already registered as 9.4 MW power producers with the Provincial Industry Office of Chiang Rai, but the villagers protested against the project. They even set up a watch, days and nights, to ensure that the company could not begin the construction in its acquired land. The figure 3.4 shows the huts that the villagers constructed in front of the project site.

Figure 3.4 Biomass Power Plant at Ban Tri Keaw Moo 8

Besides setting the research design and case selection, the methodology has chosen three methods as documentary study, field observation, and interview. The methods depicts in next section in order to gather the data.

3.2 Methods and Materials

The researcher attempted to understand insight of BtE in Thailand, which therefore three methods (research tools) were used and applied in this research. The three methods were documentary, field observation, interview and questionnaire. Each method of study was triangulated with research questions, literature review and the finding (Section 1.3) that leads to substantive information in this research.

3.2.1 Documentary Study

Documentary study is the research tool reviewing written sources. Denscombe (2007, p.244) states that vast amounts of information are held in the document, it provides a cost-effective method of gathering data because relative sources are easily accesses and inexpensive. Furthermore, the data are also open to public which

published permanent and available that can be checked by others. The sources varied and included government publication, and official statistic; newspaper and magazine; records of meeting; letters and memos; diaries; and website pages and the internet (Denscombe, 2007, pp.228-245).

Thereby, this study employed the documentary study due to access various types and sources of data covering project level as until global level. The literature of project proposals and project reports was developed to understand the details and the developments of the two BtE projects. Other documents and secondary materials such as policy paper and scholarly articles were also reviewed to provide the data of BtE projects in Thailand and worldwide context and the institution context related to the partnership mode. Documentary study was conducted at optimal level that covers the context and finding in this study.

For this reason, Documentary study was mainly used in chapter 1 and 2, which was the introduction and literature review chapters of this project. This basic knowledge was used as the foundation to develop research questions, and to elaborate the field observation and the interviews. Furthermore, documentary study was used throughout the report to triangulate the data obtained in field observation and interviews which aims to support the finding and conclusion.

To analyze the content of documents, Denscombe (2007, pp.228-245) also suggests that content analysis is a method which helps the researcher to examine any "text" whether it be in the form of writing, sound, or pictures, in a ways of qualifying the contents of the text. Choose appropriate sample of texts or images was one of application which choice the sample be quite explicit.

With this regards, the researcher applied the content analysis in the documentary study in order to analysis on what written sources is appropriate in explicit the content what being use in this research.

For validity and reliability, this method conducted through the written sources which are scientific and scholar data from the trustable sources e.g. UN, Thailand MOE, etc which were relevant? topic with this research. Although these sources were considered reliable, we took note about the authors and their purposes in order to discern any biases. However, it is also take in consideration the different authors and their purposes of the document with officially publication which is up to date data.

3.2.2 Field Observation

Observation is a way to collect primary data which is a purposeful, systematic and selective way of watching and listening to an interactive and phenomenon. It is based on direct evidence of the eyes. And it is the most appropriate method of data collection for what you want to learn about the interaction in a group (Kumar, 2011, p.140).

There are essentially two kind of observations used in the social science. First is participant observation, it is when you, as researcher, participant as the same manner as its member in a group in the activities. On other hand, non-participation observation is when you, a researcher, do not get involved in the group activities. It is a passive observe, watching, and listening to its activities (Kumar, 2011, p.141).

This study objects to obtain the partnership among stakeholders. Therefore, field observation is one of the research methods that were conducted in the study areas by the researcher in order to see the real situation of the case without external enforcement. The non-participation observation was applied to avoid changing of their behavior of participants. The purpose of the field observation was to get an overview and an indication of what their resources and perceptions to the biomass projects are, and also see how the actors participation in this partnership.

The two different cases have been observed during the June 2012 until August 2012 by researcher. Biomass Power Plant at Ban Jam Pong Moo 5 is one of the case study which is operating now. While, Biomass Power plant at Ban Tri Keaw Moo 8, which was not yet being implemented, is the second case. It took placed 3 trips each case study.

A check list was developed to ensure the comparability between the observations in the two areas. The check list's criteria was made based on the information gaining from documentary study. It was cover the following aspects: the types and availability of resources, implemented or proposed BtE technologies, perceptions, and participation to the biomass projects. The checklist had 11 criteria of observation following the sub question of research question (Appendix 1), each criteria had two options of checking as "Yes" and "No" and further comments also took note by researcher what correspond to Kumar (2011, p.142) states that narrative recording is a form of recording by descript of the interaction on his/her own words.

Recording on electronic devices was also used in this field observation method by taking a photo. And due to the historical data between 2005-2010, then the observation also double check by asking the local people (village header, and villagers) who lived in that area during that period.

In terms of validity and reliability, the observation took by the researcher which is direct data collection, and double check with the question to the community leader and local people who lived in the village during that period, and check list is based on the sub research question in order to cover the right context.

3.2.3 Interview

According to Monette, Sullivan and DeJong (1986, p.156) states interview is the method of collecting data by interviewers reading the questions to respondents (interviewees) and recording their answers.

Denscombe (1983) and Silverman (1985) states that interviews is not just conversation, it is involved a set of assumption and understanding about situation which are not normally associated with casual conservation.

In order to get the deep understanding, interview was conducted in this research in order to identify the different stakeholders' opinion on their resources and perception, and their role and participation regarding to the BtE project.

Due to various kind of interview; this research was mainly be semi-structured interview what being mention by Denscombe (2007, p.176) that the semi-structure interview is prepared to be flexible in term of order in which topic are considered, and it lets interviewees express their idea and speak more widely on the issues and the flexible of asking the questions what allow the conservation flow and deep understanding what is being more resemblance to questionnaire of structural interview.

Key stakeholders on BtE project in both cases (Appendix C) were interviewed. Identifying these stakeholders were based on the four sectors following the 5P framework that is developed in Chapter 2. Interviewer has chosen interviewees based on the data and person who refer to another person. For the government sector, the Office of Energy has been interviewed because there are representative from the MOE which take care all the national energy policy and plan, and this office is the local

office which report local activities to the Ministry. The Lai Ngao Tambon Municipality and the Wiang Nue Tambon Administrative Organization (TAO) was also interviewed, because they are the main organization who connect to the community and central government and administrative the sub-district. For private sector, one of private company was interviewed. For people sector, the key person in both cases has been interviewed e.g. the village header, the community leader person, and villagers. For professional sector, the Nakornping Energy Research and Development Institute at CMU has been interviewed because there are the energy research units in the north of Thailand which is sharing the north region as the cases area.

An interview guide was developed (Appendix C), and it was sent to interviewees in prior the actual interviews were taken place. The questions of the interview guide were determined based on the knowledge gained during the introduction and literature chapter. All interview sessions were documented by note-taking but we avoided tape recording in order to encourage the discussion of otherwise sensitive issues.

Interview conducted, as far as possible, face to face with the key informants because this encourages to dialogue and deeper conversations, which is the purpose of the interviews. Furthermore, conducting the interviews face to face gives the opportunity for researcher to ask follow-up questions. If this preferred setting is not possible, the interview was also conducted over telephones, and/or e-mails.

The interview guide classify into four categories including resources, roles, perceptions, and interaction. For resources, it is about what each sector has: biomass resources, fund, authorization power, etc. Furthermore, Role is what they act regarding to BtE project. Third, Perception is what their respond to BtE project. It is classily into 4 main groups; support, don’t agree, neutral, and non-available (N/A) by their understanding which sometime different from their responsibility. The last one is interaction is what the play with another sector both in formal and informal form both one and two way interaction.

The key informants in each sector were interviewed in order to have validity and reliability, and the data is triangulated with the other interviewees in the sector

and supported by some documentary data, field observation and interviewee ask the follow up question to make the right understanding and information.

3.2.4 Questionnaire

The questionnaire is a research tool that gathers information by asking people directly with a list of standard questions. The use of this standardized research tool is advantagous that the data is hardly affected by interpersonal factors (Denscombe, 2007, pp.153-155).

Apparently, this study employed questionnaire to carry out the VSPP survey which successfully established a BtE project in Thailand by December 2011. The questionnaire consists of several close and open questions in a bid to obtain the primary data related to; Public, Private, People and Professional involvements in the BtE projects. Six checklist questions (Appendix D) about the partnerships concerning BtE projects were asked by telephone without compromise in order to get the same scope of data. If the answers to any questions were affirmative, opened questions were then asked on how their partnerships/collaborations related to the Public, Private, People, and Professional sectors. Based on the survey, the questionnaire was configured in Thai in order to facilitate communication with the companies. The survey was conducted at the company level with the participation of the manager/head of power plant. Thus all the answers represented the whole company.

A total of 63 successful BtE project were used as the population, then by using random sampling method, a sample size is selected for this research. About 54 companies according to the sample size were determined by Yamane (1967, p.886). These 54 companies were searched via contact information with a score of 95% significant. Out of this number, only 44 companies got the contact information. But the contacts were made known to only with 28 companies due to the absence of an update telephone number. Out of the 28 companies interviewed, only 13 companies responded.

For data analyzing, data from the questionnaire represents the number of responses in order to show the frequency of the company. Data was analyzed as the number and classification to benchmarking their answers within the same scope of questions. These results were presented as the table of comparison.

In term of validity and reliability, the questions were asked directly to the manager of the BtE projects in order to get the company's information about the projects. And the questions derived from the research question of this study in order to stay in the right context.

After the research design has been developed in order to set the guideline of the study, different methods were then formulated. Later, it presents the findings during the study. This is explained in chapter 4.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Stakeholder Mapping

According to the four sectors in partnership, stakeholder mapping identifies the resources, roles, and perceptions of the key persons in each case. It describes the resources they had, the roles they played and the perceptions they held regarding the development of BtE projects. These findings are the factors to support the formulation of partnership. It is represented respectfully by sectors: namely; public, private, people, and professional sectors.

4.1.1 Public Sector

The public sector comprises of the government organizations that facilitate, regulate, control and make policies about BtE projects. Various government organizations are involved with the BtE project. These organizations can be national, provincial or local in their levels. Both cases were subjected to the similar national and provincial level of government organizations e.g. MOE, Ministry of Natural Resources and Environment (MONRE) and the Office of Energy Chiang Rai, etc. However, it is difference at the local level in the public sector. Case I, Biomass Power Plant Project in Ban Jam Pong, Moo 5 was under the Lai Ngao TAO which was later upgraded into Lai Ngao Tambon Municipality in October 2009. Case II, the Biomass Power Project at Ban Tri Keaw Moo 8, Wiang Nue Sub-district is under Wiang Nue TAO. Despite the difference the local government organizations, then roles and resources of the local government for both cases are mostly similar to what is provided from the central government. The perception may depend on their

background of the chief exclusive (Local government header). It is presented in Table 4.1

For the Resources, various government organizations involved in the BtE project has its own resources. According to most of them, they are policy makers, regulators, and facilitators, while power, authority and knowledge are their key resources related to their organization's objective.

Regarding the BtE project, the energy national plan/policy is the resource of the MOE. Furthermore, knowledge and funding (adder program, ESCON Fund) are also their resources that support the promotion of the BtE program.

The PEA also has the power, and authority related to make a buying contract of electricity, to set the price of electricity, and provides money for buying the electricity from the biomass power plant. Furthermore, this organization is also equipped with engineers, technicians and technologies related to the central grid connection.

In the local sectors like the Lai Ngao Tambon Municipality and the Wiang Nue TAO have the power, and authority related to collect the land, building, signboard tax and other communal taxes. Local governments have also other resources besides legal power. This is so because they come from the local people by election. Then, there are the local representatives who have community backup mandated to protect the community. While the central government and provincial offices can ignore local demands and concerns, the local governments cannot, because they might lose their jobs like in Wiang Nue case. The head of Wiang Nue TAO resigned from his job during the conflict problem of a BtE project being established in the area (Wiang Nue Tao, 2012).

For the Roles, each government organization is mostly the policy making, regulators and facilitator depending on their responsibility of the central organization. While, the BtE is related to many organizations in various aspects e.g. energy, health, etc, so each organization has the roles related to BtE as follow;

MOE sets the strategy of biomass policy, regulates the energy law, provides the biomass knowledge, and the fiscal incentive for a BtE project, etc. The central office of MOE, Bangkok based, have full power, and authority to make an energy and biomass policy (policy maker), also regulate the energy law (Energy Policy, Energy

Law). Conversely, MOE has set up the Office of Energy Regulatory Commission of Thailand particular area as both cases located in the north of Thailand, they are under the Office of Energy Regulatory Commission of Thailand Area I, Chiang Mai, which also set up the Provincial Office of Energy, as a kind of decentralized. Due to this, the Office of Energy Regulatory Commission of Thailand Area I, Chiang Mai has the full authority relating to licensing and approval of power plants, while, the Provincial Office of Energy is supporting the work related to energy in the local province which has no authority related to BtE project.

The Office of Energy Chiang Rai is the only provider of experts of biomass energy; and the knowledge concerning biomass energy if required by any societal segments. The Head of the Office of Energy Chiang Rai (2012) expressed "in the provincial office here, we have no experts and information about BtE project, but we can support by coordinating the MOE or other partners to get information and experts about BtE if required by some parties, we have alliances".

Meanwhile, the Office of Energy Chiang Rai has no authorization for BtE project in the province. It belongs to the Energy Regulatory Commission of Thailand, Area I Chiang Mai and all the registration documents for BtE project is submited to the Chiang Rai Industrial Office (Ministry of Industry). "We have no power and authorization to licensing and approving this BtE project, the authorization is at the office of the Energy Regulatory Commission of Thailand, Area I Chiang Mai." (Head of the Office of Energy Chiang Rai, 2012 said). He also further comment that "we have no work related to BtE project in our office currently, our roles affiliated with BtE are to support this alternative energy in the local level by improving cooking strove" (The head of the Office of Energy Chiang Rai 2012).

With references to the environmental standards, the Ministry of Natural Resource and Environment (MONRE) has full power to make an environmental policy and determined the environmental standards surrounding biomass power plant, and regulate the environmental laws. For example, the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 is the main regulation for BtE project owners and they are obligated follows the environmental standards.

PEA and MEA made the contract with BtE power plant in order to become the purchaser of the electricity, in term of setting the price and buying the energy from

biomass power plant, and facilitate the grid to the biomass power plant. According to the location of BtE power plant, both cases are under the PEA who is responsible for the areas outside the metropolitan areas of Bangkok, Nonthaburi and Samut Prakan Province.

As for local governments, the Lai Ngao Tambon Municipality and the Wiang Nue TAO collect the land, building, signboard and communal taxes from the BtE power plant following the Building and Land Tax Act B.E. 2475 and Public Health Act B.E. 2535. In addition, the Municipality and TAO also accept the community complains about biomass power plant attributed to environmental and humanity issues. Furthermore, it also coordinates with other organizations e.g. the Chiang Rai Industrial Office, Ministry of Industry to express the local needs such as the present local needs. Remember that the head of Lai Ngao Tambon Municipality (2012) said, "we have no work related to promote BtE, but we just collect the tax from the company" and the head of Wiang Nue TAO highlighted on the community complaints about biomass power plant regarding the environment and human as "we just received the community complaints about the BtE project, we just forwards the official letter to other organizations e.g. Chiang Rai Governor Office, the Chiang Rai Industrial Office, Ministry of Industry, etc., That's our role in our organization to serve the community. We also got sued by the company, but now the case is dismissed by the company. If we don't do that, the local community will say that we didn't process it" (Head of Wiang Nue TAO said, 2012).

The Perception, at the national policy level has been set for utilization of renewable energy especially biomass. MOE supports the BtE project in Thailand by setting the policy and the Alternative Energy Development Plan 2012-2021 (AEDP 2012-2021) sets the targets at 1,896 ktoe of electricity and 8,200 ktoe of heat to be generated from biomass by 2021 (DEDE, 2012). The MONRE is concerned with the environmental standard surrounding the BtE project e.g. pollution standard-air, noise, water (PCD, 2012b). Moreover, Ministry of Health is also concerned with the human health standards surrounding the BtE project in accordance with the Public Health Act (Department of Health, 2012).

The Office of Energy Chiang Rai, MOE, is also represented as transformation the local office of MOE, supports the BtE. Thus, the head of office said, "we support

the utilization of biomass energy as the alternative energy for Thailand, and also provide the biomass information. In Chiang Rai, we now have no work related to BtE power plant, but we are working with cooking stoves, we have the expertise and technology transferred to the local" (Head of Office, 2012). At the local level, "biomass energy is the energy from burning the wood, corn cob, rice husk, etc. Our organization has not engaged in promoting BtE. For this community, this time, there is no document to show that local people complain about the biomass power plant. It is good in term of energy source, but I am not sure if it is good for future environment and human health or not" (Chief of Lai Ngao Municipality, 2012). In another case, the head of office has expressed that "Biomass power plant has bad effects on environment and human health. The central government already prohibited the burning of agricultural and forestry wastes. That's why we need to support biomass power plant, because it is waste burning also" (Chief of Wiang Nue TAO, 2012).

Table 4.1 The Stakeholders of the Public Sectors

Name of Organization	Case	Resources	Roles	Perceptions
MOE	National Scale 1. Case I 2. Case II	1. power, and authority to make an energy and biomass policy (policy maker) and regulate the energy law (Energy Policy, Energy Law); 2. knowledge about the BtE; 3. funding (financial support e.g. adder) to the biomass power plant.	1. make an energy policy and biomass policy, and regulate the energy law; 2. providing the energy knowledge, and make a pilot project; 3. provide the fiscal incentive for a BtE project.	Support

Table 4.1 (continued)

Name of Organization	Case	Resources	Roles	Perceptions
The Ministry of Natural Resource and Environment	National Scale 1. Case I 2. Case II	1. power and authority to make environment standard and environmental policy (policy maker),	1. make an environmental policy and environmental standard surrounding biomass power plant, and regulate the environmental law.	N/A
The Ministry of Health	National Scale 1. Case I 2. Case II	1. power and authority to make the law and policy related human health. (policy maker)	1. make health policy and regulate tax payment for biomass power plant.	N/A
The office of the Energy Regulatory Commission of Thailand, Area I Chiang Mai	Region Scale (North Province) 1. Case I 2. Case II	1. power, and authority related to licensing and approval of power purchase; 2. power, and authority to administrative and set the policy and strategy of the electricity development fund	1. licensing and approval of power purchase. 2. administrative the electricity development fund, and power, and authority to set the policy and strategy of the electricity development fund	N/A
The Office of Energy Chiang Rai, MOE	Provincial Scale 1. Case I 2. Case II	1. experts of biomass energy; 2. knowledge about biomass energy.	1. support and develop the alternative energy in the local level (The Office of Energy Chiang Rai, 2012)	Support

Table 4.1 (continued)

Name of Organization	Case	Resources	Roles	Perceptions
The Chiang Rai Industrial Office, Ministry of Industry	Provincial Scale 1. Case I 2. Case II	1. power, and authority to licensing of the industrial factory.	1. register the industrial factory, we concerned the biomass power plant as the industrial factory in categories number 3, order 88th follow the Industry Act B.E. 2535 (Specialist engineer, 2012)	N/A.
PEA	Provincial Scale 1. Case I 2. Case II	1. power, and authority related to make a buying contract of electricity; 2. authority to set the price of electricity; 3. money for buying the electricity from the biomass power plant; 4. engineer and technology related to connect the grid of PEA	1. make the contract with biomass power plant; 2. set the price and buy the electricity from biomass power plant; 3. facilitate the grid to the biomass power plant.	N/A.
The Chiang Rai Commercial Office, Ministry of Commerce	Provincial Scale 1. Case I 2. Case II	1. power, and authority to approve the register as company.	1. register as company	N/A.
The Lai Ngao Tambon Municipality	Sub-district Scale 1. Case I	1. power, and authority related to collect the land, building, signboard tax, and well behaved of local community	1. collect the land, building, signboard tax and bad for health industry.	Neutral

Table 4.1 (continued)

Name of Organization	Case	Resources	Roles	Perceptions
The Wiang Nue TAO	Sub-district Scale 1. Case II	1. power, and authority related to collect the land, building, signboard tax, and well behaved of local community	1. collect the land, building, signboard tax and bad for health industry. 2. accept the community complain about biomass power plant regarding to environment and human	Neutral

4.1.2 Private Sector

The private sector is any profit organization including a private person and the private investors e.g. material suppliers, BtE power plant and financial institutions, etc. The two cases of BtE project are owned by private companies. The one at Ban Jam Pong, Moo 5, Lai Ngao Sub-district belongs to the Supreme Renewable Energy Co., Ltd. owned by the Bangkok based company with 10,000,000 THB of authorized capital. The other at Ban Tri Keaw Moo 8, Wiang Nue Sub-district was drawn up by the Clean Energy 2 Co., Ltd. owned by the rice mill tycoon in Chiang Rai with 260,000,000 THB of authorized capital (Department of Business Development, 2012). For the biomass supplier is the local farmers in the community especially the case of Wiang Kean, while the case of Wiang Chai plan to use their byproduct of rice mill.

For Resources, these two companies have the human resources, engineers, and technicians supporting teams, who have the BtE knowledge. They also have the BtE technology. Furthermore, they have the fund/ financial potential to operate the company which is a high investment cost. For the biomass suppliers, the agricultural and forest residues are their resources for the BtE project.

Both BtE power plants have the same “Roles” as BtE operator. These companies have potential funds to establish the BtE project with the command, operate the biomass power plant; and monitor and control the biomass power plant. They are also the buyers of biomass material from the suppliers and sell the electricity to the grid of PEA as mentioned by the manager of the Supreme Renewable Energy Co., Ltd. (2012). He said that “we buy the local biomass material, employ local people mainly but if there are no potential people in local. We then employed from outside (e.g. engineers, technicians) and we sell the electricity to the grid of PEA” (2012). And the biomass material supplier sells their byproduct from their agricultural activities, but it has to control the size of material. One of the villagers expressed by saying that “we have to cut the material in the size that the company needs especially the wood residues, for corncobs are ok” (Villager of Ban Jam Pong Moo 5, 2012).

For Perception, the companies saw the BtE as clean energy for Thailand which exhibits is very high potential biomass resources, and increasingly supported and utilized in order not to depend on imported oil and natural gas which is limited energy sources, and bad for environment. The manager of the Supreme Renewable Energy Co., Ltd (2012) reiterates that “biomass power plant is generating energy (electricity) that is clean energy. Currently, Thailand has a high biomass potential and high support from the government. It will increase utilization of biomass for energy purpose in the future. For the environment and human health problem, it generates less pollution (smoke, noise, waste water) in this factory, we controlled all the pollutions, and we continue monitoring it. We already conducted the study about the biomass material before, and then it was not a problem about the supply amount, it may be the problem of procurement”. This finding summarizes in table 4.2.

Table 4.2 The Stakeholders of the Private Sectors

Name of Organization	Case	Resources	Roles	Perceptions
The Supreme Renewable Energy Co., Ltd.	1. Case I	1. investment fund. 2. human resources (Engineer, workers) 3. BtE knowledge and technology;	1. provide the fund to establish the BtE project (Investor); 2. operate the biomass power plant; 3. monitor and control the biomass power plant	Support
The Clean Energy 2 Co., Ltd.	1. Case II	1. human resources (Engineer, workers) 2. BtE knowledge and technology 3. investment fund	1. provide the fund to establish the BtE project (Investor); 2. operate the biomass power plant; 3. monitor and control the biomass power plant	Support
The Biomass Material Supplier	1. Case I	1. biomass material resources	1. sell the biomass material resources (supplier)	Support

4.1.3 People Sector

People defined as local communities who would be affected by the impacts of the project, end users who would benefit from the project and their allies such as NGOs and the media.

The two cases are located at Ban Jam Pong Moo 5, Wiang Kean District and Ban Tri Keaw Moo 8, Wiang Chai District. Despite their similar agrarian background, they are related to BtE in a way that the nearby communities who share the environmental condition, are the end users (consumer). Eventually, people sector in both cases have the same resources, and roles to the BtE project, but their perception is unique depending on their understanding and knowledge.

For the community participation, in the Wiang Kean case, every household has participated in community activities e.g. monthly meetings that take place in the first week of each month, religious ceremonies, community development, etc. Figure 4.1 is an example of the observation of the local participation in local activities namely “Leang Pee Nung Dang ceremony which is their local custom.

Figure 4.1 The Leang Pee Nung Dang Ceremony

For Wiang Chai, the villagers are devoted to their community activities, and they are also united among themselves. Any activities, (monthly meetings, religious ceremonies, community development, etc) they all participated nicely as Figure 4.2. During the period of BtE project, there is a seriously conflict within the community. There was a serious conflict between those who agreed and those against the BtE project as the village head of Ban Tri Keaw Moo 8 (2012) mentioned, “these two groups are at loggerheads with each other and bluntly refused to join the funeral ceremonies of the other groups during the serious periods of between 2010-2011”.

Figure 4.2 The End of Buddhist Lent's Day in 2012

For Resources, the people sectors is the communities living around the BtE power plant, they have the right to protect their local resource and environment for the good condition following the discretion of public authorities can be contested under Article 67 of the Constitution of the Kingdom of Thailand that guarantees the right of a person to participate in the conservation, preservation, and exploitation of natural resources for his well-being and quality of life and protects the right of a community. They have the power to support or against the BtE project while conducting the public hearing of the BtE project what may be needed in the process of licensing and the authorization of BtE power plant.

For Roles, they are related to BtE project as local community in the project area and end users (consumer) according to their relationship with BtE project. Their roles is to observe the environment and human health problem from the BtE project (as local community), and consume the electricity (as end users of BtE producers).

Regarding perception, each community has their own perception depending on their understanding and knowledge as in table 4.3. Both communities, the primary school level are the majority of populations, they share similar cultural background (North Region). One of the villagers in the Wiang Kean case expresses his feeling about BtE project that there are no health and environmental effects. "I am here in this

community, I cannot feel any problems from the biomass power plant here" (Village Head of Ban Jam Pong, 2012). But there was an incident about the noise problem before, but the problem was already solved immediately. "A few years ago, there was the problem with noise from the plant, the community informed the plant, and the company solved it without trouble" (Villager of Ban Jam Pong, 2012). Currently, there is no problem between the community and BtE power plant, and the company has an amicable public relationship with the locals since the beginning of their operations until now. The company bought one community car for the disaster prevention and mitigation activities in the sub-district office. On the contrary, the case of Wiang Chai, witnessed opposition upheavals, people made their own trip to visit some bad examples of BtE projects and combining with the incomplete of knowledge of BtE with lignite power plant. "Burning of biomass makes smoke and dust which the community has concerned some group of people made their own trip to visit the bad example of biomass power plant and they learnt from the news also. The area of project is closed to the two rivers-Kok and Lao river is what our concerned" (Village Head of Ban Tri Keaw, 2012). The summary presented in Table 4.3.

Table 4.3 The Stakeholders of the People Sectors

Name of Organization	Case	Resources	Roles	Perceptions
Local People at Ban Jam Pong Moo 5, Lai Ngao Sub-district, Wiang Kean District, Chiang Rai.	1. Case I	1. the power of community to against and support the BtE project.	1. observe the environment and human health problem from the BtE project (Local community); 2. consume the electricity (End users of BtE producers).	Agree (Majority)
Local People at Ban Tri Keaw Moo 8, Wiang Nue Sub-district, Wiang Chai District, Chiang Rai.	1. Case II	1. the power of community to against and support the BtE project.	1. observe the environment and human health problem from the BtE project (Local community); 2. consume the electricity (End users of BtE producers).	Don't agree (Majority)

4.1.4 Professional Sector

The Professional sector consists of academic organizations that provide the knowledge for society in both national and international scales. It includes university, research institute or academic institutions. Both cases have professionals involved but there had each different strategy. These include;

Knowledge of BtE; technology of BtE and human resources is their resources on this sector, and it is beneficial to the society.

Roles, the professional sector conducts researches related to the transformation from BtE and publish it to the society (Knowledge and technology information providers). However, they also can help in conducting the project feasibility study and community participation for the company as the case of the Clean Energy 2 Co., Ltd. Furthermore, they has the strong roles in sharing knowledge by making a seminar, or conference about the BtE and in additionally, it can provide the course related to BtE.

While, many university has set up the research units to conduct research related to the BtE and publish it to the society (Knowledge and technology providers); and also make the BtE demonstration project in Khon Buri District, Nakhon Ratchasima Province, etc as example of The Center of Excellence in Biomass at the SUT.

For perception, both good and bad conditions of BtE project have been published, and can be transferred to community. The professional sector agrees on BtE project as the Naresuan University (NU) has shown that "this area (case of Wiang Chai) has adequately biomass potential for the biomass power plant. And, the biomass power plant has the lowest environmental impact after the wind power" (Professional sector, 2009). This university has professional support to the Clean Energy 2 Co., Ltd. Furthermore, CMU also promotes the utilization of BtE project by establishing the Nakornping Energy Research and Development Institute to conduct the BtE research and transfer it to community.

Table 4.4 The Stakeholders of the Professional Sector

Name of Organization	Case	Resources	Roles	Perceptions
NU	1. Case II	1. knowledge of BtE; 2. technology of BtE 3. human resources	1. conduct research related to the BtE and publish it to the society (Knowledge and technology providers); 2. conduct the project feasibility study and community participation for the company (the Clean Energy 2 Co., Ltd.). 3. make a seminar about the BtE 4. provide the course related to BtE	Support

Table 4.4 (continued)

Name of Organization	Case	Resources	Roles	Perceptions
The Nakornping Energy Research and Development Institute at CMU	1. Case I	1. knowledge and technology of BtE; 2. human resources	1. conduct research related to the BtE and publish it to the society (Knowledge and technology providers). 2. make a seminar about the BtE 3. provide the course related to BtE	Support
The Center of Excellence in Biomass at the SUT	1. Case II	1. knowledge and technology of BtE; 2. human resources	1. conduct research related to the BtE and publish it to the society (Knowledge and technology providers); 2. make the BtE pilot project in Khon Buri District, Nakhon Ratchasima Province, etc. 3. make a seminar about the BtE 4. provide the course related to BtE	Support

4.2 Partnership

As the section 4.1 explains the resources, roles and perceptions of each stakeholder, this section explains the partnership development among these four sectors and it elaborates how very small biomass power plant established in Chiang Rai in an institutional perspective using the framework of 5Ps as a guideline. The 5Ps framework indicates how each sector participates along the development of BtE project in the formal process and two cases. The partnership will be presented and discussed in this section.

4.2.1 Formal Procedure of BtE in Thailand

This section describes the formal institution of the development of the BtE projects in Thailand, which governed both projects and particular very small scale BtE projects in Thailand. This core of the formal institution that governing the BtE projects in Thailand is the procedure mandated by DEDE. Table 4.5 lists mandatory steps, roles and responsibilities of different actors as required by laws. It must be noted that for a very small BtE project with a capacity lower than 10 MW, a requirement to conduct otherwise costly EIA is waivered in order to facilitate private investments. Thus, the formal institution for projects of this size is framed pretty much under the 3Ps paradigm that focuses almost exclusively on the relationships between governmental agencies and private operators. The roles and responsibilities of the other two Ps, people and professionals, in the development of very small BtE projects are scarcely mentioned in the existing laws and regulations. Whereas, the public hearing is only participation of people sector which is in the stage of authorization of factory in the formal procedure. And the role of professional sector is not mentioned in this mandate procedure. Furthermore, the decision making of BtE projects mainly are in the central government according this formal procedure.

Table 4.5 Formal Procedure of BtE Projects in Thailand

Steps	Roles & Responsibilities
Project feasibility study	*Public Sector*: None *Private Sector*: A company conduct the report of project feasibility study *People Sector*: None *Professional Sector*: None
Design the plant, machine, and estimate the construction cost	*Public Sector*: None *Private Sector*: A company conduct the report of design the plant, machine, and estimate the construction cost. *People Sector*: None *Professional Sector*: None
Registration of a company as a juristic person	*Public Sector*: the Department of Business Development (DBD) processes the request from a company consider, and authorize the requet. *Private Sector*: A company submits the application for a request of juristic person to DBD. *People Sector*: None *Professional Sector*: None
Registration of an industrial estate	*Public Sector*: the Provincial Industrial Office (PIO) processes the application from a company and inform other relevant authorities including the local government where the plant will be located *Private Sector*: A company submits the application for a proposed project with relevant documents to PIO under the factory laws. *People Sector*: None *Professional Sector*: None
Authorization of a factory	*Public Sector*: PIO conducts inspection of the site, solicits the opinion of the local government, and makes public the registered project. Anyone can submit his/her opinion to the authority regarding the project for the period of 15 days after the announcement. After the Energy Regulatory Commission (ERC)'s review, the PIO authorizes the project and collects the license fee *Private Sector*: the company provides all required documents and, if the project is authorized, pays the license. If the project is not approved, the company can improve and resubmit the applications and documents to the authorities *People Sector*: local communities *can* provide their opinions on the proposed project to the local government

Table 4.5 (continued)

Steps	Roles & Responsibilities
	Professional Sector: None
Authorization of land use for new construction	*Public Sector*: the Tambon Adminsitrative Organization (TAO) reviews the application for a request from a company, consider, and authorize the request. *Private Sector*: A company submits the application for a request for construction, adjust the building with relevant documents to TAO. *People Sector*: None *Professional Sector*: None
Plant construction	*Public Sector*: None *Private Sector*: The company and its subcontractors construct the plant and install the system *People Sector*: None *Professional Sector*: None
Electricity selling contact	*Public Sector*: the PEA or the MEA reviews the application and signs a contact with the company *Private Sector*: the company requests for the selling contact to connect to the grid of PEA or MEA *People Sector*: None *Professional Sector*: None
Authorization of controlled energy producer	*Public Sector*: the DEDE reviews the request and checks whether the conditions *Private Sector*: the company requests with DEDE to be a controlled energy producer *People Sector*: None *Professional Sector*: None
Authorization of electricity business	*Public Sector*: ERC reviews the submission and processes the approval of the project. If approved, ERC gives a license to the producer and collect the fee *Private Sector*: The company submits an application for a license of electricity producers to ERC. If approved, its collects the license and pays the fee. If not, the company can improve and resubmit the applications and documents to the authorities *People Sector*: None *Professional Sector*: None

Table 4.5 (continued)

Steps	Roles & Responsibilities
Electricity quality approval	*Public Sector*: PEA or MEA checks the quality of electricity. If approved, it informs the date of buying (COD) *Private Sector*: The company requests the selling of the electricity to PEA or MEA *People Sector*: None *Professional Sector*: None
Operation	*Public Sector*: the local government collects the building tax and, according to the Public Health Act, B.E. 2535 monitors the operation. PEA or MEA pays adders *Private Sector*: the company operates the plant, receives adders, and renews its licenses *People Sector*: None *Professional Sector*: None

From DEDE. (2012). **Alternative energy development 2012-2022**. Bangkok: Ministry of Energy.

The actual projects neither follow nor are limited to the steps listed in Table 4.5. The next section is a reconstruction of how the two projects unfolded in Chiang Rai.

4.2.2 The Development of the Very Small Scale BtE Projects in Chiang Rai

This section elaborates the development of BtE project in the two cases using the timeline, both cases have the similar players including the four main stakeholders; public, private, people and professional sectors. They have a kind of partnership in both formal and informal ways since the beginning of the BtE until its actual utilization. Each sector has its own resources, roles and perceptions. They share the resources to obtain successful BtE projects, the description of the cases are as following;

The BtE project in Wiang Kean, the Supreme Renewable Energy Co., Ltd first came to the community in February 2005 in order to buy a land around 2 rai for the BtE power plant. Later in January 2006, the company came and attended the community meeting and officially informed them that they will build a biomass power plant. In the meeting, the company provided the biomass power plant information to community. An expert from a university was brought in for public hearing to give information about the technology from the beginning. Some farmers were interested in selling cornstalk and other residues to the plant. The company also employed social and cognitive strategies in the early stage of the development. In the meantime, the company had tried to address the concern of the people such as pollution, benefit sharing, and to remain responsive. Community leaders were introduced to external experts and researchers of the company and they had an opportunity to visit a successful BtE plant. The company organized a study visit to the BtE demonstration plant of SUT in October 2006. The trip was joined by executives of the local government, the sub-district chief, the director of the public school, village headpersons and other community leaders according to one of the villagers of Ban Jam Pong (2012) "the company made the field trip for the local community, head of TAO, head of school, village head and some villagers to visit the power plant in the northeast". In January 2008, the company attended a community meeting and presented the project after the trip (trip conclusion and discussion). After being well informed, they held a referendum. Majority of participants agreed on the BtE project. Participants were also interested in the project and revenues from selling biomass to the plant. The community also spoke of concerns over air pollution and water consumption. The company proposed the standards on air pollution, noise level, and the recycling of cooling. In addition, a co-monitoring mechanism in which representatives from the community would participate in the periodic inspections of the plant was also proposed as "we have the agreement with the company since beginning that, if there is any human and environmental problem occurs, the local community can inform the company, if there is still a problem, the company will close down" (Villager of Ban Jam Pong, 2012) After coming to positive terms with the community, the company bulldozed and fenced the area and built the office. While the construction went on, the company conducted a suitability report on the biomass

power plant and their machinery design report before they applied for authorization from PIO on 6 November 2007 with the mandated steps of DEDE.

The private developer was forthright and keen to work out the benefit sharing with the communities in early stage. The company and the locals also negotiated some benefit sharing, and attending the community activities coherently. For example, the company has supported several local activities such as student scholarships, local sport events, Wiang Kean's Pomelo Fair, etc. as part of its corporate social responsibility. Related to this, one villager of Ban Jam Pong, Moo 5 (2012) expressed that "the company donated the money to the temple development activity, the community activities". Furthermore, the manager of Supreme Renewable Energy Co, Ltd (2012) mentioned "we donated the money to support the community activities from time to time.". It is a kind of "win-win" situation between Private and People sector.

Figure 4.3 The Company Donated an Ambulance to the Community

After processing the application and the inspection, PIO authorized the project on 30 January 2008. PEA inspected the quality of the system on 13 February 2008. At the end of February, the company informed the community that the plant would soon

operate and the channel they could use to complain should pollution arise. Later on, the ambulance was donated to the local government in March 2008 for the community (Figure 4.3) regarding to benefit sharing. In April 2008 the company concluded a contract with PEA and started selling electricity to the grid. The plant has been in operation since 2008. During the operations, in May 2009, there was a complaint about the noise from the plant and the company quickly abated the nuisance. Currently, this BtE power plant has actual operation, and welcomed the visitors from any of the sectors e.g. minister of energy, university, etc. Manager of Supreme Renewable Energy Co, Ltd (2012) said "we opened the company and welcomed the external (government, university, people, community) to visit and study from our company". According to this, Dr. Piyasawat Amranan visited this company in 2008 as show in figure 4.4. Nevertheless, the head of the Office of Energy Chiang Rai (2012) also said "we do have some trip to visit the Wiang Kean BtE power plant, and if we have some seminar, we do also invite guests to visit this BtE project as well".

From Supreme Renewable Energy Co, Ltd. (2012). **External visitors**. Retrieved December 15, 2012, from http://www.thai-greenenergy.com/

Figure 4.4 The External Visitors

During their operations, this plant also got the 2nd best ASEAN Energy Award 2010 and won the Thailand Energy Award 2010. However, the plan of September 2010 to expand the capacity, met with opposition. It was withheld because the villagers were concerned about the increased of biomass supply which is contrary to the land activities in the area. “Some people did not agree with the expansion of the company, because the land in the community is now converted to para rubber plantation area, housing, etc, so we therefore assumed that to be the problem of the biomass material after company capacity expansion” (Villager of Ban Jam Pong, 2012). Most interviewed informants in this case perceived the BtE project as it was positively and considered it a success, although villagers opposed its planned expansion.

Some others wanted to see more direct benefits from it in terms of free electricity or a reduction in energy price. The head of Lai Ngao Municipality (2012) said “we are in this community, we can’t see the direct benefit to this community e.g. the electricity to community from the company, or cheap electricity price”.

While the BtE project in Wiang Chai was conceived by Clean Energy 2 Co., Ltd., the company acquired 74 rai of land in late 2008 through the head of the local government and sub-district chief. But, the communities first thought that only a rice mill would be built before, then later learnt that a BtE plant was also planned to use by-products from the rice mill. The company organized a study visits to BtE plants in Surin, Pichit, Kampangphet, Bureerum, Ubonratchani which started in October 2008 for some community leaders. It accords to “the company invited the village leader, villagers, government office, and media in the communities around 60 persons to visit Muang Cha Learn Biomass Power Plant in Buruesi Sub-district, Muang District, Surin Province” (Chiang Rai people protesting against biomass power plant even though Naresuan University confirmed only small impact on environment, 2009). From December 2008, the company attended monthly community meetings with 11 villages but the issue was not in the agenda of the meetings. An expert from a Naresuan University was brought in to give information about the technology. Referendums which were held during these meetings which were not afore tangible information about BtE project: 10 villages supported the project and one, the Ban Wiang Derm Moo 2, was against. Then local government on 20 January 2009 issued

an official letter to the company that the area was not under the building control laws and the company was free to develop the project as supported by the majority. The company began bulldozing the land and constructed a workers' hut. But the work was stopped by the protest which was organized for the first time on 5 February 2009. A report opposing the project was proposed on 8 February by 500 villagers to the district governor. The district chief had to call for a multi-stakeholders' meeting on 19 February 2009 but could not resolve the conflict. Regarding this Villager of Moo 9, they expressed that "it was first officially informed by the company that they will make a biomass power plant in that area in this meeting of 19th February at the District governor's office. Before that, we don't know anything, we just heard it from gossips". Later on, the head of the TAO was forced to resign on 20 March 2009 (Wiang Nue TAO, 2012). The company applied for authorization to PIO on 12 May 2009. Upon hearing the news, the against group filed complaints to various bodies including PIO, PEA, the District Office, the Governor of Chiang Rai, and the Internal Security Operations Command (ISOC). According to the information of ISOC (2009), around this time there was a conflict over the commission fee among those who helped the company acquire the land including some incumbents in the local government. The election of head of the TAO in July 2009 saw the rise to the power of those against the project which replaced the former executives who were supportive to the project. Apparently, "I was selected to be the head of this organization to help solve this conflict, and process the local need to other organizations" (Head of TAO, 2012). On 23 September 2009, a study visit was organized by the communities themselves to a BtE plant in Surin with help from a local political activist who was related to the Village head of Ban Tri Keaw (2012). He commented that "the villagers made the field trip to see the biomass power plant, if we go with the company they will take us to the good biomass power plant, then we make our own trip, and we paid the trip ourselves". After a long delay, PIO finally authorized the project on 4 March 2010. The company continued its construction, commissioning a construction company to build the plant and fencing the area. However, the groups opposing the project put up a fierce protest and obstructed the construction. They camped in front of the site (Figure 4.5).

From Chiang Rai local people presenting happiness towards an acquitting of biomass power plant pretesting worth 1.12 million baht being sue in court. (2012, May, 22). **Prachathai News**. Retrieved October 9, 2012, from http://prachatai.com/journal/2012/05/40614

Figure 4.5 The Camp of Against Group

On 30 August 2010, the company went to the Civil Court suing the protesters for losses worth 1.12 million Baht for the delay in construction. Several other litigations followed. The project remained halted while the litigation continued. The project has not yet been materialized. The Administrative Court ordered the project to be suspended on 30 August 2011 while the Court investigated into the validity of the licensing. The Civil Court also suspended its trail on 21 May 2012 while waiting for the ruling of the Administrative Court. The company had applied for extension of its license on 11 August 2011 and granted 700 more days. In July 2012, the company sold 38 rai of land back to villagers. Presently, the area has no development on site.

Table 4.6 illustrates the development of the two projects during the period of two and a half years. It reports the details every six months into the project's life in order to have the whole picture of the long period apparently. Although the two

projects were governed by the same set of formal rules, they featured different form of partnership strategies, which in turn, steered the development of the projects into different paths.

Table 4.6 Timeline of the Development of Two BtE Projects in Chiang Rai.

Time	Case 1: Wiang Kean Project	Case 2: Wiang Chai Project
0-6 months	The project was conceived by Supreme Renewable Energy Co., Ltd. to build a BtE plant on the land (2 rai) that it acquired in February 2005. The company informed the community about its BtE project in Jan 2006. An expert from a university was brought in for public hearing to give information about the technology.	The project was conceived by Clean Energy 2 Co., Ltd. The company acquired 74 rai of land in late 2008 through the then head of the local government and sub-district chief. But, the communities first thought that only a rice mill would be built before later learnt that a BtE plant was also planned to use byproducts from the rice mill. The company organized a study visits to BtE plants in Surin, Pichit, Kampangphet, Bureerum, Ubonratchani started in Oct 2008 for some selected community leaders. In Dec 2008, the company attended a monthly community meeting with 11 villages but the issue was not in the agenda of the meetings. An expert from a university was brought in to give information about the technology. Referendums were held in these meetings: 10 villages supported the project and one, the Ban Wiang Derm Moo 2, was against.

Table 4.6 (continued)

Time	Case 1: Wiang Kean Project	Case 2: Wiang Chai Project
7-12 months	The company organized a study visit to the BtE demonstration plant of SUT. The trip was joined by executives of the local government, the sub-district chief, the director of the public school, village headpersons and other community leaders.	The then local government on 20 Jan 2009 issued an official letter to the company that the area was not under the building control laws and the company was free to develop the project as supported by the majority. The company began bulldozing the land and constricted a worker hut. But the work was stopped by the protest which organized for the first time on 5 February 2009. A report opposing the project was proposed on 8 Feb by 500 villagers. The district chief had to call for a multi-stakeholder meeting on 19 February 2009 but could not resolve the conflict. The head of the local government was forced to resign on 20 March 2009. On 12 May 2009, the company applied for authorization to PIO. Upon learning the news, the against group filed complaints to various bodies including PIO, PEA, the District Office, the Governor of Chiang Rai, and the ISOC. According to the information of ISOC, around this time there was a conflict over the commission fee among those who helped the company acquiring the land including some incumbents in the local government.

Table 4.6 (continued)

Time	Case 1: Wiang Kean Project	Case 2: Wiang Chai Project
13-18 months	The company bulldozed and fenced the area and built the office. An ambulance was donated to the local government.	The election of executives of the local government in July 2009 saw the rise to the power of those against the project which replaced the former executives who were supportive to the project. On 23 Sep 2009, a study visit was organized by the communities themselves to a BtE plant in Surin with a help from a local political activist.
19-24 months	The company applied for authorization from PIO on 6 Nov 2007.	After a long delay, PIO finally authorized the project on 4 Mar 2010. The company continued its construction commissioning a construction company to build the plant and fencing the area. However, the group opposing the project put up a fierce protest and obstructed the construction. Some of them camped in front of the site.

Table 4.6 (continued)

Time	Case 1: Wiang Kean Project	Case 2: Wiang Chai Project
25-30 months	In Jan 2008, the company attended community meetings and presented the project. Participants were interested in the revenues from selling biomass to the plant but also spoke of concerns over air pollution and water consumption. The company proposed the standards on air pollution, noise level, and the recycling of cooling. In addition, a co-monitoring mechanism in which representatives from the areas would participate in the periodic inspection of the plant was also proposed. The company and the locals also negotiated some benefit sharing (an ambulance was donated to the local government in Mar 2008. At the end of the meeting, a referendum was held. A large majority approved the project. After processing the application and the inspection, PIO authorized the project on 30 Jan 2008. PEA inspected the quality of the system on 13 Feb 2008. At the end of February, the company informed the community that the plant would soon operate and the channel they could use to complain should pollution arise. Apr 2008 the company concluded a contract with PEA and started selling electricity to the grid.	On 30 Aug 2010, the company went to the Civil Court suing the protesters for losses worth 1.12 million Bahts for the delay in construction. Several other litigations followed. The project remained halted while the litigation continued.

Table 4.6 (continued)

Time	Case 1: Wiang Kean Project	Case 2: Wiang Chai Project
Present	The plant has operated since 2008. The company has supported several local activities such as scholarships, local sport events, Wiang Kean's Pomelo Fair, etc. as part of its corporate social responsibility. The plant got the 2nd best ASEAN Energy Award 2010 and won the Thailand Energy Award 2010. However, the plan in September 2010 to expand the capacity met by the opposition and has been withheld since.	The project has not yet been materialized. The Administrative Court ordered the project to be suspended on 30 Aug 2011 while the Court investigated into the validity of the licensing. The Civil Court also suspended its trail on 21 May 2012 while waiting for the ruling of the Administrative Court. The company had applied for extension of its license on 11 Aug 2011 and granted 700 more days. In Jul 2012, the company sold 38 rai of land back to villagers.

In comparison, the formal procedure, and experience from the two cases studies have shown different partnership strategy as illustrated in figure 4.6. The formal procedure exposed mainly the partnership between private and public sectors only. This partnership is an electricity selling contract and adder program between company and PEA/MEA. This partnership is formal partnership as a contract. While the Wiang Kean case partnership was formal partnership between company and the PEA in order to sell the electricity and receive the adder program. Furthermore, the company also has a formal partnership with the professional sector because the company requested for advice from the professional sector about the technology information in order to develop technology and meet the environmental standards. Nevertheless, the company has an informal partnership with the local people through public participation by requesting information, and obtaining feedback from the community in order to make the company's decision which is at the stage of "Consult" according to the spectrum of the international association for public participation. For Wiang Chai, there was not continuation process because there was a local election in the local government office which changed the institution in their case. Then the development seemed to have the two periods of time "Time 1: Before

election", and 'Time 2: After election". For the period "Time 1: Before election", the partnership between the private and public sectors occurred in order to buy the land at the beginning of the project. However, the partnership between the company and the professional sector is conducted a project feasibility study and a referendum in the community. Furthermore, there was also informal partnership between Professional and People sectors by conducting a referendum. This referendum was held at an early stage before the participants were not yet well informed about the project. It was miss-inform which not meet the stage of "Inform" according to the spectrum of the international association for public participation. In the period, "Time 2: After election", the project became an uphill struggle after the candidate who didn't agree with the BtE project won the local election. So, the partnership that was mainly between the public and the people sector which comprised of the local public organization (TAO), proposed the policy against the industrial factory (BtE project) and to promote the agricultural activities in the community.

The stakeholders concerned during the formal procedure of the BtE project

The stakeholders concerned during the BtE case I project

The stakeholders concerned during the BtE case II project

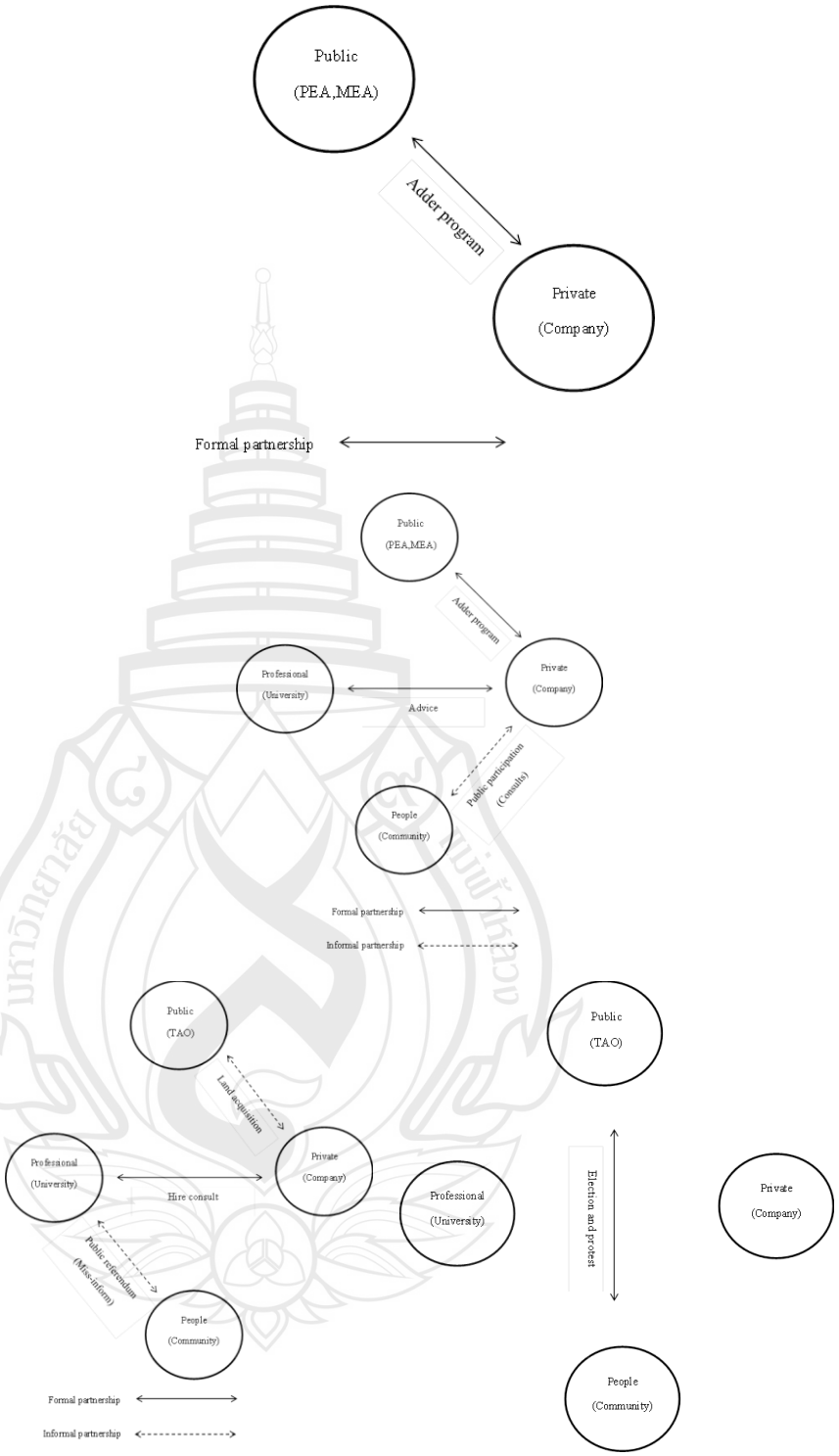


Figure 4.6 Stakeholders' Participation in the BtE Project

4.2.3 Survey's Results

The consolidated survey data in table 4.7 depicts that the successful BtE project was as a result of the partnership of the 5Ps sectors namely Public, Private, People and Professional sectors. Amongst the surveyed companies illustrated, there was corporation between the Public and Private partnership through the adder program. The BtE project must receive an approval from the local community prior the project could be undertaken, whilst all private sectors must receive a consent from the local community. Seven out of thirteen successful BtE projects received confirmation from the Professional sector. It thus confirms that the participation of the Professional sector helped to obtain one of the small scale successes of the BtE projects in order to meet the technological and environmental standards. The private sector employed the university to study and investigate the impacts of the BtE project such as energy and environmental impacts and provide the BtE project consults to educate them to understand the BtE environment. The university could also use the BtE project as an actual Lab to study and investigate environmental issues practically. In addition, most of the successful BtE companies had their own material, only 4 companies relied on outsource materials, but they had the contract with the resource suppliers such as the palm oil company, the rice mill, etc. Some surveyed companies have shown the tripartite monthly's meeting in order to share the information to make the stakeholders to understanding.

Table 4.7 The Results of Consolidated Surveys of Companies

Company	Owned Biomass Resource	Type of Biomass Resource	Public [A]	Private	People [E]	Professional
A01	No	Wood residues	Yes	Yes	Yes	Yes
A02	Yes	Rice husk	Yes	Yes	Yes	Yes [F]
A03	Yes	Sugar cane	Yes	Yes	Yes	No
A04	Yes	Sugar cane	Yes	Yes	Yes	No
A05	No	Rice husk	Yes	Yes [B]	Yes	Yes [G]
A06	Yes	Sugar cane	Yes	Yes	Yes	Yes [F]
A07	Yes	Sugar cane	Yes	Yes	Yes	No
A08	Yes	Sugar cane	Yes	Yes	Yes	No
A09	No	Palm empty bunch	Yes	Yes [C]	Yes	No
A10	Yes	Sugar cane	Yes	Yes	Yes	Yes
A11	No	Rice husk, Eucalyptus bark ,Palm empty bunch	Yes [D]	Yes [D]	Yes [D]	Yes [G]
A12	Yes	Sugar cane	Yes	Yes	Yes	Yes [H]
A13	Yes	Coconut fluff	Yes	Yes	Yes	No

Note. [A]Electricity purchasing contract and adder program

[B]Trading partner with rice mill

[C]Trading partner with the palm oil company

[D]Tripartite meeting in every month

[E]Public participation

[F]Environment examiner

[G]Case study and research

[H]Environment and energy adviser

Based on the formal procedure, experience from the two cases of study and the companies' surveys, the next section discusses the institutional findings influencing the success and failure of BtE projects.

4.3 Discussion

This section analyzes the findings of the study related to the factors that contributed to the successful BtE project. It highlights and supports the framework in chapter 2. It specifically focuses on the discussion of the fourth and fifth Ps via People and Professional sectors.

4.3.1 Formal Procedure are Necessary but Not Sufficient Requirements

According to the formal procedure for a very small BtE project in Thailand, it was designed to fast track and to reduce the regulatory costs by the exemption of EIA which is a notable example. Despite good intentions, we found that the leniency of the formal institution can hurt the viability of very small BtE projects. Thus, under a broad institution, the discretion of the public authorities may be contested under Article 67 of the Constitution of the Kingdom of Thailand that guarantees the right to a person to participate in the conservation, preservation, and exploitation of natural resources for his well-being and quality of life, and protects the rights of a community.

This leads to change in the institution that governed the BtE projects from the involvement of the Public and Private sectors to addressing the People and Professional sectors. Both cases understood this change of the real situations that appeared to gain public acceptance. According to the formal procedure, it superseded the minimum criteria mandated by the DEDE with the partnership between Public and Private sectors. The project development strategy of both cases showed the involvement of People and Professional sectors, but they had different strategy. Wiang Kean case brought to light the Public-Private-People-Professional Partnerships in the development project, while Wiang Chai also highlighted the partnership with the Public and Professional sectors, but the partnership with the People sector was not well obtained due to the lack of transferring and understanding the information.

The success of very small BtE projects lied not only in meeting the formal procedure which are mainly Public and Private partnership, but also perceived the partnership of People and Professional sectors as in Wiang Kean's case. It is thus

confirmed by the consolidated surveys of the companies that most of the successful BtE projects have partnership among Public, Private, People and Professional sectors.

4.3.2 Community Understanding and Participation is Indispensable

Due to the process of laws and rights of local community, both cases complied and elaborated on the People sector with the BtE project, through a public hearing and participation, which according to Majamaa (2008), proposed that the end user, (People sector) should be considered in the development project at its early stages of the project. Furthermore, both cases also tried to obtain the so-called "social license to operate" from the People sector. Private developers in the cases appeared to understand the essence of this. And the People sector should be involved and participated as a partnership. Both cases also exposed the referendum held by the community, and the Professional support which made the community to understand. The success of the Wiang Kean BtE project was as a result of the referendum which first of all educated and informed the public correctly, but on the contrary, the Wiang Chai case was different. The People sector was not well informed and this made the people to become antagonistic to the BtE project in their community.

Moreover the Public participation was scheduled at the beginning of the project development in order to gain their acceptance before submitting the document to license the project. But, the very small scale BtE project according to a mandated procedure by DEDE, accepted the document for project licensing first and then given 15 days of public hearing.

Regarding the spectrum of the International Association of Public Participation in 2007, both cases were keen to show public acceptance of the projects but went differently to gain this. The Wiang Chai project failed even to inform local stakeholders. Then they became the opposing group in the area. On the other hand, the participation in Wiang Kean went at least to the consultation level. This comparison showed the merits of sincerity and patience.

4.3.3 The Involvement of Professionals can Strengthen the Project but Not A Panacea

The professionals were highlighted as strengths of the project as indicated in section 2.3. This study shows that the involvement of Professionals can strengthen the project. The engineering experts were in the best position to explain the BtE technologies, their advantages, disadvantages, pollution abatement and cleaner technologies. The involvement of the Professional sector in the Wiang Kean project enhanced the technological prowess of the company that claimed to go beyond legal environmental pollution standards and resource usage. However, the same professionals were not as helpful in resolving social conflicts, especially when they had a tie with one side in the conflict. As a matter of fact, the experts who were hired to conduct public hearing and referendum in Wiang Chai could not re-enter and were literally chased out from the area by the protesters as was the evidence from the interviews. "The Narasure University was employed to preside over the public hearing in this community. Conversely, the community refuted any public participation and they dispelled this group of people. They prohibited this group from entering into their village" (Village Head of Ban Tri Keaw Moo 8, 2012).

In addition, it needed the professional forum for the negotiation with all stakeholders, and neutral facilitators according to the benefit of professional fora (Sabatien, 2009). From the media evidence (More than 500 Wiang Nue villagers protested against power plant, 2009) "the Wiang Chai Governor chaired the meeting of the local leaders, local government, university, and the company. During this meeting, it was agreed that the project should be postponed". In the same meeting, all the grievances of the participants were not completely resolved because the People sector was still active in the community to watch the companies' activities. Furthermore, the local people had no professionals to negotiate with other stakeholders, so the meeting was mostly about the termination of BtE projects without sharing the ideas and benefits.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Biomass is one of the major renewable energy sources and is expected to play a greater role in future world energy scenarios. Thailand is enriched with this energy resource. Biomass might be the solution for the country with high growth of energy demand due to economic development and population growth. Chiang Rai has the largest biomass potential among the nine provinces in the North of Thailand. In addition, the utilization of agricultural and forest residues in a BtE plant instead of open burning might help alleviating the haze crisis that has got worsened in recent years.

In order to harness these resources, countries need an institution that ensures appropriate and timely participation of private companies, public authorities, and influential groups in the communities and professionals. A multi-case design has been employed in this study under the 5Ps framework that has been developed to understand the factors influencing the adoption of very small scale BtE projects in Chiang Rai by exploring the influence of Public, Private, People and Professional actors and their Partnership to the success of BtE projects. Two cases a successful one in Wiang Kean and the other controversial one in Wiang Chai were selected for the comparison. The data were collected by documentary study, field observation and stakeholder interviews. In addition, to validate the results of the multiple-case study an industrial survey was conducted with other successfully established BtE plants in Thailand.

The key findings are purported to be the stakeholders of both cases which have the role and resources that can contribute to successful BtE projects in Chiang Rai. Furthermore, due to the change of BtE project governing, the cases have shown

the understanding of this changing. The finding showed the formal procedure prescribed mainly the partnership between public and private sectors with limited involvement of the people sector that deemed insufficient based on this comparative case study. The 5Ps framework can partially contribute to the understanding of the factors necessary for the success of a BtE project including resource sharing among the stakeholders, creating win-win situation, and gaining public acceptance. Public hearing and participation is a way to gain the acceptance but it should not be only in the beginning stage as demanded by the formal procedure. When there is a risk attached to the ongoing construction and operation, public participation should take place not only at some stage but should happen on a continuous basis along the project's life.

The addition of the professional involvement enhances the power of the framework because this sector can strengthen the project by providing the BtE knowledge in order to reduce the gap of knowledge of the stakeholders. This sector can also be monitor of the pollution in the area, and use the project area as a case study of their researches and classes. However, the analysis showed that this sector introduced by one side might not be so helpful in solving the social conflict between two coalitions. Therefore, the professional sector should participate since the beginning stage of the project where the stakeholders were not yet antagonized, and professionals should be careful and not rely or be affiliated mainly on a single stakeholder.

Despite the fact that the stakeholders share information, ideas and receive benefits from this project, it may be suggested that the central government offers them a say in the decision making process. This will hereby grant them the democratic opportunity to exercise their human rights on issues concerning their environmental health. Furthermore, the public hearing might take place since early stage of the project development within the reasonable time period. And the Public-Private-People-Professional Partnership might be the solution to obtain the successful BtE projects in Thailand.

5.2 Policy and Practical Recommendation

The findings of this research point toward some adjustments and additions to the existing formal procedure. The following recommendations are based on the understanding that the structural formulation of partnership is indispensable to obtain this successful BtE power project. The project developer should take the 5Ps into consideration and make a strategy. Meanwhile, it will be more practicable if gaining the community's support through sharing the benefits (win-win) among the stakeholders.

Exempting very small BtE projects from strict requirements (EIA), although well intended, can undermine the project's integrity and viability if this is perceived as a way to externalize the environmental and social costs. Under such a formal procedure, private developers and public authorities need to go beyond the minimum requirements by formulating partnership with the people and professional sectors and should not lose sight of the people and the strength of the professionals' involvement. Only then very small BtE projects can truly contribute to the challenging development of renewable energy and the fight against the haze problem in the region.

In addition, referendum and stakeholder negotiation are to be implemented for public acceptance, because cost of implementing the referendum and stakeholder negotiation are lower than using the EIA method. The referendum and stakeholder negotiation should better take place in the beginning of the project and stakeholder negotiation should also along the project due to the long period of project operations. It reinforces the relationship among the stakeholders especially People sector in order to enhance a better understanding. And the participation of stakeholder should not be just informed, but it should be in a stage that takes a feedback from other stakeholder into consideration.

Furthermore, the government can promote and set the sustainability criteria of the biomass utilization in order to make sure the use the sustainability of this energy. These sustainability criteria may need to include many aspects e.g. energy efficiency, clean technology, and social condition, e.g. the medical checkup for the local community.

Finally, biomass power plant is the new energy generation outlook in Thailand. The professional sector should get involved at the early stage of BtE project to eliminate gap of knowledge, thus contributes to better understanding of the biomass power plant.

5.3 Suggestion for Future Research

Future research should be carried out in order to gain more insight and expose the detailed findings concerning similar projects. This would need the participation of many organizations based on qualitative interviews. In addition, since this study encompasses only two cases in the North of Thailand. To confirm the generalizability of the findings, such as factors against the proliferation of BtE plants in the Northeast region being enumerated, the facts from the detailed findings should develop basis similar research in other parts of the country, or international stages. Besides, there is a need for more research on the role of professionals in conflict resolution in the management of natural resources.

Future research could focus on different sizes of the BtE projects such as; the Independent Power Producer and the Small Power Producer. To elaborate on this issue, the basic framework could be provided for other development of other technologies such as biogas, solar energy and other project developments, which include: dam construction, industrial construction, and infrastructural development, just to name a few.

REFERENCES

REFERENCES

Ahmed, S. A. & Ali, S. M. (2006). People as partners: Facilitating people's participation in public-private partnerships for solid waste management. **Habitat International 30**(4), 781-796.

Aldrich, H. A. (1979). **Organizations and environments**. Englewood Cliffs, N.J.: Prentice Hall.

Basu, P. (2010). **Biomass-characteristic.** Biomass gasification and pyrolysis, practical design. Retrieved April 20, 2012 from http://www.sciencedirect.com/science/article/pii/B9780123749888000027

Benson, J. K. (1978). The interorganization network as a political economy. In L. Karpik (Ed), **Organization and environment** (pp. 69-102). London: SAGE.

Biomass Energy Center. (n.d.). **What is biomass?.** Retrieved May 1, 2012, from http://www.biomassenergycentre.org.uk/portal/page?_pageid=76,15049&_dad=portal&_schema=PORTAL

Chiang Rai local people presenting happiness towards an acquitting of biomass power plant pretesting worth 1.12 million baht being sue in court. (2012, May, 22). **Prachathai News**. Retrieved October 9, 2012, from http://prachatai.com/journal/2012/05/40614

Chiang Rai people protesting against biomass power plant even though Naresuan University confirmed only small impact on environment. (2009, February 19). **Manager News**. Retrieved November 30, 2012, from http://www.manager.co.th/Local/ViewNews.aspx?NewsID=9520000019234

Chiang Rai Provincial Agriculture Extension Office. (2012). **Annual crop data in 2011 report**. Chiang Rai: Chiang Rai Provincial Agriculture Extension Office.

Community Development Department. (2011a). **BMN**. Bangkok: Community Development Department, Ministry of Interior.

Community Development Department. (2011b). **NRC 2C**. Bangkok: Community Development Department, Ministry of Interior.

Danish Government. (2011). **The energy strategy 2050- from coal, oil and gas to green energy**. Copenhagen: Danish Ministry of Climate and Energy. Retrieved April 3, 2012 from http://www.ens.dk/Documents/ Netboghandel%20-%20publikationer/2011/Energy_Strategy_2050.pdf

Denscombe, M. (2007). **The good research guide for small-scale social research projects**. England: McGrew Hill.

Denscombe, M. (1983). Interview, accounts and ethnographic research on teachers. In M. Hammersley (Ed.), **The Ethnography of schooling: Methodological Issues**. Duffield: Nafferton Books.

Department of Agriculture Extension. (2012). **Land used data**. Bangkok: Ministry of Agriculture and Cooperatives. Retrieved May 5, 2012 from, http://www.agriinfo.doae.go.th/year55/general/ land/land53.1.pdf

Department of Alternative Energy Development and Efficiency (DEDE). (2010). **Thailand alternative energy situation 2010**. Bangkok: Ministry of Energy.

Department of Alternative Energy Development and Efficiency (DEDE). (2011). **Tools for development and investment of alternative energy: Biomass energy**. Bangkok: Ministry of Energy.

Department of Alternative Energy Development and Efficiency (DEDE). (2012). **Alternative energy development plan 2012-2022**. Bangkok: Ministry of Energy.

Department of Business Development (DBD). (2012). **Business Information Database**. Bangkok: Ministry of Commerce.

Department of Health. (2012). **Health Act B.E. 2535**. Retrieved August 22, 2012, from http://www.anamai.moph.go.th/more_news.php?cid=66&filename=index

Dudley, J. R. (2011). **Research methods for social work** (2nd ed). New York: Pearson.

Earl, G. & Regan, M. (2003). **From the three P's to the three W's**. Press Conference in Public Private Partnerships and Beyond. Brisbane, Australia.

Energy Sector Management Assistant Program (ESMAP). (2007). **Technical and economic assessment of off-grid, mini-grid and grid electrification technologies**. Washington, DC: World Bank.

Environmental Impact Evaluation Bureau. (2010). **Environmental impacts assessments (EIA)**. Retrieved July 25, 2012, from http://www.onep.go.th/eia/index.php?option=com_content&view=article&id=67:2010-10-04-22-39-53&catid=4:2010-09-16-04-32-17&Itemid=10

Environmental Policy and Planning Office (EPPO). (2012a). **Energy conservation program and guidelines, criteria, conditions and expenditure priorities of the energy conservation promotion fund during the fiscal period 2000-2004**. Bangkok: Ministry of Energy. Retrieved May 30, 2012, from http://www.eppo.go.th/encon/encon-fund00.html

Environmental Policy and Planning Office (EPPO). (2012b). **Regulations of very small-scale power producers**. Bangkok: Ministry of Energy. Retrieved May 30, 2012, from http://www.eppo.go.th/power/powerN/File/%288%29/1.pdf

European Commission. (2010). **Report from the commission to the council and the European parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling: Commission staff working document**. Brussels, Belgium: European Commission.

Food Agriculture Organization (FAO). (2009). **Global terrestrial observing system**. **Rome. Version 10**. Retrieved May 1, 2012, from http://www.fao.org/gtos/doc/ECVs/T12/T12.pdf

Gray, C. F. & Larson, E. W. (2006). **Project management: The managerial process** (3rd ed.). New York: McGraw Hill.

Heclo, H. (1978). Issue network and the executive establishment. In A. King (Ed), **The new American political system**. Washington, DC: American Enterprise Institute for Public Policy Research.

Institute of Public Policy Research (IPPR). (2001). **Building better partnerships**. London, United Kingdom: Institute of Public Policy Research.

International Association for Public Participation. (2007). **IAP2 Spectrum IAP2 Spectrum**. Retrieved November 1, 2012, from http://www.iap2.org/associations/4748/files/spectrum.pdf

International Energy Agency (IEA). (2011). **2011 Key world energy statistics**. Paris, France: SOREGRAPH. Retrieved March 30, 2012, from http://www.iea.org/publications/freepublications/publication/key_world_energy_stats-1.pdf

Johansson, B. (2000). **Economic instruments in practices 1: Carbon tax in Sweden**. Sweden: OECD workshop on innovation and the environment. Environmental Protection Agency.

Kanniainen, V. & Määttä, K. (Eds.). (2001). **Competition justice from the perspective of economics (In Finnish: Taloustieteellinen näkökulma kilpailuoikeuteen)**. Helsinki, Finland: Lakimiesliiton kustannus.

Karekezi, S. & Kithyoma, W. (2006). Bioenergy and Agriculture: Promises and challenges: Bioenergy and the poor. Washington DC: International Food Policy Research Institute.

Kernaghan, K. (1993). Partnership and public administration: Conceptual and practical considerations. **Canadian Public Administration, 36**(2), 57-76.

Kickert, W. J. M, Klijn, E. H. & Koppenjan, J. F. M. (1997). **Managing complex network**. London: SAGE.

Kingdon, J. W. (1984). **Agendas, alternatives and public policies**. Boston, MA: Little Brown.

Klijn, E. H. & Teisman, G. R. (1991). **Effective policy marking in a multi actor setting: networks and steering**. In L. Schaap, C.J.A.M. Termeer & M.J.W. van Twist (Eds), Autopoiesis and configuration theory: New approach to societal steering. (pp. 99-112). N.P.

Kouwenhoven, V. (1993). **The rise of the public private partnership: A model of the management of public-private cooperation: Modern governance**. London: New Government-Society Interactions.

Kumar, R. (2011). **Research methodology: A step-by-step guide for beginners**. Los Angeles: SAGE.

Kuntaliitto, S. (2003). **Best service - Report of alternatives in municipality services (In Finnish: Parasta palvelua – selvitys kuntapalveluiden järjestämisen vaihtoehdoista)**. Helsinki: Lundström.

Mahapatra, S., Chanakya, H. N. & Dasappa, S. (2009). **Evaluation of various energy devices for domestic lighting in India: Technology, economics, and CO2 emissions**. Bangalore, India: Centre for Sustainable Technologies, Indian Institute of Science. Retrieved March 30, 2012, from http://ac.els-cdn.com/S097308260900074X/1-s2.0-S097308260900074X-main.pdf?_tid=166c4c0ae03086fbf220b1b52b444400&acdnat=1335517169_01872069b7b83c28087c3ecd361f84aa

Majamaa, W. (2008). **The 4th P - People- in urban development based on Public-Private-People Partnership**. Doctoral Dissertation. Helsinki University of Technology. Retrieved March 3, 2012, from https://aaltodoc.aalto.fi/bitstream/handle/123456789/4559/isbn9789512295852.pdf?sequence=1

More than 500 Wiang Nue villagers protested against power plant. (2009, February 19). **Matichon News**. Retrieved October 15, 2012, from http://www.matichon.co.th/news_detail.php?newsid=1235040743&catid=19

McKendry, P. (2002). **Energy production for biomass (part 2): Conversion technology**. Colchester, UK: Applied Environmental Research Center Ltd.

McQuaid, R. W. (2000). **The theory of partnership: Why have partnerships?', in public private partnerships: Theory and practice in international perspective**. London: Routledge.

Monette, D. R, Sullivan, T. J. & DeJong, C. R. (1986). **Applied social research: tool for the human services**. New York: Holt, Rinehart and Winston.

Neuma, W. L. (2006). **Social research methods: Qualitative and quantitative approaches** (6th Ed.). Boston: Pearson Education.

Nisar, T. (2007). Risk management in Public-Private partnership contracts. **Public Organization Review 7**(1), 1-19.

Office of Energy Chiang Rai. (2012). **Role and responsibility**. Retrieved August 22, 2012, from http://chiangrai.energy.go.th/index.php

Pollution Control Department (PCD). (2012a). **Air pollution in the north of Thailand at 10 March 2012**. Bangkok: Ministry of Natural Resources and Environment. Retrieved May 1, 2012 from http://aqnis.pcd.go.th/webfm_send/1500

Pollution Controlled Department (PCD). (2012b). **Enhancement and conservation of national environmental quality act B.E. 2535**. Bangkok: Ministry of Natural Resources and Environment. Retrieved April 20, 2012, from http://www.pcd.go.th/info_serv/reg_envi.html

Rentizelas, A. A., Tolis, A. J., & Tatsiopoulos, I. P. (2009). Logistics issues of biomass: the storage problem and the multi-biomass supply chain. **Renewable and Sustainable Energy Reviews 13**, 887-894. Retrieved April 20, 2012, from http://www.sciencedirect.com/science/article/pii/S1364032108000142

Rubin, A. & Babbie, E. R. (2005). **Research method for social work** (5th ed.). Belmont, CA: Thomson Learning, Inc.

Sabatier, P. A. (Ed.). (2007). **Theories of the policy process**. University of California. Davis: Westview Press.

Sander, B. & Skott, T. (2007). **Bioenergy for electricity and heat- experiences from biomass-fired CHP plant in Denmark**. Dong Energy. N.P.: Vatterfall.

Scharpf, F. W., Reissert, B. & Schnable, F. (1978). Policy effectiveness and conflict avoidance in intergovernmental policy formation. In K. I. Hanf & Scharpf (Eds). (1978). **Interorganizational policy making: Limits to coordination and central controls** (pp. 345-70). London: SAGE.

Shaoul, J. (2005). A critical financial analysis of the private finance initiative: selecting a financing method or allocating economic wealth?. **Critical Perspectives on Accounting, 16**(4), 441-471.

Shell International BV. (2009). **Shell energy scenario to 2050**. (4th ed). Netherlands: The Hague. Retrieved June 20, 2012, from http://www.shell.com/content/dam/shell/static/future-energy/downloads/shell-scenarios/shell-energy-scenarios2050.pdf

Silverman, D. (1985). **Qualitative methodology and sociology**. Aldershot: Gower.

Smoke crisis in Chiang Rai. (2012, March 20). **Daily News**. Retrieved March 30, 2012, from http://www.dailynews.co.th/thailand/18141

Supreme Renewable Energy Co, Ltd. (2012). **External visitors**. Retrieved December 15, 2012, from http://www.thai-greenenergy.com/

Susangarn, C. (2007). **Public private partnership in Thailand: Past experiences and future prospects**. Bangkok: Ministry of Finance.

Teisman, G. R. (1992). Complexe besluitvorming: Een pluricentrisch perspectief op besluitvorming over ruimtelijke inverteringen. Vuga, s-Gravenhange. In Kickert, W. J. M., Klijn, E. H. & Koppenjan, J. F. M. (Eds). **Managing complex network**. London: SAGE.

Thai Parliament. (2007). **Constitution of the kingdom of Thailand (B.E. 2550)**. Retrieved October 11, 2012, from http://www.senate.go.th/th_senate/English/constitution2007.pdf

Thompson, J. D. (1967). **Organizations in actions**. New York: McGrew Hill.

UNESCO. (1992). **The RIO declaration on environment and development**. Retrieved May 18, 2012, from http://www.unesco.org/pv_obj_cache/pv_obj_id_5153A80E5D000D9118833F33BE125378F1050100/filename/RIO_E.PDF

UNFCCC. (2005). **Clarifications of definition of biomass and consideration of changes in carbon pools due to a CDM project activity**. Retrieved May 2, 2012 from http://cdm.unfccc.int/ EB/020/eb20repan08.pdf

United Nation. (2012). **Sustainable energy for all**. Retrieved May 1, 2012, from http://www.sustainableenergyforall.org/objectives/renewable-energy

UN Energy. (2007). **Sustainable bioenergy: A framework for decision makers.** Retrieved May 5, 2012, from http://www.un-energy.org/sites/default/files/share/une/susdev.biofuels.fao_.pdf

Voytenko, Y. (2010). **Bioenergy in Ukraine: Sustainable pathways for the development of Ukraine's agro-biomass potential**. Doctoral Dissertation. The Central European University. Budapest.

Wiang Chai District Agriculture Extension Office. (2012). **Land use in Wiang Nue**. Chiang Rai. Wiang Chai District Agriculture Extension Office.

Wiang Kean District Agriculture Extension Office. (2012). **Land use in Lai Ngao**. Chiang Rai. Wiang Kean District Agriculture Extension Office.

Wiang Nue TAO. (2012). **Directory of head of Wiang Nue TAO**. Chiang Rai: Wiang Nue TAO.

Wong, M. (2006). **Satisfying all stakeholders in evaluating the feasibility of public-private partnership projects: A structural equation model approach**. University of Hong Kong, Hong Kong.

World Bank. (2000). **World development report 1999/2000: Entering the 21 century.** Washington, DC: Oxford University Press.

World Bank. (2007). **Public-Private Partnerships - a new concept for infrastructure development, UN/ECE BOT Group, 1998**. Retrieved May 5, 2012, from http://rru.worldbank.org/Documents/ Toolkits/Highways/pdf/42.pdf

World Business Council for Sustainable Development (WBCSD). (2007). **Biofule. Issues brief: Energy and climate focus area**. N.P.: n.p.

Yamane, T. (1967). **Statistics, an introductory analysis** (2nd ed.). New York: Harper and Row.

Yin, R. K. (2003). **Case study research design and methods** (3rd ed.). California: SAGE.

Zhang, X. (2006). Factor analysis of public clients' best-value objective in public-privately partnered infrastructure projects. **Journal of Construction Engineering and Management 132**(9), 956-965.

Zhang, X. (2005). Concessionaire’s financial capability in developing build-operate-transfer type infrastructure projects. **Journal of Construction Engineering and Management, 2005**(1), 1054-1064.

APPENDICES

APPENDIX A

TOOLS OF FIELD OBSERVATION

Checklist (Reasons)		Criteria	Note
Yes	No		
		Community has Villager header	
		Community has community committee	
		Villagers active to the community activities	
		Villagers unity	
		Community has closed relationship to politicians	
		Community has closed relationship to investors	
		Community has closed relationship to NGO	
		Community has closed relationship to Professional	
		Community has abundant biomass residues	
		Community locate closely forestry	
		Community can utilize forestry	

APPENDIX B

INTERVIEW GUIDE

Public Sector

Name:……

Organization:……

Address:……

What is objective of your organization? (Please introduce your organization)

……

……

……

What is energy from biomass in your point of view?

……

……

……

What is biomass power plant in your point of view?

……

……

……

Do your organization support Biomass-to-Energy project? why?

……

……

……

What your organizations contribute work to the area of Biomass-to-Energy project?

……

……

……

Do your organization work with other partners (Public, Private, People, Professional sector) related to Biomass-to-Energy project?

……

……

……

Do you think your organization can contribute more work related to Biomass-to-Energy project?

……

……

……

Thank you!

Private Sector

Name:…….
Organization:……
Address:……
What is objective of your organization? (Please introduce your organization)
……
……
……
What is energy from biomass in your point of view?
……
……
……
What is biomass power plant in your point of view?
……
……
……
Do your organization support Biomass-to-Energy project? why?
……
……
……
What your organizations contribute work to the area of Biomass-to-Energy project?
……
……
……
Do your organization work with other partners (Public, Private, People, Professional sector) related to Biomass-to-Energy project?
……
……
……
Do you think your organization can contribute more work related to Biomass-to-Energy project?
……
……
……

Thank you!

People Sector

Name:…….
Organization:…….
Address:……
What is objective of your organization? (Please introduce your organization)
……
……
……
What is energy from biomass in your point of view?
……
……
……
What is biomass power plant in your point of view?
……
……
……
Do your organization support Biomass-to-Energy project? why?
……
……
……
What your organizations contribute work to the area of Biomass-to-Energy project?
……
……
……
Do your organization work with other partners (Public, Private, People, Professional sector) related to Biomass-to-Energy project?
……
……
……
Do you think your organization can contribute more work related to Biomass-to-Energy project?
……
……
……

Thank you!

Professional Sector

Name:…….
Organization:…….
Address:……
What is objective of your organization? (Please introduce your organization)
……
……
……
What is energy from biomass in your point of view?
……
……
……
What is biomass power plant in your point of view?
……
……
……
Do your organization support Biomass-to-Energy project? why?
……
……
……
What your organizations contribute work to the area of Biomass-to-Energy project?
……
……
……
Do your organization work with other partners (Public, Private, People, Professional sector) related to Biomass-to-Energy project?
……
……
……
Do you think your organization can contribute more work related to Biomass-to-Energy project?
……
……
……

Thank you!

APPENDIX C

LIST OF INTERVIEWEES

Table C1 List of Interviewees

Name of Organization	Sector	Interviewees	Interview Format	Date
The Provincial Office-Chiang Rai, Ministry of Energy	Public Sector	Head of Office	Face-to-Face	26 June 2012
The Lai Ngao Municipality	Public Sector	The Chief Executive Officer	Face-to-Face	6 July 2012
The Wiang Nue TAO	Public Sector	The Chief Executive Officer	Face-to-Face	4 July 2012
The Supreme Renewable Energy Co., Ltd.	Private sector	Manager	Face-to-Face /Telephone	27 July 2012
Bang Jam Pong Moo 5, Lai Ngao Sub-district	People Sector	Community Leader	Face-to-Face	15 June 2012
Bang Jam Pong Moo 5, Lai Ngao Sub-district	People Sector	Villager	Face-to-Face /Telephone	13 October 2012
Ban Tri Keaw Moo 8, Wiang Nue Sub-district	People Sector	Community Leader	Face-to-Face /Telephone	4 July 2012
Ban Tri Keaw Moo 8, Wiang Nue Sub-district	People Sector	Villager	Face-to-Face	2 August 2012
Ban Tri Keaw Moo 8, Wiang Nue Sub-district	People Sector	Villager	Phone	11 October 2012
Ban Tri Keaw Moo 8, Wiang Nue Sub-district	People Sector	Lawyer	Phone	10 October 2012

APPENDIX D

QUESTIONNAIRE

1. Do you have your own biomass material?
   .....Yes .....No

2. Do you have public involvement in your BtE project?
   .....Yes .....No

How?.....

3. Do you have private involvement in your BtE project?
   .....Yes .....No

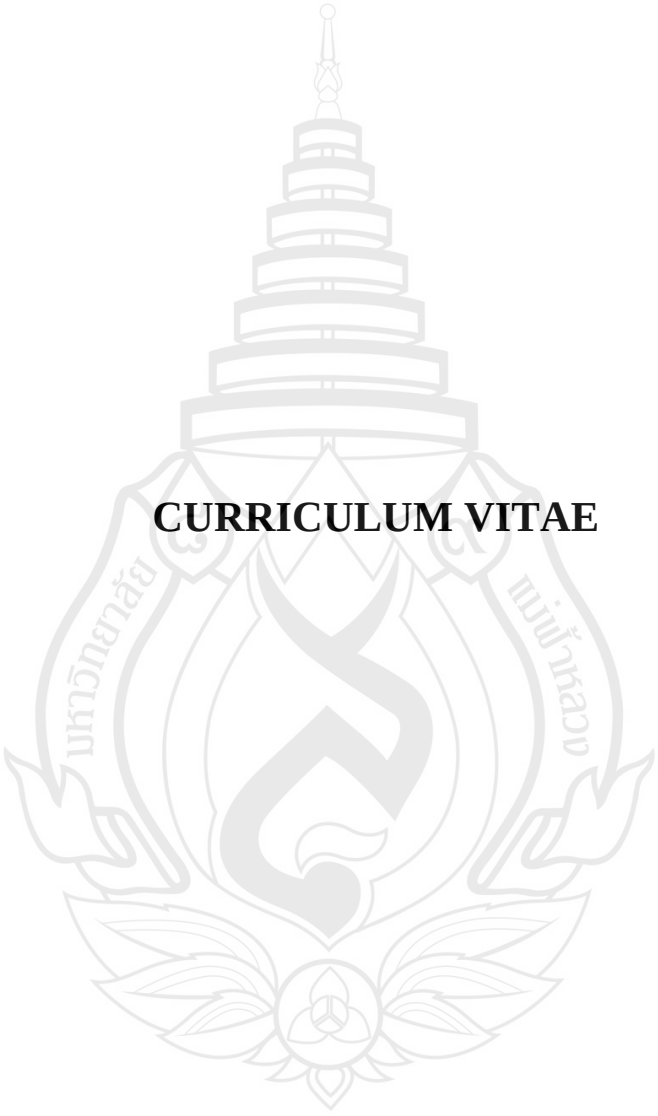
How?.....

4. Do you have people involvement in your BtE project?
   .....Yes .....No

How?.....

5. Do you have professional involvement in your BtE project?
   .....Yes .....No

How?.....



CURRICULUM VITAE

CURRICULUM VITAE

NAME	Mr. Nattapan Kongbuamai
DATE OF BIRTH	29 October 1986
ADDRESS	118 Moo 10, Srisaket Sub-district, Nanoi District, Nan, Thailand 55150

EDUCATIONAL BACKGROUND

2009	Bachelor of Economics Economics Mae Fah Luang University

WORK EXPERIENCE

2012-Present	Teaching Assistant School of Management, Mae Fah Luang University
2009-2012	Research Assistant The Center for Natural Resources and Environmental Management, Mae Fah Luang University

PUPLICATION

Kongbuamai, N., Manomaivibool, P., & Remmen, A. (2012). **Biomass to energy in Thailand: An institutional perspective on the challenges of very small projects in Chiang Rai**. The First Mae Fah Luang University International Conference 2012 on Future Challenges Towards ASEAN Integration. Mae Fah Luang University (MFU), Chiang Rai, Thailand.