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

Nattapan Kongbuamai[1,*], Panate Manomaivibool[1], Arne Remmen[2]

[1] The Institute for the Study of Natural Resources and Environmental Management, Mae Fah Luang University, Chiang Rai 57100, Thailand
[2] Department of Development and Planning, Aalborg University, Aalborg 9220 Denmark
*e-mail: K_nattapan@hotmail.com

Abstract

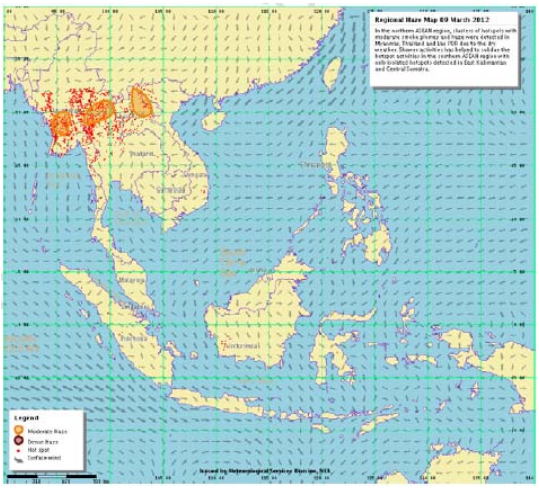
Mishandling of agricultural and forestry residues can lead to environmental and health threats. During the summer months, open burning of these materials in the ASEAN countries worsened the smog and haze crisis in the region. Converting this biomass into modern forms of energy such as electricity and heat can contribute to the reduction of hotspots under the ASEAN Agreement on Transboundary Haze Pollution and strengthen the energy security in the region. However, despite the seemingly abundance of the waste materials and favorable policy stimulus from national governments, the development of biomass-to-energy (BtE) plants in the region has not been that promising. For example, Chiang Rai which has the largest biomass potential in the North of Thailand has only one BtE power plant in Wiang Kean District with a capacity of merely 0.13 MW. This study aims at understanding the institutional factors influencing the adoption of BtE by contrasting two cases of very small BtE projects (less than 10 MW) in Chiang Rai, Thailand. The multi-case design employs and triangulates data from various sources including documentary study, field observations, and qualitative interviews to understand the implementation procedures of BtE projects, and resources and perceptions of stakeholders in Ban Jam Pong Moo 5, Wiang Kean and Ban Trikeaw Moo 8, Wiang Chai. The Wiang Kean project has been successfully built and operated since 2008. On the other hand, the project in Wiang Chai the proposal of which had been drawn up in 2010 with the planned capacity of 9.4 MW has struggled to gain public acceptance and not been materialized. The 5Ps framework is constructed to explain whether and how the Partnerships between Public, Private, People and Professional actors contribute to the successful delivery of the BtE projects. The analysis identifies 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.

Keywords: biomass, renewable energy, partnership model, project implementation

Introduction

As one of the world's most dynamic bloc of economies, Southeast Asia (SEA) has enjoyed high economic growth at an average of more than 5% per annum since 1982. With this growth, the Association of Southeast Asian Nations (ASEAN, 2008) projected that the primary energy demand would grow by 76% in 2030 a much higher figure than the average growth rate of the rest of the world. To feed the energy-hunger region, all sources of power

must be mustered including agricultural by-products that are plentiful in SEA. Lim and Lee (2011) estimate that if all of the 208 million tons of biomass generated annually in the region was recovered, more than 70 TWh of electricity would be generated. However, most of biomass utilization was in the form of direct combustion of firewood that was not only inefficient but also created in-door air pollution. The byproducts were often underutilized and burnt in open field as waste. This majorly led to the worsened haze condition during the summer months, especially around the golden triangle of Lao PDR, Myanmar, and Thailand (Figure 1). An image classification and in-depth spatio-temporal analysis of burned areas in Chiang Mai, Thailand, for example, revealed that the burning pattern that consumed around 20% of the total area correlated with the agricultural cycle (Dontree et al., 2011). ASEAN has long regarded haze as one of the important regional pollution since the inception of the ASEAN Co-operation Plan on Transboundary Pollution in 1995. Therefore, converting biomass into modern forms of energy such as electricity and heat will hold a promise not only to the energy security of the region but will also remove part of the causes of the haze problem – contributing to the Article 9b of the ASEAN Agreement on Transboundary Haze Pollution adopted in 2002 by "developing other appropriate policies to curb activities that may lead to land and/or forest fires".



Source: ASEAN Specialized Meteorological Center: ASMC, 2012

Figure 1 Haze, hotspots and surface wind derived from the NOAA-18 satellite on 9 March 2012.

Along this line of development, the Thai Government has promoted the utilization of Biomass-to-Energy (BtE) since the 7th National Economic and Social Development Plan (1992-1996). The Department of Alternative Energy Development and Efficiency (DEDE, 2010) estimated that Thailand had around 33,000 ktoe of biomass potential. About a third of this potential was utilized in 2010 but mostly in the form of firewood and only 26% of the utilization was used to generate electricity or heat. Thus, the 2012-2021 Alternative Energy Development Plan (AEDP) sets the targets of 1,896 ktoe of electricity and 8,200 ktoe of heat to be generated from biomass (DEDE, 2012). In other words, according to the AEDP, biomass will be the leading source of green energy contributing to 66% of electricity and 91% of the heat from renewable energy by 2021.

Fiscal and non-fiscal incentives are provided to BtE projects in Thailand. Such projects entitle to many tax breaks and electricity generated from biomass enjoys premium adders for alternative energy. Several institutes have also been set up to undertake R&D activities including the Center of Excellence in Biomass at Suranaree University of Technology, and the biomass programs at Nakornping Energy Research and Development Institute, Chiang Mai University and at the Energy Research Institute, Chulalongkorn University. Therefore, it was not so surprising that almost 400 investors have expressed their interest in BtE projects by becoming very small power producers (VSPPs) since the announcement of the generous adders in 2006. However, only 63 projects had been successfully established and connected to the grid of Provincial Electricity Authority (PEA) and Metropolitan Electricity Authority (MEA) by 2011. Out of these only three plants were set up in the North of Thailand with a combined capacity of merely 11.13 MW.

Against this backdrop, the main objective of this study is to understand the factors influencing the adoption of very small BtE projects by examining a successful project and a failed project to establish a small-scale power plant in Chiang Rai, Thailand through the institutional framework. The 5Ps framework was constructed based on Majamaa's (2008) 4Ps framework to investigate the role of *P*ublic, *P*rivate, *P*eople and *P*rofessional actors and their *P*artnership in the project developments.

Methodology

This study followed a comparative case-study design. The cases were nested in Chiang Rai which was one of the provinces most suffered chronically from the worsened summer haze condition: the level of particulate matters smaller than 10 micrometers (PM_{10}) measured in Mae Sai, Chiang Rai on 10 March 2012 was the highest stood at 437.6 $\mu g/m^3$, far exceeded the air quality standard of 120 $\mu g/m^3$. Chiang Rai was also chosen because, while it had the largest biomass potential in the North of Thailand, less than 1 MW of electricity was harnessed by one VSSP. 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 Trikeaw Moo 8, Wiang Chai District had yet to be materialized since its conception in 2010. The description of the cases and the development of the projects will be provided in the following sections.

The study employed multiple methods to collect data about the two BtE projects. Documentary study was conducted on sources such as project proposals and project reports, to understand the details and the developments of the two projects. Other documents and secondary materials such as policy paper and scholarly articles were also reviewed to provide the context of BtE projects in Thailand. Although these sources were considered reliable, we took note about the authors and their purposes in order to discern any biases. The information was also double checked with field observations. The first author visited Wiang Kean and Wiang Chai 3 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. A checklist was devised to ensure the comparability between the two cases. Ten semi-structure interviews were also carried out with key informants including representatives from the provincial office of the Ministry of Energy (MoE), the local governments and the villages where the projects located, and the companies that invested in

the projects. Topical interviewing was a technique aiming at surfacing stakeholders' perceptions and rationales for or against BtE and their participation in the studied projects. An interview guide was developed and sent to the informants before the interviews. The interviews were conducted as far as possible face to face. Follow-up sessions were conducted over the phone and email exchanges were used to get information from an R&D institute. All interviewing sessions were documented by note-taking but we avoided tape recording in order to encourage the discussion of otherwise sensitive issues. The checklist and the interview guide are available upon request.

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 (see Kickert et al., 1997) a network management strategy that differed 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 *P*ublic-*P*rivate *P*artnership (PPP) by adding the fourth P, *P*eople 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 non-governmental organizations (NGOs) and the media. Because a BtE project requires considerable technical knowledge that might not be internalized within the three sectors, we hypothesized that the role of the *P*rofessional sector should be potent and added a fifth P. The professionals included but not limited to universities, and research institutes. Figure 2 graphically depicts the 5Ps framework.

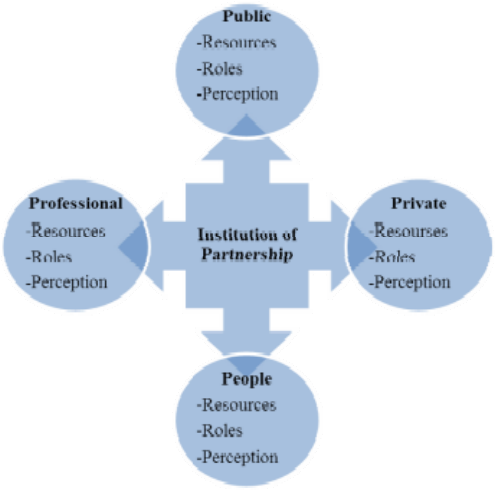


Figure 2 Public-Private-People-Professional Partnership (5Ps) Framework.

Results and Discussion

Short description of the case

The Wiang Kean project is located at Ban Jam Pong, Moo 5, Lai Ngao Sub-district in Wiang Kean District. The Wiang Chai project is located at Ban Trikeaw Moo 8, Wiang Nue Sub-dsitrict in Wiang Chai District. Both were agriculture-based communities. 17 km^2 of Lai Ngao were agricultural areas and 38% of the population in Ban Jam Pong was in the agricultural sector. Corresponding figures in Wiang Nue and Ban Trikeaw were 7 km^2 and 58%. However, despite their similar agrarian background that would supply of agricultural residues to the projects, 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 Trikeaw Moo 8, Wiang Nue Sub-dsitrict, 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 public opposition in this second case was strong and fierce. At one point the villagers even set up a watch, days and nights, to ensure that the company would not be able to begin the construction in its acquired land.

Before accounting to the factors that can explain the differences between the two projects, the next sub-section describes the formal institution of BtE in Thailand, i.e. official rules, which governed both projects.

Formal institution of BtE in Thailand

At the core of the formal institution governing BtE projects in Thailand is the procedure mandated by DEDE. Table 1 lists mandatory steps and the roles and responsibilities of different actors as required by laws. It must be noted that for a very small project with a capacity lower than 10 MW a requirement to conduct otherwise costly environmental impact assessment (EIA) is waivered in order facilitate private investments. Thus, the formal institution for projects of this size is framed pretty much under the PPP 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.

Table 1 Formal institution of BtE projects in Thailand.

Steps	Roles & Responsibilities
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 provincial industrial office 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 *Professional Sector*: None

Steps	Roles & Responsibilities
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 Provincial Electricity Authority (PEA) or the Metropolitan Electricity Authority (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 Department of Alternative Energy Development and Efficiency (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
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.C. 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

However, the actual projects neither neatly follow nor are limited to the steps listed in Table 1. The next section will reconstruct how the two projects unfolded in Chiang Rai.

Actual development of the projects

Table 2 illustrates the actual development of the two projects during the period of two and a half years. Due to space limitation, we report the details every six months into the project's life. Although the two projects were governed by the same set of formal rules, they featured different network management strategies, which in turn, steered the development of the projects into different paths.

In the Wiang Kean Project the private developer was forthright and keen in work out the benefit sharing with the communities. The company also employed social and cognitive strategies in the early stage of the development. Community leaders were introduced to experts and researchers external to the company and they had an opportunity to visit a successful BtE plant. The referendum was not held until the communities were informed about the project. In the meantime, the company had tried to address the concern of the people such as pollution and benefit sharing. The company remained responsive. For example, in May 2009, there was a complaint about the noise from the plant and the company quickly made improvement. Most interviewed informants in the first case perceived the BtE project as it was positively and considered it as a success, although villagers opposed its planned expansion and some others wanted to see more direct benefits from in terms of free electricity or a reduction in energy price.

Table 2 Timeline of the development of two biomass-to-energy 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. Some farmers were interested in selling cornstalk and other residues to the plant. There was no referendum.	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 series of 7 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.
7-12 months	The company organized a study visit to the BtE demonstration plant of Suranaree University of Technology. 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 Feb 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 Feb 2009 but could not resolve the conflict. The head of the local government was forced to resign on 20 Mar. 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 Internal Security Operations Command (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.
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 Jul 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.

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.
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.

While the Wiang Chai Project featured some similar elements, the network management strategies differed from its counterpart in Wiang Kean in four major ways. First, most of local people did not learn the whole picture of the project from the very beginning. For some, the first time they were certain about the BtE project was when the district chief called a multi-stakeholder meeting on 19 February 2009. Second, referendum was held at an early stage when the participants were not yet well informed about the project. Third, the developer appeared to have a close tie with the former executives of the local government. This fact might prevent a fruitful discussion on benefit sharing to the wider circle in the communities, especially during the time of high political competition between opposing partisans. The project became an uphill struggle after the group opposing to it won the local election. Fourth, the company and some authorities' strategy that focused on the legality of the project could be contested by the protesters in new venues like the Administrative Court (established in 1999). With greater check and balance in the political system, official decisions were no longer absolute.

Based on the experience of the two projects, the next section discusses some institutional factors influencing the adoption of BtE projects.

Discussion

A very small BtE project, while providing wider environmental benefits in terms of carbon-neutral, renewable energy and reduction of regional haze pollution, can cause local problems that are not well regulated. The process if not well designed and operated can generate dust and fine particles, noise and vibration. Water is also needed for cooling and the discharge of heated water can affect the aquatic ecosystems. However, because of its size, the very small project is subject to fewer mandatory requirements and standards. The formal institution for a very small BtE project in Thailand is designed to fast track and to reduce the regulatory costs. The exemption on EIA is a notable example.

Despite good intentions, we find that the leniency of the formal institution can hurt the viability of very small BtE projects. Because it requires little to obtain the legality for such a project, it does not weigh much when PPP is in dispute with the people, as shown in the Wiang Chai case. Under a wider institution, the discretion of public authorities can be contested under Article 67 of the Thai Constitution 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 to sue state agencies over the issues. The Administrative Court is by far one of the most effective ways to exercise these rights.

The success of very small BtE projects, thus, lies in not only meeting the formal rules, which should be perceived as minimum requirements, but also in obtaining the so-called 'social license to operate' from the people sector. Private developers in our cases appeared to understand the imperative of this. Both were keen to show public acceptance of the projects but went differently to gain this. According to the spectrum of the International Association for Public Participation (2007) which classifies public participation into 5 levels (inform, consult, involve, collaborate, and empower), the Wiang Chai project failed even to inform local stakeholders properly about the nature of the project. That they were not initially informed about the existence of BtE was vividly recounted by the opposing group. The participation in Wiang Kean, on the other hand, went at least to the consultation level and the company was able to obtain valuable inputs from initial public hearing without referendum.

This comparison shows the merits of sincerity and patience. Having a lot of hands in support at one stage does not mean much if the hands raised were not based on informed consent. Therefore, it is advisable to have information sharing and hearing, and have sticking issues discussed first, before holding referendum. Besides timing, the size of the project can be a moderating factor. The closer to the upper limit of being a VSPP (10 MW), the more suspicious a project might look that requires more effort to gain trust from local community. And, as the comparative case study demonstrated trust could be very difficult to gain once the first impression was spoiled.

This study also shows that the involvement of professionals can strengthen the project but they are not a panacea. The engineering experts are in the best position to explain the BtE technologies, their advantages and disadvantages, and 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 standards in pollution and resource uses. However, the same professionals might not be 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. Therefore, there is a need for more research on the role of professionals in conflict resolution in the management of natural resources. In addition, because this study is exploratory in its nature and based only on two cases in the North of Thailand, more research is needed to confirm the generalizability of the findings in the other part of Thailand and in SEA.

Conclusion

ASEAN countries are enriched with renewable energy resources. They have relatively abundant renewable energy sources, especially biomass, as they are among the major producers of key agricultural products such as oil palm, rubber, coconut, and rice. However, in order to harness these resources, countries need an institution that ensures appropriate and timely participation of private companies, public authorities, people and communities, and professionals. Exempting very small projects from strict requirements, although well intended, can undermine the project's integrity and its viability if this is perceived as a way to externalize the environmental and social costs. Under such a formal institution, private developers and public authorities need to go beyond the minimum requirements 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 sustainable development and the fight against the haze problem in the region.

Acknowledgements

The authors are grateful for a University Postgraduate Research Grant Scheme from Mae Fah Luang University, which fully supported this research, and express their gratitude to the Asia Development Bank (ABD) for its financial support through the Mae Fah Luang University-ADB/EOC project on "Capacity Building for Natural Resources Management and Socio-economic Benchmarking in the GMS. The authors would also like to thank Dr. Hansa Saguannoi for her constructive inputs throughout the study.

References

1. Ananthanawat C, Vilaivan T, Hoven VP. Sens Actuators B: Chem 2009;137:215-221.
2. ASEAN. Selected Key Basic ASEAN Indicators 2008, 2008. [Online]. Available: www.aseansec.org (accessed 28.11.09).
3. DEDE. Year Plan of Alternative Energy Development, 2008-2022. Bangkok, Thailand: Ministry of Energy Bangkok, 2012.
4. DEDE. Thailand Alternative Energy Situation 2010. Bangkok, Thailand: Ministry of Energy Bangkok, 2010.
5. Dontree S, Thumtakhop S, Chamniwikaiyapong P, Noisuya S. Final Report: Prioritizing of Burned Areas Using Multi-source Spatial Data for Open Field Burning Surveillance and Prevention in Chiang Mai Province. Chiang Mai, Thailand: Thai universities for Healthy Public Policies, Chiang Mai University, 2011.
6. Kickert WJM, Klijn EH, Koppenjan JFM. Managing Complex Network. London, England: Sage, 1997.
7. Lim S, Lee KT. Leading Global Energy and Environmental Transformation: Unified ASEAN Biomass-based Bio-energy System Incorporating the Clean Development Mechanism. Pulau Pinang, Malaysia: School of Chemical Engineering, Universiti Sains Malaysia, 2011.
8. International Association for Public Participation. (2007). IAP2 Spectrum IAP2 Spectrum. USA.
9. Majamaa W. (2008). The 4th P - People- In Urban Development based on Public-Private-People Partnership. Espoo, Finland: Helsinki University of Technology, 2008.