# How Open Innovation Models Might Help the Thai Energy Sector to Address the Climate Change Challenge?

## *A Conceptual Framework on an Approach to Measure the Impact of Adoption of Open Innovation*

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Keywords: Open Innovation, Climate Change, Energy Sector, External Knowledge.

Abstract: Climate change has increasingly impacted businesses both on their growths and a risk of sustainability. The energy sector has been the main contributor of carbon emissions to the atmosphere, accounting for 66.5 percent of total world emissions (Herzog, 2009). As a consequence, the energy sector will be a focus of international scrutiny and strategy of emission reduction. With the recent controversial concerns in global warming issue, various mitigation and adaptation technologies, measures, and strategies, have been undergoing proposed and implemented since the early 2000s. Such activities require a usage of both internal and external knowledge in developing those innovations to be launched consistently and successfully. Several researchers have identified that relying on closed innovation system to create innovation is insufficient and no longer sustainable for a knowledge intensive sector in particular. The open innovation model, proposed by Henry Chesbrough in 2003, has been frequently applied to offer a more effective approach in generating innovation by using internal and external knowledge. There is, however, a lack of in-depth research carrying on the issue of how one could efficiently implement open innovation to address the certain challenge, especially in energy sector which are now encountering the challenge of climate change. The purpose of this research is to develop an open innovation model that can assist in adopting open innovation process in Thai energy sector with a view to combating with climate change concern. The study also aim to assess the impact of the integration of open innovation approaches within Thai energy sector through its appreciation level of the related stakeholder with a view to suggest policy implications for energy sector in contesting with a controversial climate change concern in the future. While this research focuses on energy sector in Thailand, its findings should be relevant for other countries that are in the process of combating with climate change concern.

## 1 INTRODUCTION

Climate change has increasingly impacted businesses both on their growths and a risk of sustainability. The energy sector has been the main contributor of carbon emissions to the atmosphere, accounting for 66.5 percent of total world emissions as shown below in figure 1 (Herzog, 2009). As a consequence, the energy sector will be a focus of international scrutiny and strategy of emission reduction. Petroleum businesses including oil & gas, and petrochemical industries, which have a signature of intense energy consumption and therefore high carbon emissions are obligated to efficiently manage energy use and to challenge themselves for new approaches of carbon emission reduction.

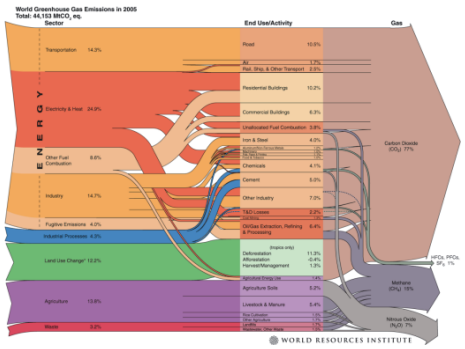


Figure 1: World Greenhouse Gas emissions in 2005.

With the recent controversial concerns in global warming issue, various mitigation and adaptation technologies, measures, and strategies, have been

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How Open Innovation Models Might Help the Thai Energy Sector to Address the Climate Change Challenge? - A Conceptual Framework on an Approach to Measure the Impact of Adoption of Open Innovation.
DOI: 10.5220/0004170102290234
In *Proceedings of the International Conference on Knowledge Management and Information Sharing* (KMIS-2012), pages 229-234
ISBN: 978-989-8565-31-0

undergoing proposed and implemented since the early 2000s. These processes have been applied at both organisation and national contexts, with a core objective of improving their environmental performance as well as sustaining the social well-being. Such activities require a usage of both internal and external knowledge in developing those innovations to be launched consistently and successfully. Several researchers have identified that relying on closed innovation system to create innovation is insufficient and no longer sustainable for a knowledge intensive sector in particular, for instance food, pharmaceutical, software, biotechnology, telecommunication, and energy sectors (Bianchi et al., 2010); (Giarratana and Luzzi, 2009);( Hakkim and Heidrick, 2008); (Huang, 2011); (Lichtenthaler and Lichtenthaler, 2009); (Lööf and Heshmati, 2006); (Sarkar and Costa, 2008). The open innovation model, proposed by Henry Chesbrough in 2003, has been frequently applied to offer a more effective approach in generating innovation by using internal and external knowledge. Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively (H. Chesbrough, 2003, 2006b).

There is, however, a lack of in-depth research carrying on the issue of how one could efficiently implement open innovation to address the certain challenge, especially in energy sector which are now encountering the challenge of climate change.

The purpose of this research is to develop an open innovation model that can assist in adopting open innovation process in Thai energy sector with a view to combating with climate change concern. The study also aim to assess the impact of the integration of open innovation approaches within Thai energy sector through its appreciation level of the related stakeholder with a view to suggest policy implications for energy sector in contesting with a controversial climate change concern in the future.

This impact of open innovation will be examined through qualitative (multi-case study and comparative) analyses. The multi-case study analysis is applied firstly to review the energy industry in term of environmental aspect and the current adoption of open innovation. The interview approach will be carried out with a view to identify past open innovation activities and past innovation models as well as the future direction of the organization related to climate change strategy. An impact of open innovation will be assessed using a structured interview approach with a view to examine the extent of the appreciation level of related stakeholder in open innovation activities in energy sector. The comparative analysis will be then conducted with a view to identify the appropriate open innovation activities from other selected countries that has yet to be implemented in Thailand. The findings, juxtaposed with the results from the previous methodologies, will be consolidated to develop a Knowledge Management implication for Thai energy sector in order to help in implementing open innovation practices in the future. Lastly, the roadmap that will help implementing open innovation in Thai energy sector will be provided. While this research focuses on energy sector in Thailand, its findings should be relevant for other countries that are in the process of combating with climate change concern.

## 2 SCIENTIFIC POSITION

The core research question for this research is "How Open Innovation models might help the Thai Energy Sector to address the climate change challenge?". This research will develop around the core discipline of "Management and especially Management of innovation". Another discipline will be also applied in this research in order to assist in answering such question, namely, "Change management". This is because the expected outcome of this research is also to address the challenge of implementing "efficiently" open innovation in public sector. In order to answer this research question, three sub-questions will be investigated as

1. What is the existing innovation approach applied in public sector and in the Thai energy sector?
2. Which open innovation initiatives are currently adopted by the energy sector in other countries? And how transferable are these practices?
3. What kind of open innovation practices or model is adapted to the Thai situation?

## 3 LITERATURE REVIEWS

The conceptual framework of open innovation has been widely applied in both macro and micro levels with a view to overcome a limitation of closed innovation system (Almirall and Casadesus-Masanell, 2010); (Barge-Gil, 2010); (Chesbrough, 2006a; 2011). It has been demonstrated through various studies in several sectors that open innovation can accelerate the process of creating

innovation through a better managing of the inflow and outflow knowledge (Chesbrough, 2010); (Dahlander et al., 2008); (Dreyfuss, 2011); (Giarratana and Luzzi, 2009); (Hakkim and Heidrick, 2008); (Harison and Koski, 2010); (Huang, 2011); (Lichtenthaler, 2009). This research is therefore initially developed around the benefit of adopting open innovation as well as the approach to gain knowledge from both private and public initiatives.

The emission from energy sector is the dominant anthropogenic emission that gradually emerged to a larger concern in global warming issue (Houghton et al., 2002). In Thailand, for example, emission from energy sector accounted for approximately 70 per cent of total greenhouse gas (GHG) emissions in the year 2000 (ONEP, 2010). The climate change concern has been firstly captured by researchers in the mid 1980s. This resulted in the establishing of several international entities, for instance Intergovernmental Panel of Climate Change (IPCC) in 1988 (IPCC, 2010) and United Nations Framework convention on Climate Change (UNFCCC) in 1990 (UNFCCC, 2007).

The rationale behind these establishments is to bring together researchers and think-tanks in both public and private bodies with a view to develop and propose an appropriate mitigation plan as well as an acceptable international agreement to ensure that all countries have been fairly contributed in combating recent global warming issue. While, a global climate change agreement has yet to be finalized, a certain direction that likely to be occurred is that all countries have to reduce their GHG emission in order to keep the increasing global temperature under an average of 2c or less in 2050 (EG Science, 2008; Metz, Davidson, Bosch, Dave, & Meyer, 2007). To achieve this commitment, GHG emission emitted from developed country is expected to decrease by 30% by 2020 and by 85% by 2050 relative to 1990 (EG Science, 2008). Due to the requirement in adjusting its economic structure – as a result of globalisation and manufacturing bloom - developing country emissions are expected to increase up to 2020 with following a dramatically reduction to the same level in 1990 (EG Science, 2008). This demonstrates that there will be a substantial reduction of GHG emission not only in developed countries but also for the developing countries in the future, including Thailand. This pressure will be inevitably passed through energy sector as it is a main contributor of the country GHG emission. Using the benefits of open innovation, it can be therefore assumed that adapting open innovation into the routine operational approach might assist Thailand energy sector in responding with this incoming pressure.

The recent literatures on open innovation emphasis four main research streams, namely Technology transaction, user innovation, business model, and innovation markets (Lichtenthaler, 2011). Lichtenthaler (2011) has proposed the conceptual framework for open innovation that emphasis three level of managing knowledge as knowledge exploration, knowledge exploitation, and knowledge retention at internal and external contexts to capture those research streams as shown in figure 2 below.

| | | Knowledge exploration | Knowledge retention | Knowledge exploitation |
|---|---|---|---|---|
| Internal | Organisational level | Inventive capacity | Transformative capacity | Innovative capacity |
| | Project level | Make decision | Integrate decision | Keep decision |
| | Individual level | Not-invented-here attitude | Not-connected-here attitude | Not-sold-here attitude |
| External | Organisational level | Absorptive capacity | Connective capacity | Desorptive capacity |
| | Project level | Buy decision | Relate decision | Sell decision |
| | Individual level | Buy-in attitude | Relate-out attitude | Sell-out attitude |

Figure 2: Open innovation conceptual framework.

Various researchers emphasis that open innovation can contribute to the better approach of achieving organizational goals. However, to appreciate the actual benefit of the adoption of open innovation, an in-detph analysis of the open innovation model is required. The biggest part of open innovation initiatives deal with knowledge generation, problem solving, collective development and etc. There is a lack of in-depth research regarding the assessment of the impact of the adoption of open innovation initiatives especially in public or former large public entity that has been reformed (ie. privatisation, restructuring, and regulatory reform). This research, therefore, attempts to investigate this issue by applying the conceptual framework developed by Lichtenthaler (2011) as a core framework to analyse the organisational approach in adopting open innovation and its appreciation level.

Based on the need of the nation that require to generate less GHG emission in the future to reduce a global warming problems, green innovation technology is required to be either incrementally and radically innovated (Bartlett & Trifilova, 2010). Open innovation can be one of the key approaches in assisting all related entities to create a green innovation technology as well as sustain its development process in the future.

Even though, the researches carrying out the issue of energy sector and climate change have been constantly emphasising since the late 1980s, the

conceptual framework of open innovation has just been recently introduced in 2003. Therefore, there is a lack of literature in the area of the relationship between open innovation and energy sector, especially in climate change aspect. Arnold (2009) proposed that open innovation methods can help in combating climate change. The study developed around several open innovation methods, for instance dialogues, idea contest, focus group, communities, and intermediary agencies. This study highlights the strengths and weaknesses of such methods to combat climate change using a case study method on 13 mainly German-based companies. The findings illustrate that open innovation methods can help in combating climate change. However, it depends on methods as well as applicability conditions which have yet to be studied in detail (Arnold, 2009).

Hakkim (2008) attempted to analyse the process in developing a technological innovation method within energy sector using open innovation concept. A case-study method was applied in analysing the usage of open innovation in the Canadian research agencies. It was found that integrating an open innovation through a collaborative research and development (R&D) among participants has played a key role in the success of tested energy project in Turkey (Hakkim and Heidrick, 2008). Goduscheit et al. (2011) applied similar approach to analyse the open innovation model in the large energy project in Denmark. Despite the successful of the project as a result of applying open innovation, the study identified two key barriers in the adoption of open innovation, namely the ability to understand and the willingness to employ the open innovation approaches (Goduscheit et al., 2011). The results from both studies have strengthened the benefit of adopting open innovation in the habitual operation and strategy. This aligns with several studies that attempted to validate the benefit of open innovation in other industries (Bianchi et al., 2010); (Cainelli et al., 2006); (Chesbrough, 2010); (Van der Meer, 2007).

It can be found that previous open innovation literatures attempted to identify the superiority of open innovation regardless the extent of its actual impact and the applicability conditions. Therefore, in order to overcome such shortfall, this research attempts to propose a measurement framework as well as factors that make up a measurement for effectiveness of open innovation by using energy sector as a core case study in the climate change perspective. While this research emphasises public sector, especially in energy sector in Thailand, its findings should be relevant for other countries that are in the process of combating with climate change concern. The findings can also be applicable to measure the appreciation level of the adoption of open innovation on public sectors in other industries.

# 4 PROPOSED CONCEPTUAL FRAMEWORK

In order to answer the research questions, three main research methods will be adopted namely a multiple case study methodology, systematic comparative analysis (SCA), and focused or semi-structured interview approach. The overall research framework is shown in figure 3 below

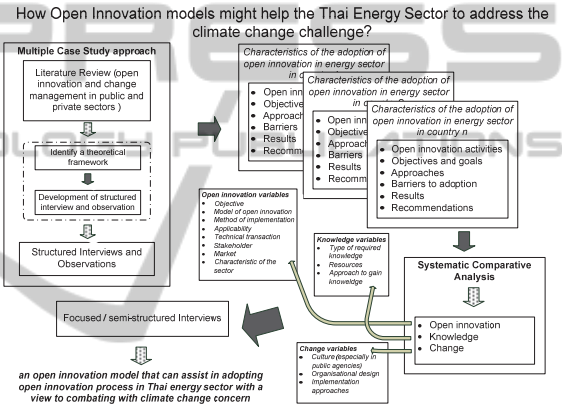


Figure 3: The proposed overall research framework.

In the first phase, the research will, firstly, adopt a multi case study method (Yin, 2003). This phase will consist of three main activities. Initially, literature review on the matter of open innovation practices both in private and public sectors will be conducted in order to appreciate what kind of open innovation models are transferable as well as why and how are their efficiencies given the respective objectives. The review will include the literature in the context of change management with a view to identify the pattern of change in public sector which leads to the success implementation of open innovation. Moreover, another purpose of this activity is to develop theoretical framework which integrate open innovation and change management together to guide developing the next step. Secondly, a list of questions developing from the main issues and theoretical frameworks from the previous step will be designed to be used for the following structured interviews and observations. Lastly in the first phrase, structured interviews and observations

will be conducted on selected personnel related with Thai energy sector as well as other selected countries as a best practice with a view to investigate current status of practices and to identify characteristics of the adoption of open innovation in public and private sector that related to energy industry as well as the approaches that were developed to facilitate the change in organization as the result of adopting these initiatives.

The systematic comparative analysis will be introduced in the second phase with a view to examine the applicability of international open innovation approaches – identified from the previous phrase – to Thailand energy sector. The systematic comparative analysis will be conducted emphasising three core variables, namely open innovation variable (eg. objective, model of open innovation, method of implementation, applicability, technical transaction, stakeholder, market and characteristic of the sector, knowledge variable (eg. type of required knowledge and resources), change variable (eg. culture of public agencies, organisational design).

An impact of adoption the selected open innovation approaches on Thai energy sector will be measured through an appreciation level using focused or semi-structured interview approach in the third phase. In order to measure an appreciation level of stakeholders as an impact of the adoption of open innovation which is difficult to be straightforward, a flexible, accessible and intelligible and, capable of disclosing important and often hidden facets of human and organizational behavior type of interview is required. The focused or semi-structured interview approach can overcome such difficulties occurred in structured interview approach (Qu and Dumay, 2011). Kvale and Brinkmann (2009) also concluded that the focused interview approach is the most effective and convenient means of gathering information as it allows interviewer to adjust the questioning style according to the response of interviewee and be able to evoke the fullest responses from the interviewees as well as providing interviewees to be able to share their information generously. The outcomes from this stage will be consolidated to develop an open innovation model to be applied in Thai energy sector for combating climate change challenges.

# 5 CONCLUSIONS AND FUTURE WORK

It has been proven through various studies that open innovation can somehow assist organisation to increase the number of innovations as well as accelerate the process of generating innovation through the utilisation of both internal and external knowledge. There is, however, a lack of in-depth research carrying on the issue of how one could efficiently implement open innovation to address the certain challenge. In this study, the conceptual framework is proposed with a view to overcome that shortfalls by using Thai energy sector and the current climate change challenge as a case study. The proposed conceptual framework will be tested through the abovementioned steps including obeservation and interviewing approaches. The expected outcomes will be the open innovation model as well as related policy implication that will be initiatived with a view to enhance the benefits and accelerate the adoption of open innovation model in Thai energy sector.

Several changes are expected to be engaged in all industries, especially in the emission intensive industries due to the current concerns in world sustainabile development. It is inevitable that the new technology, mitigation and adaptation options are required to be generated continuously in response to those changes. Open innovation is a very promising model, and should be seriously considered at both an organizational, as well as national, level. However, understanding the impacts of using it and how to implementing it efficiently should be the next task for any organization thinking about adopting it in the future.

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