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LED lighting in Asia: How standardization regimes influence stakeholders in standard setting

Geerten van de Kaa; Mark Greeven

Abstract

Climate change is a severe threat to global development and top priority on the international agenda. In order to fight climate change, reducing greenhouse gas emission is essential. Taking into account that energy consumption is the main cause of greenhouse gas emission, energy efficiency plays an important role within the international debate on climate change. Within this context, LED lighting, as one of the existing energy-efficient technologies, provides a lighting solution which uses less energy than most other types of lamps. Hence, stimulation of the transitions towards the adoption of LED lighting across developing countries and Asia, can contribute to reduce greenhouse gas emissions. Research shows that standard setting is essential to achieve significant improvements in energy efficiency. Due to a lack of established regional standards for LED, numerous domestic and international organizations, governments and associations in Asia are involved in the standardization process and influence each other following a variety of interests, complicating standard setting. Moreover, the great differences between Asian countries in terms of local industry and institutional conditions make it difficult to develop one overall standard that can be accepted in all these countries. The question arises how local conditions influence which stakeholders play a role within the standardization process of LED lighting in developing countries and Asia. We build on research that suggests that institutions influence the standardization process, for instance Montealegre's study

(1999), which indicates that institutions such as the government, private sector and international organizations influence the standard setting process. We argue that the diversity in local conditions can be captured by institutional conditions, in particular how they influence the role of industry versus government actors in the standardization process. We propose to distinguish countries in terms of their standardization regime; the landscape of the standardization regime is shaped by political, professional and business interests, which are represented by the stakeholders involved in the standardization process. A selection of developing countries in Asia will be analysed in depth, including China, Thailand, the Philippines, Vietnam and Indonesia. To analyse the government and industry actors that influence the standardization process of LED lighting in Asia a stakeholder analysis will be conducted. Contrary to what we expect, we show that different stakeholders are involved in LED standardization in developing countries in Asia. This shows that developing countries in the Asian region are active in both innovation and standardization.

Introduction

Climate change is a severe threat to global development and top priority on the international agenda. In order to fight climate change, reducing greenhouse gas emission is essential. Taking into account that energy consumption is the main cause of greenhouse gas emission, energy efficiency plays an important role within the international debate on climate change. Within this context, LED lighting, as one of the existing energy-efficient technologies, provides a lighting solution which uses less energy than most other types of lamps. Hence, stimulation of the transitions towards the adoption of LED lighting across developing countries and Asia, can contribute to reduce greenhouse gas emissions. Research shows that standard setting is essential to achieve significant improvements in energy efficiency. However, currently regional standards for lighting quality for LED do not exist in developing countries and Asia. In order to stimulate the transition to LED lighting, international organizations and regional associations can be instrumental to set standards within the Asian region. Numerous organizations and associations are involved in the standard setting procedures and influence

each other, which makes this process complex. Moreover, the great differences between the countries involved in terms of local conditions make it difficult to develop one global standard.

The objective of this paper is to explore the stakeholder infrastructure for standardization in Asia. Specifically we aim to study the relevance and importance of different stakeholders involved in the standard setting process. Both theory on standardization and stakeholder theory will be applied to analyse which actors influence the standardization of LED lighting in Asia. Taking into account that the world has become increasingly interconnected and that the transition to LED lighting in developing countries affects many individuals, groups and organizations, stakeholder analysis provides valuable insight in the standardization process. The focus will be on the industrial and institutional level of stakeholders. In this way, a strategic view of the institutional and industrial landscape will be developed. Based on this research, implications and recommendations for the standardization process will be developed.

The scope of this project is Asia, including Philippines, Thailand, Vietnam, Indonesia and China. China is an example of a country that is far ahead in terms of the standardization of LED and has a lot of manufacturing interest. Thailand and the Philippines are examples of countries where the government is driving the standardization process and where a number of efforts for the standardization of LED are going on. Indonesia and Vietnam are examples of countries which are far behind. The focus is on the standardization process of LED in this region. The level of analysis will be institutional and industrial, including international organizations and regional associations, regulated, governmental and semi-governmental bodies. The specific stakeholders to focus on include national utility, lighting associations, standard setting institutes, the industry, and energy efficiency bodies.

The analysis of transnational standard setting of LED in Asia gives us insight into the process of standardization and fits into a growing academic interest in standardization processes. The purpose of this paper is to provide insight into the institutional and industrial actors that influence the standard setting process of LED lighting in developing countries and Asia. Especially in this geographical area research in the field of standardization is limited.

The paper is organized as follows. Chapter 2 provides a literature review and theoretical background. Important concepts such as institutional theory, standardization theory and stakeholder theory will be explained. In chapter 3 the methodology and limitations will be introduced. Chapter 4 shows the results and discussion. Finally, chapter 5 states the conclusions and recommendations.

Theory

Standardization

There is a growing academic interest in standardization processes (Hommels et al., 2008). Over the past few decades, research on standardization has been conducted by academics from a variety of disciplinary backgrounds, including engineering, economics, business, technology management and education (De Vries, 2011). While research on standardization was originally mainly based on technological considerations, it now takes into account that standardization processes are also characterized by economic and political interests (Egyedi, 2008). Research on standardization has been mainly focused on developed countries and not so much on developing countries (Van de Kaa et al 2013). Standardization takes place at different scales. Besides the development of standards at a company level and an inter-organizational level, standardization has become increasingly important at an international scale. Especially the regional level is becoming more important (De Vries, 2008), for instance Europe or Asia. Standards can be the outcome of committee-based and market-based standardization (Farrell & Saloner, 1988). In other words, standards can be established through market forces, or through official standardization institutes. When standards are established by market forces, they are called *de facto* standards, and are the outcome of market-mediated processes. *De jure* standards are defined by standardization institutes, including government regulations, industry committees and associations and approved by authoritative national or international bodies before market adoption (David & Greenstein, 1990). While earlier research (1980s) is mainly focused on *de facto* standards, later on (1990s – early 2000s) the emphasis of research has shifted towards committee standards, especially committee standards of the formal standards bodies and consortia (Egyedi,

2008). In this study the focus lies on *de jure* standards. So the analysis will be on the level of organized standardization, defined as organizational bodies in which committees negotiate and adopt standards (Werle, 2001a). Standardization processes are characterized by a high degree of complexity, which is caused by the intertwined technical, economic and political interests of the parties involved. Involvement of several stakeholders such as engineers, politicians, industrialists, international standardization bodies in the negotiation of norms and standards, makes the standardization processes difficult to achieve (Hommels et al., 2008). So the literature on standardization provides us with several frameworks to gain insight in the standardization processes. They underline the importance of standardization institutes such as government regulation, industry committees, and international standardization commissions. However, the literature does not deal with the specific role the stakeholders play within the standardization process, especially in developing countries where a lot of uncertainty exists. Moreover, the literature does not deal with how the stakeholders influence the standardization processes and each other. Within the standards process coordinated by committees, such as formal standard bodies, consortia, and government agencies, negotiation of standards is a key area, since it directly affects what interests, values and norms will be included in the standard (Egyedi, 2008). Negotiations are based on conflicting interests and aim to reach a consensus among various stakeholders (Pfetsch, 2008). In reality this consensus is often based on a balance between technical excellence and acceptability (Dijkstra, 2008). In order to reach consensus it is useful to identify which interests play a role. To identify and prioritize the stakeholders that are part of the institutional environment for standardization in Asia stakeholder theory will be applied.

Stakeholder theory

Stakeholder theory deals with the identification of stakeholder groups that require attention from an organization. It provides a framework to separate stakeholders from non-stakeholders and to understand an organization and its increasingly unpredictable external environment (Mitchell et al., 1997). A stakeholder can be defined as ‘*any group or individual who can affect or is affected by the achievement of the organization’s objectives*’ (Freeman, 1984). Thus, stakeholders can be persons, groups, organizations, institutions, societies, neighbourhoods and even the natural environment

(Mitchell et al., 1997). One of the important methods applied in stakeholder theory is the stakeholder analysis, which is the classification of stakeholders into useful categories that give insight into how stakeholder groups influence an organization (Rowley, 1997). In the literature, agreement exists about the main steps that are part of a stakeholder analysis. It begins with the identification of stakeholder groups. The second step is to determine the relevant interests, also called the stakes, of the stakeholders. The final step involves the evaluation of the type and level of stakeholder power or salience (Wolfe & Putler, 2002).

De Vries et. al. (2003) proposes a method for stakeholder identification and classification especially for standardization processes. This tool for the systematic identification of stakeholders and the determination of their positions takes into account that standardization organizations are different from firms, which result in a different stakeholder approach. This approach takes a broad perspective by including all parties that may affect and that may be affected by the standardization process, which represents the open character of standardization. In addition, the identity of the stakeholder groups influenced by standards varies significantly and depends on the kind of the standardization process. While some standards mainly affect employees, others mainly affect certification institutes.

The two-step stakeholder analysis results in a balanced stakeholder representation. The first step consists of the identification of all potential stakeholders in a standardization process. Nine directions to identify stakeholders are proposed, based on the diverse ways in which a standard can be important to stakeholders. However, some directions can be more relevant for a standardization process than others. In other words, they serve as search heuristic in order to avoid overlooking some stakeholder groups. The nine categories are **Product chain** (such as suppliers, transporters, and trade companies), **End users and related organizations** (large companies, small-and medium sized enterprises, public organizations and individual employees), **Designers** (designers of the product the standards relates to, such as specialized companies), **Physical system** (analysis of physical interactions with other technical systems and compatibility will result in stakeholders involved in the development and production of elements of the surrounding system), **Inspection agencies** (for instance dedicated organizations, certification bodies, testing laboratories, or government enforcement agencies),

Regulators (Standards are often related to government regulation), **Research and consultancy** (for instance universities, research institutes and consultants), **Education** (such as educational programs for students and professionals), and **Representative organizations** (these organizations represent the interests of their members, such as professional organizations and consumer organizations.)

This first step of the stakeholder analysis results in a long list of stakeholders. The second step of the analysis proposed by De Vries (2003) deals with this and aims to involve the stakeholders in the standardization process and is based on the Stakeholder Saliency Model of Mitchell et al. (1997). According to this model, stakeholders possess one or more of the three key attributes: power, legitimacy, and urgency (Mitchell et al., 1997). These key stakeholder attributes provide the basis of a theory categorize classes of stakeholders, and make a distinction between essential stakeholders in the standardization process and less important stakeholders. Moreover, the stakeholder saliency model provides insight into the probable roles stakeholders can play and how to involve various stakeholders in the standardization process (De Vries, 2003).

The stakeholder attribute of power refers to the power of a stakeholder to influence a firm (or in this case, the standardization process or the success of the resulting standard (De Vries, 2003)). Within the context of standard setting processes, power is established by using resources to influence the standardization process. Resources that should be taken into account include time available, financial position, technical expertise and the position on the network of firms and organizations to which the standard applies (De Vries, 2003). The power of a stakeholder depends on whether a stakeholder can gain access to these means to influence the standardization process. However, access to these means is not a steady state. So power can be acquired, but also be lost. In other words, power is transitory (Mitchell et al., 1997).

Legitimacy refers to the legitimacy of a stakeholder within the standardization process. Legitimacy refers to socially accepted and expected structures or behaviours (Mitchell et al., 1997), and can be defined as *‘a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions’*

(Suchman, 1995). If, for instance, an organization uses its power in a way which society evaluates as irresponsible, it will lose its legitimacy. Legitimacy can be divided in formal legitimacy and perceived legitimacy. Formal legitimacy looks whether *‘the stakeholder is formally entitled to participate in the process’*, while perceived legitimacy asks *‘do the other stakeholders accept or support the participation of this stakeholder in the process?’* (De Vries, 2003). De Vries (2003) points out that almost every stakeholder is formally legitimate, but that the *‘significance of the stakeholder’s participation largely depends on his perceived legitimacy’*.

Urgency refers to the urgency of the stakeholder’s claim. In other words, it clarifies to what extent a stakeholder demands for immediate attention. The degree of urgency of a stakeholder can be determined by analysing its recent action: *‘has the stakeholder been active in pursuing his goals regarding this standardization issue?’* (De Vries, 2003). By adding the attribute of urgency the stakeholder model is able to capture the dynamics that arise as a result of interactions between stakeholders and an organization. The stakeholder attribute of urgency is based on time-sensitivity and importance or criticality of a relationship or claim. Time sensitivity is further defined as *‘the degree to which managerial delay in attending to the claim or relationship is unacceptable to the stakeholder’* (Mitchell and al, 1997). Criticality refers to the degree of importance of the relationship or claim to the stakeholder. Important to note here is that urgency is a perception. Hence, the possibility exists that a stakeholder regards its claim as urgent, but in fact the claim is not.

Based on the three attributes power, legitimacy and urgency, the degree of salience of a stakeholder can be determined. The more attributes a stakeholder possesses, the higher the degree of salience. Salience is defined as *‘the degree to which managers give priority to competing stakeholder claims’* (Mitchell et al., 1997). In other words, the more salient, the more important a stakeholder is. Three categories can be identified: latent stakeholders, expectant stakeholder, and highly salient stakeholders. The most important stakeholders possess all three stakeholder attributes.

The category of latent stakeholders consists of dormant stakeholders, discretionary stakeholders, and demanding stakeholders (Mitchell et al., 1997). Latent stakeholders possess only one attribute and are

perceived to have a low degree of salience. *Dormant stakeholders* possess power to influence the standardization process (De Vries, 2003). Since these stakeholders do not possess the attributes of legitimacy or urgency, they are not able to use this power. Usually there is no participation or interaction between dormant stakeholders and the standardization process. However, Mitchell et al. (1997) suggest that managers should be aware that if dormant stakeholders acquire either urgency or legitimacy, they will become more salient. The dynamic nature of the stakeholder model makes this possible. Therefore they should be monitored (De Vries, 2003). *Discretionary stakeholders* possess legitimacy, but they lack the power to influence a standardization process (De Vries, 2003) and their claims are not urgent. Due to lack of power and urgency of this group of stakeholders, there is no direct pressure for them to participate. Although they lack urgency, it might be useful to involve discretionary stakeholders, since their legitimate role in the standardization process is acknowledged by other participants or potential buyers of the standard (De Vries, 2003). *Demanding stakeholders* possess the attribute of urgency. Although this group has an urgent claim, they do not have the power or legitimacy to move their claim. This group is irritating, but not dangerous. As long as demanding stakeholders do not acquire power or legitimacy, the stakeholder's claim remains latent and largely unconsidered (Mitchell et al., 1997).

The category of expectant stakeholders consists of dominant stakeholders, dependent stakeholders, and dangerous stakeholders. Expectant stakeholders possess two attributes and have moderate salience (Mitchell et al., 1997). *Dominant stakeholders* possess both power and legitimacy, but due to lack of urgency this group has no urgent need to participate in the standardization process. However, for the standardization process participation would be desirable. Since this group has legitimate claims as well as the power to act on these claims, they can possibly have a lot of influence on the standardization process. As a consequence, efforts should be made to involve this group of stakeholders (De Vries, 2003). In other words, this is a class of stakeholders that is important to managers and receive much of attention. This group of stakeholders can be involved by relating the standardization process to other matters that are relevant for them, such as combining the development of one standard with the development of related standards that are urgent for this group. Governmental organizations are often

dominant stakeholders (De Vries, 2003). *Dependent stakeholders* possess legitimacy and urgency, but lack power. This group is called dependent, because in order to impose their will, they depend on others for power. Important to note is that a dependent stakeholder can become part of the most salient stakeholder class if dominant stakeholders adopt its claims, for instance through guardianship of other stakeholders (Mitchell et al., 1997). This group of stakeholders is relevant for the support of a standard and their participation is needed. However, this group often does not have access to resources needed to participate in the standardization process. Involving these stakeholders in the standardization process is usually not so difficult and can be done for instance by financial support and access to technical expertise. (De Vries, 2003). *Dangerous stakeholders* possess urgency and power, but lack legitimacy. Since this stakeholder group will be coercive and possibly violent, it can be of danger to an organization. Examples are sabotage, strikes and terrorism (Mitchell et al., 1997). Although this group of stakeholders have no formal place in the standardization process, their strategies should be taken into account during the process (De Vries, 2003).

Definitive stakeholders are highly salient stakeholders and possess all three attributes. So they have the power to influence the standardization process, the standard is important for them, and their involvement is undeniable (De Vries, 2003). By acquiring one of the missing attributes, an expectant stakeholder can become definitive. The most common way of stakeholders to become definitive, is first be a dominant stakeholder and then move into the definitive category. So when a stakeholder possesses power and legitimacy, and its claim becomes urgent, high priority should be given to this stakeholder. In short, a high degree of salience of a stakeholder requires acknowledgement and action (Mitchell et al., 1997). Often this group of stakeholders is in fact the driving force behind the standardization process and they are already highly committed to standardization activities (De Vries, 2003). Stakeholders without any attributes are not taken into account by this framework and are regarded as non-stakeholders (Mitchell et al., 1997).

Methodology

The study is characterized by a multiple case study strategy, since this provides insight into ‘*a contemporary phenomenon within its real life context, especially when the boundaries between a phenomenon and the context are not clearly evident*’ (Yin, 1994). Taking into account that standardization is a complex process, in which numerous organizations and associations are involved and influence each other, and which also differs per country, multiple case study is an appropriate approach. Moreover, case study research is especially applicable in new topic areas and focuses on ‘*understanding the dynamics present within single settings*’ (Eisenhardt, 1989). Hence, by a multiple case study a better understanding of the standardization processes in developing countries can be gained.

A few developing countries which are expected to be different in terms of standardization regime serve as case study and will be analysed in depth, including China, Thailand, the Philippines, Vietnam and Indonesia. First the institutional context in the countries involved will be briefly discussed, mainly focussed on the policy and regulatory institutions related to energy efficiency and lighting. The institutional overview on a country level will be followed by a stakeholder analysis to analyse the institutional and industry actors that influence the standardization process of LED lighting in developing countries and Asia.

The stakeholder analysis will be done according to stakeholder theory of De Vries (2003). In order to evaluate the power, legitimacy and urgency of each stakeholder, first desk research will be conducted. Websites, news articles, events, conferences, forums and platforms will be analysed to gain insight in the role of each stakeholder and to look how they interact with each other. To evaluate the three attributes, questions derived from research of De Vries (2003) will be used. In order to evaluate power, the question “*Has the stakeholder the resources to affect the standardization process or the success of the resulting standards?*” is relevant. Resources include time available, financial position, technical expertise and/or the position in network of firms and organizations to which the standard applies. Since almost every stakeholder is formally legitimate, only perceived legitimacy will be taken into account. The question “*do the other stakeholders accept or support the participation of this stakeholder in the process?*” is relevant here. To evaluate urgency the answer to the question “*Has the*

stakeholder been active in pursuing his goals regarding this standardization issue?” is relevant. This desk research has been complemented with eleven interviews with key stakeholders.

Case studies typically combine several data collection methods (Eisenhardt, 1989). This research consists of both primary and secondary data. Secondary data will be gathered from academic publications, books, reports and websites. The literature review and desk research will be complemented with in-depth interviews with relevant stakeholders in the countries involved, as interviews are a highly efficient way to collect rich, empirical data (Eisenhardt & Graebner, 2007).

Results

Stakeholder infrastructure for LED standardization in Asia

Within the product chain of LED, distributors, manufacturers, and large purchasers are the main stakeholders. Countries in which LED is manufactured include China, Korea, Taiwan, Singapore, and Japan. Major stakeholders include big global companies such as Philips, GE and Osram, regional manufacturers and small manufacturers. Large purchasers include major retailers such as Tesco, Walmart, Ikea and Carrefour. The product chain will be further discussed in section 4.2 about China. Regarding the standard for LED lighting, end users are stakeholders that are involved in the implementation and use of the specifications of the standard. On an international and global level relevant stakeholders include international standard setting institutes and related organizations. For the standardization of LED, policy makers on both international and global level play a role. International and regional institutions are important stakeholders who influence the standardization process. Relevant organizations for LED that serve the interests of their members include international lighting associations.

Applying the method for stakeholder identification of De Vries (2003) results in the relevant stakeholders at the international and regional level (see table 1).

Table 1: Stakeholder analysis international and regional level

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Stakeholder	Power	Urgency	Legitimacy	Classification				
	Time	Financial	Technical	Position	Total (%)			
Asia Lighting Compact (ALC)	Y	-	Y	Y	75%: P	L	U	Definitive
Global Lighting Forum (GLF)	Y	Y	Y	Y	100%: P	L	U	Definitive
The International Electrotechnical Commission (IEC)	Y	Y	Y	Y	100%: P	L	U	Definitive
World Bank	Y	Y	-	Y	75%: P	L	-	Dominant
Asian Development Bank	Y	Y	-	Y	75%: P	L	-	Dominant
ECO-Asia CDCP	Y	Y	Y	Y	100%: P	L	U	Definitive
International Solid State Lighting Alliance (ISA)	Y	-	Y	Y	75%:P	L	-	Dominant
Lux Pacifica	-	-	Y	Y	50%: -	L	-	Discretionary
International Association of Lighting Designers (IALD)	-	-	Y	-	25%: -	L	-	Discretionary
Professional Lighting Designers' Association (PLDA)	Y	-	Y	-	50%:-	L	-	Discretionary
Efficient Lighting Initiative (ELI)	Y	-	Y	Y	75%: P	L	U	Definitive
Lites.Asia	Y	-	Y	Y	75%: P	L	U	Definitive
En.lighten	Y	Y	Y	Y	100%: P	L	U	Definitive
SEMI	N	N	Y	Y	50%: -	L	-	Discretionary

Stakeholder infrastructure for LED standardization in China

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Since 2002, China has shown a dramatic increase of its LED production (Stevenson, 2009). As a result of the rapid growth of China's LED market driven by the Chinese government, China has now already become the biggest export and production country of solar LED and landscape lights and is the leading manufacturing country of lighting products in the world. Currently there are about 4000 enterprises working in China's LED industry, which is scaling up rapidly in terms of size. LEDs are extensively used across China for road lighting and indoor lighting (USAID, 2011). A variety of manufacturing categories exists, such as LED chip manufacturers (around 10), LED driver manufacturers, manufacturers focused on assembling, and packaging plants (Sujendan, 2011). There are about 1,000 packaging plants in China. LED manufacturers can be divided into big global manufacturers, quality regional manufacturers and small scale workshop. The big global manufacturers are represented by global giants from Japan, Europe and the U.S. such as NICHIA, TOYODA GOSEI, LUMILEDS, CREE, and OSRAM. These leading global enterprises manufacture high-class LEDs, own core technology patents, and have many years of experience in the LED industry (Salis, 2011). They mainly focus on the high-end market (USAID, 2011). An example of a quality regional manufacturer in China is Danson Electronics, a multimillion dollar company that is producing high quality lamps, such as LED and CFLs, mainly for the Australian market. The company holds several patents and is focused on product quality and reliability (Danson, 2011). The company shares its technical knowledge with international organizations such as Asia Lighting Compact (ALC) and Lites.Asia, thereby showing their commitment to promote energy efficient lighting in Asia.

Applying De Vries (2003) results in the relevant stakeholders for LED standardization in China (see table 2).

Stakeholder	Power	Legitimacy	Urgency	Classification

	Time	Financial	Technical	Position in	Total (%)			
Standardization Administration of the P.R.C. (SAC)	Y	Y	Y	Y	100%: P	L	U	Definitive
China National Institute of Standardization (CNIS)	Y	Y	Y	Y	100%: P	L	U	Definitive
China Standard Certification Center	Y	Y	Y	Y	100%: P	L	U	Definitive
State Grid Corporation of China	N	Y	N	Y	50%: -	L	-	Discretionary
China Southern Power Grid	N	Y	N	Y	50%: -	L	-	Discretionary
National Development Reform Commission (NDRC)	Y	Y	Y	Y	100%: P	L	U	Definitive
China Ministry of Science and Technology (MOST)	Y	Y	Y	Y	100%: P	L	U	Definitive
Ministry of Industry and Information Technology	Y	Y	Y	Y	100%: P	L	U	Definitive
China Association of Lighting Industries (CALI)	Y	Y	Y	Y	100%: P	L	U	Definitive
China Illuminating Engineering Society (CIES)	Y	Y	Y	Y	100%: P	L	-	Dominant
China Solid State Lighting Alliance (CSA)	Y	Y	Y	Y	100%: P	L	U	Definitive

Table 2: Stakeholder analysis China

Stakeholder infrastructure for LED standardization in The Philippines

As a result of the growing impact of energy use on climate change and in order to be able to support the energy requirements of its economic and social development goals, the Philippines is currently

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facing the challenge to search for clean energy solutions and energy efficiency. The policy and regulatory framework for energy efficiency in the Philippines consists of various policy and regulatory instruments which are responsible for the creation of regulatory authorities, the provision of incentives and the development of technical, safety and product standards. Within the energy sector, the government plays a key role both in terms of participation and regulation (USAID, 2007a). The government of the Philippines introduced in 2005 the Philippine Efficient Lighting Market Transformation Project (PELMATP) to stimulate efficient lighting solutions by integrating several energy efficient lighting programs into standards, labelling program and promotional events. As a result of this project, the President of the Philippines has called for a ban of incandescent lamps by 2010, which makes the Philippines one of the first Asian countries that bans incandescent lamps. PELMATP has been succeeded by the Philippine Energy Efficiency Project (PEEP) in 2009 (En.Lighthen, 2011). However, institutional barriers to the effective implementation of policies and programs still exist. Firstly, energy agencies are not enough involved with other departments and institutions and too much focused on their own department. Secondly, besides weak implementation of laws, verification and enforcement of standards are also lacking. In addition, regulators and manufacturers do not have enough capacity to harmonize energy efficiency standards. Government agencies for example lack adequate institutional capability as they have not enough manpower. Moreover, current regulation does not provide incentives to utilities to implement demand-side management projects (USAID, 2007a).

Applying De Vries (2003) results in the relevant stakeholders for LED standardization in the philippines (see table 3).

Table 3: Stakeholder analysis Philippines

Stakeholder	Power	Legitima	Urgency	tion	Classifica
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	Time	Financial	Technical	Position	Total (%)			
The Department of Trade and Industry - Bureau of Product Standards (DTI-BPS)	Y	Y	Y	Y	100%: P	L	U	Definitive
CEPALCO	-	Y	-	Y	50%: -	L	-	Discretionary
VECO	-	Y	-	Y	50%: -	L	-	Discretionary
MERALCO	-	Y	-	Y	50%: -	L	-	Discretionary
Philippine Department of Energy (DOE)	Y	Y	Y	Y	100%: P	L	U	Definitive
Philippine Lighting Industry Association Inc. (PLIA)	Y	-	Y	Y	75%: P	L	U	Definitive

Stakeholder infrastructure for LED standardization in The Thailand

As a result of the economic growth since the mid of the 1980s, energy consumption in Thailand is increasing rapidly. In order to secure energy supply and sustain Thailand's economic development, the Thai Government took several efforts to improve energy efficiency and energy conservation, which are the main focus of Thailand's energy policy. The main government energy agency is the Ministry of Energy (MOEN), which consists of six offices and departments involved in energy-related activities. Since 1992, various laws and decrees to promote energy-efficiency and renewable energy programs have been issued, of which the ENCON Act is the most significant one. Following the ENCON Act, the Thai Government established the Energy Conservation Promotion Fund (ENCON Fund) to provide financial support to governmental agencies, state enterprises, NGO's, businesses and individuals involved in energy efficiency. The Fund has financially approved several energy efficiency

activities and programs, o.a. projects on lighting devices. The EGAT Demand Side Management Program is one of the examples of successful programs. This program was mainly focussed on energy efficiency labelling schemes for o.a. CFLs. However, although successful energy efficiency programs have been implemented, many government programs were not cost-effective or unsuccessful. Other barriers exist regarding implementation, monitoring and evaluation. While Thailand has adequate regulations related to energy efficiency, these regulations are not effectively enforced. Another barrier is that, although all energy related activities are consolidated under one ministry, there is still lack of policy coordination among agencies. Furthermore, there is lack of effective incentives programs to encourage saving energy (USAID, 2007b).

Applying De Vries (2003) results in the relevant stakeholders for LED standardization in Thailand (see table 4).

Stakeholder	Power	Legitima	Urgency	Classifica				
	Time	Financial	Technical	Position	Total (%)			
Thai Industrial Standard Institute (TISI)	Y	Y	Y	Y	100%: P	L	U	Definitive
Electricity Generating Authority of Thailand (EGAT), part of Ministry of Energy	Y	Y	Y	Y	100%: P	L	U	Definitive
Provincial Electricity Authority of Thailand	Y	Y	Y	Y	100%: P	L	-	Dominant

(PEA), under the Ministry of Internal Affair									
Ministry of Energy (MOEN)	Y	Y	Y	Y	100%: P	L	U	Definitive	
Illuminating Engineering Association of Thailand (TIEA)	Y	N	Y	Y	75%:P	L	U	Definitive	

Table 4: Stakeholder analysis Thailand

Stakeholder infrastructure for LED standardization in Vietnam

Currently, Vietnam is rapidly developing its infrastructure, economic zones, industrial parks, tourism resorts, and commercial and residential buildings, which has led to the creation of a big market for street lighting, commercial and residential lighting in Vietnam. In fact the Vietnam Lighting Market is primarily driven by the building and construction industry. Lighting currently accounts for 25.3% of total energy consumption in Vietnam. Energy has been a key component of Vietnam's rapid economic growth over the last decade. Meeting the growing power demand is a great challenge for the government. In order to sustain economic development and reduce adverse environmental impact, the government of Vietnam stresses the importance of energy conservation and energy efficiency in its National Energy Policy (VEEPL, 2011). Vietnam's National Energy Policy encourages for instance energy efficiency by stimulating to replace low-efficient equipment and facilities. Several government decrees and decisions emphasize energy efficiency and conservation. The most important one is the Decree on Energy Saving and Efficient Use of Energy, issued on 3 September 2003, which addresses the roles and responsibilities for both government and society related to energy efficiency and

conservation (USAID, 2007c). In 2010, a new law on Energy Conservation and Efficiency came into effect, which underlines the government's efforts to encourage energy saving. According to this law energy efficient products have to be labeled to stimulate the production of these products and to substitute outdated equipment with low energy efficiency. However, as a result of the complexity of the law and its high technical specialization, the implementation of the law is expected to face certain problems (VNEEP, 2010).

The Ministry of Industry and Trade (MOIT), overall responsible for managing the energy sector and for the energy efficiency agenda in Vietnam, approved the 'National Strategic Program on Energy Saving and Effective Use' in 2005, which set ambitious energy saving targets for Vietnam by aiming savings from 3% to 5% in total energy consumption in 2006 - 2010 and from 5% to 8% in 2011 - 2015. Besides the MOIT, the Ministry of Science and Technology (MOST), has several responsibilities in terms of energy conservation, such as issuing national standards for the energy efficiency of end-use devices and appliance, including lighting products (USAID, 2007c). However, although energy efficiency laws and decrees do exist, implementation is still a major issue due to lack of capacity, technical knowledge and resources. So stable and sufficient human and financial resources are needed to implement the energy efficiency laws and policies in the long term are needed. In addition, capacity building is needed for standards, labeling and testing regimes (USAID, 2007c).

Besides laws and decrees, important programs on energy efficiency have been launched over the past years. The UNDP and GEF launched for instance the 'Energy Efficiency Public Lighting' (VEEPL) project to enhance the transition to more energy efficient lighting by providing technical and policy support. In addition, in 2010 the UNEP and GEF supported Vietnam to promote a large scale market transformation towards efficient lighting and the phasing-out of incandescent lamps, also called the Enlighten Initiative (Enlighten, 2011). Part of this project is to strengthen and harmonize quality and performance-based standards and procedures in Vietnam.

Applying De Vries (2003) results in the relevant stakeholders for LED standardization in Thailand(see table 5).

Stakeholder		Power					Legitima	Urgency	Classifica tion
		Time	Financial	Technical	Position in	Total (%)			
Directorate for Standards, Metrology and Quality (STAMEQ)		Y	Y	Y	Y	100%: P	L	U	Definitive
Electricity of Vietnam (EVN)		N	Y	N	Y	50%: -	L	-	Discretionary
Vietnamese Academy of Science and Technology (VAST)		Y	Y	Y	Y	100%: P	L	-	Dominant
Ministry of Industry and Trade (MOIT)		Y	Y	Y	Y	100%: P	L	-	Dominant
Vietnam Urban Lighting Association (VULA)	Urban	Y	N	Y	Y	75%: P	L	-	Dominant

Table 5: Stakeholder analysis Vietnam

Stakeholder infrastructure for LED standardization in Indonesia

Indonesia has great potential to apply energy efficient technologies, since it is expanding rapidly, and it does not have that much capacity, while the energy demand is growing at the same time. If Indonesia will not manage the energy demand, it will be a challenge for everybody. However, over the past few years Indonesia has not shown major progress (Ton, 2011). Reason is that the Indonesian government has given relatively little attention to energy-efficiency opportunities and past policies did not stimulate efficient energy use. As a result of subsidized energy prices investing in energy-efficiency has been unattractive. Moreover, due to low domestic prices for electricity and oil, Indonesia is facing high energy intensity, which is a major burden on the government budget. Recently, the Indonesia government is moving away from subsidies, which led to higher prices for electricity and fuels. Hence, more energy efficient energy has become more attractive for consumers. However, one of the major institutional challenges for Indonesia is to generate sufficient support to overcome inertia (USAID, 2007). Other main challenges are the still relatively low cost of electricity and the limited buying power of the majority of energy consumers.

Although investing in energy-efficiency has been unattractive, Indonesia launched several demand side management programs with some success, for instance the introduction and promotion of CFLs. Although the government of Indonesia is currently strengthening existing major CFL promotional programs, no promotional programs on LED exist (En.Lighthen, 2011). Furthermore, Indonesia established testing laboratories. These testing labs have not sought international accreditation yet. Indonesia is also involved in the Barrier Removal to the Cost-Effective Development and Implementation of Energy Efficiency Standards and Labeling (BRESL) project, supported by UNDP and GEF (BRESL, 2011).

In order to be able to meet projected energy demand, setting energy performance standards is the most cost-effective market intervention, which will lead to increased market penetration of energy efficient

technologies (USAID, 2011). Specific institutional challenges related to standard setting in Indonesia include transparency during the preparation of technical regulations and the coordination among concerned ministries. In addition, limited availability of accredited product certification bodies and inspection bodies are a major obstacle (Lites.Asia, 2009).

Applying De Vries (2003) results in the relevant stakeholders for LED standardization in Indonesia (see table 6).

Stakeholder	Power	Legitima	Urgency	tion	Classifica
	Position in Technical Financial Time	Total (%)			
National Standardization Agency of Indonesia	Y	Y	Y	Y	100%: P L U Definitive
Perusahaan Listrik Negara (PLN)	N	Y	N	Y	50%: - L - Discretionary
Agency for Assessment and Application of Technology (BPPT)	Y	Y	Y	Y	100%: P L U Definitive
Ministry of Energy and Mineral Resources (MEMR)	N	Y	Y	Y	75%:P L - Dominant
Asosiasi Industri Perlampuan Listrik Indonesia	Y	N	N	Y	50%: - L U Dependent

(APERLINDO)									
Clinton Initiative, Foundation	Climate Clinton	Y	Y	N	Y	75%:P	L	U	Definitive
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Gesellschaft Internationale	Y	Y	N	Y	75%:P	L	-	Dominant

Table 6: Stakeholder analysis Indonesia

Conclusion

By conducting a stakeholder analysis of the actors involved in the standardization of LED technologies, a typical product innovation, we show that contrary to our expectations, developing countries in the Asian region are actively involved in both innovation and standardization.

This research is subject to some important limitations. One of the major limitations of this research is that five countries are involved in the research. Hence, the results are not generalizable. In order to harmonize standards within the Asian region, further research is needed on other Asian countries, such as India, Sri Lanka, Malaysia, Pakistan, Bangladesh, and Nepal. Another limitation is the number of in depth interviews. Especially for Indonesia it was difficult to get a response from relevant stakeholders. In addition, data gathered from interviews might be biased, caused by image-conscious informants (Eisenhardt & Graebner, 2007). In order to limit this bias, I have tried to interview as many highly knowledgeable stakeholders who view the standardization process of LED from different perspectives.

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