



Regional Report on Efficient Lighting in Southeast Asia

November 2011





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Executive Summary

This draft report presents publicly available information on efficient lighting activities worldwide, with an emphasis on 11 countries in Southeast Asia:

- Brunei Darussalam
- Cambodia
- Indonesia
- Laos
- Malaysia
- Myanmar (Burma)
- Philippines
- Singapore
- Thailand
- Timor Leste
- Vietnam

The report is provided to inform the Southeast Asia regional workshop convened by United Nations Environment Program (UNEP) and Global Environment Facility (GEF) *en.lighten* initiative on 4 November 2011, in Singapore. During the forum countries will be invited to:

- Consider the multiple benefits of efficient lighting and assess the applicability of the *en.lighten* recommendations to promote the transition following an integrated approach;
- Enact legislation that would establish minimum energy performance standards for incandescent lamps and develop an integrated approach addressing all necessary aspects to effectively; and thus,
- Join the *en.lighten* Efficient Lighting Global Partnership;
- Phase out inefficient lamps as the first step to promote more efficient and sustainable lighting.

The *en.lighten* initiative proposes these activities as tangible, affordable ways to reduce costs for consumers, reduce carbon dioxide and other atmospheric emissions, bring quality lighting services to all people, and protect the environment in Southeast Asia. Estimates made by *en.lighten* suggest that, by replacing all inefficient incandescent GLS with CFLs, countries in the South East Asian region could:

- Achieve *annual* energy savings of 16.52 TWh, equating to approximately USD 1.6 billion dollars in savings in electricity costs to consumers;
- Avoid approximately 12 million tonnes of CO₂ emissions each year, or 2.8% of the annual CO₂ for the region.

The report briefly notes the advantages of efficient lighting, strategies for transitioning from conventional lamps to higher efficiency lamps, and how such strategies utilize cost-effective tools to tackle climate change and achieve environmental objectives. Barriers to a rapid transition to efficient lamps, such as first costs and perceived costs are addressed, as well as concerns such as end-of-life disposal for lamps and hazardous materials.

Examples of regulations and standards already enacted by countries in other regions offer a context for looking at Southeast Asia's strengths and readiness to



transition to high efficiency general service lamps. The en.lighten partnership offers an integrated policy approach that has four cohesive actions, each of which is described herein:

- Minimum Energy Performance Standards
- Supporting Policies and Mechanisms
- Measurement, Verification and Enforcement
- Environmental Sustainability and Sound End of Life Approaches

National initiatives for a transition to efficient lighting are examined in detail. Of the 11 countries, four have strong readiness for a transition to high efficiency lighting, three have moderate readiness, and four have limited readiness. Overall, the region has strengths and experience in:

- fiscal measures to support energy efficiency, such as rebates and financing tools;
- voluntary activities such as compact fluorescent lamp distribution and energy awareness programs; and,
- lighting manufacturing.

Regionally, there is moderate evidence of regulatory mechanisms and economic/market-based instruments to phase out inefficient lamps. Several countries have established some monitoring, verification and enforcement activities, and some have facilities for lamp product testing and quality assurance. However, these resources presently are not available to all countries. Very limited efforts and facilities are focused on sustainability and sound end of life approaches.

To determine how Southeast Asian countries could effectively and sustainably transition to efficient lighting, the report offers issues for stakeholder discussion. Leaders in the region can build on these strengths:

- All the countries included in this study participate in international climate change agreements. This level of interest and commitment is a promising precedent for participating in UNEP's en.lighten Partnership.
- All have policy or programmatic structures in place that either presently regulate lamps, or could be expanded to do so in the future. This bodes well for rapidly making a transition to efficient lighting.
- The region has an existing infrastructure for international collaboration, with lighting harmonization activities ongoing. Collaboration and harmonization can help aggregate the regional market to ensure that good quality products are available at reasonable cost.
- Multilateral institutions (including Asian Development Bank, Global Environment Fund, United Nations and World Bank) have invested in, and might be able to support new, lighting efficiency programs in member countries in the region. These institutions together with private sector investors are exploring the prospects for high efficiency lighting product



manufacturing and distribution facilities in the region's developing countries.

- Several countries are expanding or planning lighting manufacturing, quality testing and collection/recycling facilities for many types of lamps. Notably, the region hosts globally important manufacturing centers for LEDs. These investments will help the region's economy grow as the global lighting market expands. Having regionally-located facilities also ensures that local programs can address and benefit from all phases of the life cycle of emerging lighting technologies.
- As a global carbon economy develops, with its population of nearly 600 million people, urbanization and strong growth, Southeast Asia could be an attractive area for wealthy countries and investors to explore through carbon development mechanisms (CDM) or other market-based climate change mitigation programs.

Joining the UNEP/GEF en.lighten Global Partnership would help each country leverage international resources and signal a readiness to bring the benefits of efficient lighting to every household, preserve the region's unique environmental assets and tackle climate change.

Information in this draft report is based on interviews and correspondence with energy experts in each country, analyses published by en.lighten, and, databases and energy reports from the United Nations and multilateral institutions such as the Asian Development Bank, the Global Environment Fund, and the World Bank. A bibliography and list of resources and organizations complete the report, along with Appendices that include Country Lighting Assessments and announcements regarding countries in other regions that have joined the en.lighten global partnership.

With input from stakeholders from Southeast Asian countries, the draft report will be updated and posted on the en.lighten website: www.enlighten-initiative.org

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Abbreviations

The following abbreviations are used in this report:

ACE	ASEAN Centre for Energy
ACMECS	Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy
ADB	Asian Development Bank
AHEEER	ASEAN Harmonized Electrical and Electronic Equipment Regulatory Regime
ALC	Asia Lighting Compact
APEC	Asia Pacific Economic Cooperation
AS	Australian Standard
ASEAN	Association of Southeast Asian Nations
B2TE	Energy Technology Center (Indonesia)
BCA	Building Construction Authority
BIS	Bureau of Indian Standards
BIMS-TEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BPPT	<i>Badan Pengkajian dan Penerapan Teknologi</i> (Agency for the Assessment of Application of Technology) (Indonesia)
BPS	Bureau of Product Standards (Philippines)
BPSTC	Bureau of Product Standards Testing Center (Philippines)
BRESL	Barrier Removal to the Cost-Effective Development and Implementation of Energy Efficiency Standards and Labeling
BS	British Standards
BSN	<i>Badan Standardisasi Nasional</i> (National Standardization Agency of Indonesia)
CCT	Correlated Color Temperature
CDM	Clean Development Mechanism
CEO	Chief Executive Officer
CFL	Compact Fluorescent Lamp
CIE	International Commission on Illumination
CLASP	Collaborative Labelling and Appliance Standards Program
CNS	Chinese National Standard (China, Taipei)
CO ₂	Carbon dioxide

COMEXI	External Commerce and Investment Council of Ecuador
COP	Conference of Parties
CRI	Color Rendering Index
DAO	Department Administrative Order
DC	Direct Current
DEDE	Department of Alternative Energy Development and Efficiency (Thailand)
DEFRA	Department of Environment, Food and Rural Affairs (U.K.)
DfE	Design for Efficiency
DGNREEC	Directorate General of New-Renewable Energy and Energy Conservation (Indonesia)
DINAMA	National Direction for the Environment (Uruguay)
DSM	Demand-Side Management
DSM	Department of Standards Malaysia
EASe	Energy Efficiency Improvement Assistance Scheme
EC	European Commission
EDTL	<i>Electricidade de Timor Lorosae</i>
EE&C	Energy Efficiency and Conservation
EGAT	Electricity Generating Authority of Thailand
ELI	Efficient Lighting Initiative
ELSTF	Energy Labelling and Standards Task Force (Brunei)
EN	European Standard
EPR	Extended Producer Responsibility
ESCO	Energy Service Company
ESU	Energy Sustainability Unit
ETTV	Envelope Thermal Transfer Value
EU	European Union
EVN	Electricity of Vietnam
GBI	Green Building Index
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEN	Global Ecolabeling Network
GFA	Gross Floor Area
GHG	Greenhouse gas

GLS	General Service Lamp
GREET	Grant for Energy Efficient Technologies
GWh	Gigawatt-hour
HEPS	High Energy Performance Standards
IA	Implementing Agency
IBRD	International Bank for Reconstruction and Development
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
INMETRO	National Institute of Metrology, Standardization and Industrial Quality (Brazil)
IS	Indian Standards
ISO	International Organization for Standardization
LEO	Low Energy Office
lites.asia	Lighting Information and Technical Exchange for Standards in Asia
KAN	<i>Komite Akreditasi Nasional</i> (National Accreditation Body of Indonesia)
kWh	Kilowatt-hour
LEDs	Light-emitting diodes
MEPS	Minimum Energy Performance Standards
MRA	Mutual Recognition Agreement
MS	Malaysian Standard
Mt	Million (metric) tons
Mtoe	Million tons of oil equivalent
NEA	National Environmental Agency (Singapore)
NLTC	National Lighting Test Centre (China)
NMC	National Metrology Centre (Singapore)
NML	National Metrology Laboratory (Malaysia)
NUS	National University of Singapore
NZS	New Zealand Standard
OLADE	Latin American Energy Organization
PEEP	Philippine Energy Efficiency Project
PELMATP	Philippine Efficient Lighting Market Transformation Project
PEN	<i>Pengelolaan Energi Nasional</i> (National Energy Management)

	(Indonesia)
PILESLAMP	Phase-Out of Incandescent Lamps and Energy Saving Lamps Promotion
PLN	<i>Perusahaan Listrik Negara</i> (State Electricity Company of Indonesia)
PNC-IEC	Philippine National Committee of the IEC
PNS	Philippine National Standards
PPSQF	Philippine Product Safety and Quality Foundation
PREE	Peer Review Mechanism on Energy Efficiency
PROCAEH	<i>Programa de Calidad de Artefactos Electricos para el Hogar</i> (Argentina)
PROMECC	Promotion On Energy Efficiency and Conservation
PSPIP	Power Sector Priority Investment Project
QA/QC	Quality Assurance/Quality Control
REACH	Renewable Energy, Energy Efficiency and Climate Change
RETILAP	<i>Reglamento Técnico de Iluminación y Alumbrado Público</i> (Technical Regulation of General and Public Lighting (Colombia))
RIKEN	<i>Rencana Induk Konservasi Energi Nasional</i> (Indonesia's National Energy Conservation Master Plan)
ROG	Regional Operations Group
RoHS	Restriction of Hazardous Substances
SAMM	<i>Akreditasi Makmal Malaysia</i> (Laboratory Accreditation Scheme of Malaysia)
SANS	South African National Standards
SAR	Special Administrative Region
SARI	Southeast Asia Regional Initiative for Energy
SC	Subcommittee
SEALS	Scientific Environmental & Analytical Laboratory and Services, Inc.
SGLS	Singapore Green Labelling Scheme
SIRIM	Standards & Industrial Research Institute of Malaysia
SNI	<i>Standar Nasional Indonesia</i> (National Standards of Indonesia)
SPRING	Standards, Productivity and Innovation Board (Singapore)
STAMEQ	Directorate for Standards, Metrology and Quality (Vietnam)
TC	Technical Committee
TCVN	Vietnamese Standards



TEI	Thailand Environment Institute
TFET	Trust Fund for East Timor
TIS	Thai Industrial Standards
TISI	Thai Industrial Standards Institute
TV	Television
TWh	Terrawatt-hour
UEM	United Engineers Malaysia
UKAS	United Kingdom Accreditation Service
UNCOMTRA DE	United Nations Commodity Trade Statistics Database
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
USD	United States Dollar
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
VEEPL	Vietnam Energy Efficiency Public Lighting
VNEEP	Vietnam National Energy Efficiency Program
W	Watt(s)
ZEO	Zero Energy Office

1 Introduction

This draft report presents publicly available information on efficient lighting activities worldwide, with an emphasis on 11 countries in Southeast Asia:

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- Save approximately 12 million tonnes of CO₂ emissions each year, or 2.8% of the annual CO₂ for the region.

1.1 Benefits of Joining the *en.lighten* Global Partnership

Throughout the report the benefits of joining the *en.lighten* Global Partnership are emphasized.

The Global Partnership provides an opportunity for countries to work with UNEP *en.lighten* and other nations to achieve a coordinated global transition to efficient lighting. UNEP and its partners will support interested countries to



design and implement National Efficient Lighting Strategies, including relevant policies that will enable their country to make the transition to energy-efficient lighting quickly and cost-effectively.

An integrated approach for designing policy measures will be utilized so that the transition can be sustained by the domestic market without continued external support and integrate environmental sustainability considerations.

The en.lighten Global Partnership will provide targeted technical expertise to support the development of these policies to minimize the time and resources required to implement viable National Strategies and coordinated regional activities. Further, to support participating countries in their actions, en.lighten also is able to offer:

- A comprehensive toolkit based on examples of national best practice and experiences, to promote market transformation at national level, with key factors for success and identified risks;
- Guidance and training materials for governments, private sector and civil society on various lighting related topics (standards development; certification and verification; communication and awareness raising; consumer and environmental protection; and, collection and recycling); and,
- To support research and action, en.lighten offers “Country Lighting Assessments” on its website: www.enlighten-initiative.org.

See Appendix A for the assessments published by en.lighten for eight of the above countries. For news on countries that have declared their commitment to the en.lighten Global Partnership, see Appendix B.

1.2 Main lighting types addressed by the report

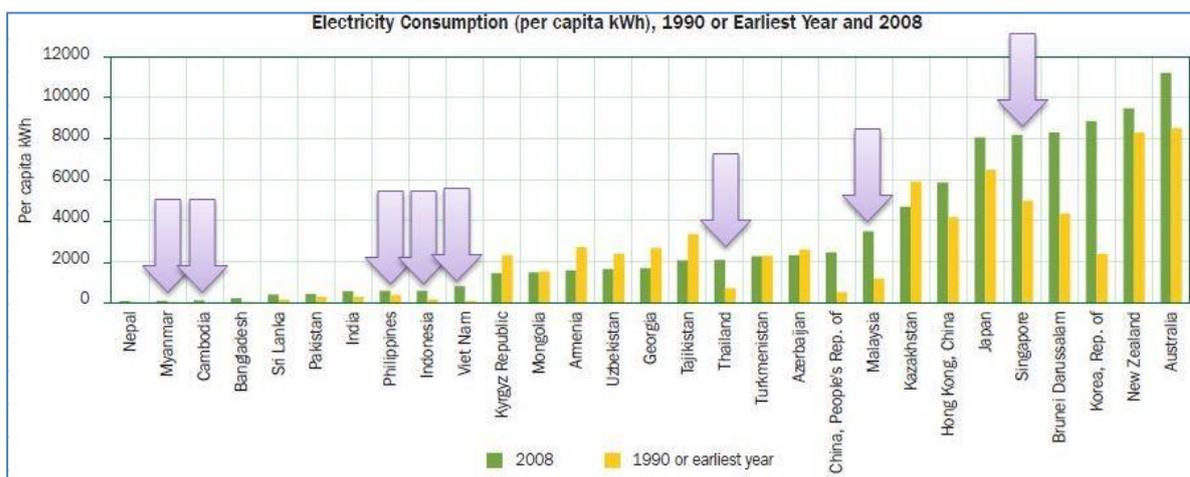
The report is primarily limited to analysis and discussion to lamps, especially those lamps used for “general service” illumination in and around households and public and commercial buildings. Typically these are pin-base, bayonet or screw-base lamps used to illuminate relatively small areas indoors and outdoors. This service is often termed, “ambient lighting.” The most common energy-efficient lamps for this purpose are: compact fluorescent lamps (CFLs) and light-emitting diode lamps (LEDs). Higher-output lamps intended for commercial, industrial and large area outdoor applications are not addressed directly in this report, nor are luminaires (fixtures) or controls (switches).

2 The Advantages of Efficient Lighting

2.1 Efficient lighting delivers good quality service and uses resources effectively

Each point of light may not seem to have a significant impact, but lamps are ubiquitous worldwide. In sum they represent a significant energy use and are responsible for fuel-based emissions that have a global climate impact. Efforts worldwide to increase the energy efficiency of lighting products aim to deliver the same or greater lighting service benefits while reducing electrical and fuel use, reducing peak demand on electrical grids, and reducing costs of operation for users. Overall demand for electricity is increasing, as shown in Figure 1, and so is the demand for electricity for lighting.

Figure 1. Changes in electricity consumption per capita (kWh), 1990—or earliest year available—and 2008. Countries highlighted (with arrow) from left to right: Myanmar, Cambodia, Philippines, Indonesia, Vietnam, Thailand, Malaysia and Singapore. (Source: ADB 2011)



If increased demand for lighting services is met with inefficient technology, then associated emissions increase, consumers spend more on lighting energy and thus have less money available for other goods and services, electrical systems are burdened by lighting demand, and spent lamps create a large amount of solid waste.

Alternatively, if increased demand for lighting services is met with efficient technology (high-efficacy lamps), then associated emissions are reduced, consumers spend less on lighting energy for the same or greater amount of light and thus have more choices of how to spend their cash, and, longer-lasting efficient lamps lower the amount of solid waste related to lighting.

The benefits of promoting high-efficiency lighting are widely accepted as outweighing any risk and/or the costs of inaction. Although commonly referred to as “incandescent lamp phase-out programs,” countries can pursue several strategies under this moniker. One strategy does ban incandescent lamps, and may do so in a step-wise fashion over a period of several years. Typically this

strategy initially bans the sale, distribution and manufacture of the highest wattage incandescent general service lamps (GLS), and then proceeds to ban progressively lower wattage and/or other types of incandescent lamps, such as directional lamps. A second strategy sets technology-neutral minimum efficiency performance standards for all GLS, and sometimes, for other types of lamps, too. Like the first strategy, the second may take a progressive approach over several years, increasing the stringency of the efficiency and quality requirements. Regulations that phase out lamps via either strategy (or via a combination of both) cause the average efficiency of all lamps used in a country to increase over time. Another result of phase-out regulations that include quality assurance measures is that the increased use of innovative and efficient new technology delivers better service, to more people, at a lower lifetime cost.

Many Southeast Asian countries have large opportunities to take advantage of the benefits of efficient lamps. Both population growth and the strong trend toward urbanization increases lighting demand. As countries seek to improve lives and economies, lighting can enhance literacy and productivity. As rural residents move into and around cities, they seek modern, well-illuminated environments, especially as their income increases. Refurbishment or replacement of large areas of older building stock with new, multi-story buildings gives local governments and developers the chance to install fixtures that use efficient lamps.

2.2 Efficient lighting can be a cost-effective tool and a rapid means for tackling climate change and environmental objectives

Several of the countries in this study have decades of experience with manufacturing, distributing and applying high-efficiency lighting. Departments responsible for energy, environment and climate are aware that lighting is a familiar and accessible tool for meeting climate change program objectives. Lamps are relatively simple to deploy and they deliver immediate benefits.

Lighting influences the global climate and environment in three significant ways:

- Light from electrical appliances is associated with emissions of carbon dioxide and other greenhouse gases released from the burning of fossil fuels to create electricity.
- Burning fossil fuel also emits black carbon (soot). If not removed at the power plant, black carbon emitted into the atmosphere absorbs infrared radiation, increasing atmospheric temperatures. When deposited on snow, black carbon accelerates glacial and polar ice melts (US AID 2010)¹.

¹ “Black carbon in soot is the dominant anthropogenic absorber of incident solar radiation in the atmosphere – it is approximately 1 million times stronger than CO₂ per mass unit of mass – and contributes to the warming of the atmosphere at the global level. Black carbon also warms the atmosphere by absorbing thermal infrared radiation from the ground and within clouds. Furthermore, because it directly heats surfaces on which it is deposited and changes surface albedo (surface reflectivity), black carbon is a major contributor to the accelerated melting of Arctic sea and land ice, glaciers and seasonal snow covers.” (US AID 2010)



- Lighting manufacturing, distribution, use and end-of-life disposal involves some materials that are toxic.

Lighting represents a significant demand of energy resources, as summarized by en.lighten: “Using current economic and energy efficiency trends, it is projected that global demand for artificial light will be 60% higher by 2030 with a great deal of that linked to the construction and operation of new buildings in developing economies...” By 2003, artificial lighting required the “equivalent of approximately 650 million tons of oil equivalent (Mtoe), which was equivalent to 8.9% of total global primary energy consumption.” “The International Energy Agency estimated that in 2007 total electricity consumption for lighting was 2,650 TWh. This represents almost 19% of global electricity use.” Furthermore, without action to increase the efficiency of lighting technologies and mandate their use, “global lighting electricity demand will reach almost twice the output of all modern nuclear power plants, amounting to 4,250 TWh...” Osram, one of en.lighten’s industrial partners, notes that, “Over one-third of the electricity used worldwide for lighting today could be saved. Seizing this opportunity would also impact atmospheric emissions, because “globally, lighting-related CO2 emissions are estimated at 1,900 million tons (Mt) of CO2, equivalent to approximately 8% of world emissions.” (UNEP 25 September 2009).

The most recent forecast for global lamp sales, based on a model that accounts for the expected trend toward use of more efficient lamps, gives a sense of the tremendous volume of lamps sold. This forecast also estimates the numbers of lamps at end of useful life that will enter the solid waste stream.

Table 1. Forecast of Lamp Sales and Lamps Entering the Waste Stream, 2011 and 2020.

General Service Lamps (GLS), by Light Source	2011 (millions)	2020 (millions)	Change (%)
Sales: incandescent and halogen-incandescent	9607	3482	-63.8%
Sales: compact fluorescent	4142	5375	29.8%
Sales: light-emitting diode	453	2827	524.1%
Entering waste stream: incandescent and halogen-incandescent	11239	3660	-67.4%
Entering waste stream: compact fluorescent	2088	5063	142.5%
Entering waste stream: light-emitting diode	6	1320	21900.0%

Source: Jeffcott, forthcoming.

The transition to efficient lighting has implications for the type and quantity of waste materials that should be anticipated. Lamps contain materials that at several points in the product life cycle (extraction and processing of materials, manufacturing, direct use, and end-of-life disposition) may have an environmental impact. Whether incinerated, placed in a sanitary landfill, or discarded in an informal waste location, lighting materials and products can pose

hazards. Materials of concern include but are not limited to: mercury, lead and plastics. Using best-practice manufacturing and distribution limits the impact of materials during manufacturing and transport. At the end of useful life, collection and recycling programs can reduce local environmental impact from spent lighting products.

Table 2. Countries taking action to address lamps and related hazardous wastes

Country	Lamp and Hazardous Waste Activities
Argentina (2)	Processing a regulation requiring manufacturers and importers to collect and recycle CFLs.
Brazil (2)	Law #12,305 of 2 August 2010, National Policy on Solid Waste, makes manufacturers, distributors and disposal companies responsible for handling hazardous materials. Ministry of Environment plans to regulate collection and recycling for efficient lamps.
Cuba (2)	Collects linear fluorescent lamps. Planning a CFL collection system and considering reducing price of a CFL if customer turns in spent and unbroken CFL.
Ecuador (2)	Ministry of Environment is starting a CFL waste management program.
European Union	Reduction of Hazardous Substances (RoHS)
Philippines	Plans to build a lamp waste treatment facility to process 6 million lamps annually.
Uruguay (2)	"Rational Management of Mercury-containing Products in Uruguay", coordinated by the National Direction on the Environment (DINAMA), along with UNEP, UNIDO and the Basel Center in Uruguay.
USA	Large quantities of fluorescent lamps must be treated as hazardous waste. Numerous local laws pertain to CFLs.

Sources: (1) en.lighten country lighting assessments; (2) UNEP/OLADE 2011; (3) UNEP 2011; (4) Jeffcott, forthcoming.

International environmental conventions set the stage for action to reduce the use of inefficient lamps and retire outmoded technology in favour of high-efficiency, higher quality lighting. Some of the international agreements spurring changes in the lighting industry are shown in the table below. Southeast Asian countries have made strong commitments to address climate change by reducing emissions, and, to protect the environment by controlling wastes.



Table 3. International convention participants in Southeast Asia, by country. (Source: UN)

International Conventions	Brunei	Cambodia	Indonesia	Laos	Malaysia	Myanmar	Philippines	Singapore	Thailand	Timor-Leste	Vietnam
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	X	X	X		X		X	X	X		X
Kyoto Protocol to the United Nations Framework Convention on Climate Change		X	X	X	X	X	X	X	X	X	X
Montreal Protocol on Substances That Deplete the Ozone Layer	X	X	X	X	X	X	X	X	X		X
United Nations Framework Convention on Climate Change	X	X	X	X	X	X	X	X	X	X	X



3 Obstacles to Promoting Efficient Lighting

In nearly any field of technology, risk aversion and comfort with the status quo are barriers to adoption of new technology, unless the new technology offers exciting, value-added services. Efficiency in itself is somewhat conceptual and not tangible enough to stimulate most buyers and users. Like larger appliances and building systems, some of the benefits of efficient lighting, like lower operating costs, are only apparent if the buyer or user considers an economic proposition, such as calculating return on investment.

High efficacy lamps typically have a higher first cost than conventional lamps. For a buyer or user to appreciate efficient lighting's climate change potential would require encouragement from a trusted authority, product education, and sometimes, financial assistance.

3.1 Need for product quality assurance systems

For a buyer or user to be satisfied with a new product, the product must perform as well or better than expected. For efficient lighting program success, all parties promoting the new products must set reasonable expectations. If anyone in the supply chain fails to deliver a reliable product that performs as promised, the resulting negative experiences can be very difficult to overcome. Retrospectively we have documented the struggles of CFL introduction and promotion programs, and can attribute many of the challenges to poor product performance and exaggerated performance claims.

From decades of lighting market transformation experience we know that requiring best-practice quality management in manufacturing along with accuracy-in-labelling are essential for program success. All regulations pertaining to phase-out programs should include at least three elements: performance standards; testing protocols to verify performance; and, enforcement mechanisms.

Establishing an effective compliance regime is one key means of improving the impacts of standards and labelling programs. Monitoring, verification and enforcement programs help to deliver more energy savings and reduced emissions of greenhouse gases, all of which will have been defined in existing standards and labelling programs but which can only be truly verified through compliance activities. Achieving high rates of compliance brings benefits to all stakeholders, such as:

- Consumers: reducing energy costs by being able to buy and use quality products at fair prices;
- Governments: achieving key environmental and economic policy objectives.
- Industry: operating in a fair market encourages investment and technological innovation;



For guidance on setting up measurement and verification programs, refer to the en.lighten toolkit (UNEP, forthcoming).

3.2 Information concerning the real “price” of efficient lighting

First cost is not the only element in the economics of delivering efficient lighting services. Although conventional incandescent lamps have a low initial cost, they require electricity to operate. Conventional lamps also have a relatively short useful life (less than 1000 hours), and thus must be replaced more frequently than efficient lamps that can operate for several thousands to tens of thousands of hours. The amount of electricity and replacement cost savings garnered by using efficient lamps may not be obvious to the user, depending on how electrical service is billed.

The cost of electricity also includes the losses incurred in the electrical distribution system. Generating electricity for lighting has material, operational and environmental costs. Finally, at end of useful life, the lamp has a disposal or recycling cost. Communicating the sum of the obvious and hidden costs of lighting is challenging but achievable through public information campaigns, product information, and financial tools (such as return-on-investment calculators). Often government agencies and/or electric utilities deliver information to the public and to customers about lighting technology and efficiency options.

3.3 Divided (split) incentives

Many parties benefit from the promotion, purchase, installation and use of efficient lamps. Sometimes the benefits are spread amongst the parties, but are not apparent to all involved. The most obvious case of divided incentives in residential lighting is in a multi-tenant building where the owner or operator installs inefficient lighting, but the tenants must pay the electrical costs. By working with a tenant advocate, the building owner/developer/landlord could be encouraged to install more efficient lighting, and thus be able to offer an added savings value to tenants. This is also a case where third parties, such as energy service companies, can offer financing or shared savings schemes that address the barrier of higher first cost while still delivering savings to the tenants.

3.4 Perceived risks of new lighting technologies

Although the energy efficiency and climate benefits of high efficiency lamps are well-documented, some people and organizations believe that there are risks associated with the use of CFLs and LEDs. These risks are widely debated in the news media and online, particularly for CFLs due to their mercury content, but often the risks are overstated or not supported by evidence. In all cases, however, risks should be weighed with benefits, and evaluated with regard to the situation in which the product will be used. Concerns include but are not limited to:

- Greater first cost of the product;
- Product reliability and length of life;



- Exposure to specific wavelengths of energy, radiant intensity and dynamic effects of light produced by the lamps and electronic gear;
- Exposure to toxic materials, such as mercury, lead and plastics; and,
- Form and aesthetics (size, weight, style).

4 Global Moves to Phase-Out Inefficient Lighting

Many countries have already begun to increase the stringency of their lighting minimum energy performance standards, with the intent of phasing out the least efficient light source technologies. Other countries are developing (or plan to develop) similar regulations. Most countries do not enact outright bans on incandescent lamps as a technology *per se*. Depending on the stringency of its regulations, a country may allow lamps that utilize halogen-incandescent, CFL, LED or other light sources. Halogen-incandescent lamps cost more than regular incandescent lamps but offer higher efficacy. Generally, CFLs deliver more lumens (quantity of light) per monetary unit than do the other light sources. Eventually, the lighting industry expects that LEDs will compete as a high-efficacy and cost-competitive source. Recognizing that industry will continue to improve the efficacy of light sources, some countries adopt regulations that gradually increase efficacy requirements over time.

Table 4. Southeast Asian countries with efficient lighting policies in place.

Southeast Asia	Efficient Lighting Activities and Policies in Place
Indonesia (1)	The government of Indonesia is currently strengthening existing major CFL promotional programs. Currently no mandatory performance standards for CFL or other lamp types exist however a voluntary labelling program based on a locally derived lumen/watt based energy efficiency index entered into force in 2008.
Malaysia (1)	At the UNFCCC COP-15 in December 2010, the Malaysian Government committed to reduce carbon intensity by 40% by 2020. The phase-out of incandescent lamps, to be implemented in two phases, is a cornerstone of this policy. The first phase, from January to December 2011, involves stopping all production, import and sales of >100watt bulbs. The second phase, from January 2012 till the end of 2013, will end the production, import and sales of all other light bulbs. In March 2010, the Minister of Energy and Water announced the intention to stop all production, import and sales of incandescent light bulbs by or before January 2014.
Philippines (1) (4)	In February 2008, the President of the Philippines called for a ban of incandescent lamps by 2010. Legislation is not yet in place for a ban, but labelling has been required since 2002. Philippines National Standard IEC 969-1988. Self-Ballasted Lamps for General Lighting Service. Amendment 1: Performance requirements. Amendment 2: Performance requirements. Department of Trade and Industry, Bureau of Product Standards (BPS).
Thailand	TIS 2310-2549 (2006): Self Ballasted Lamps for General Lighting Services: Energy Efficiency Requirements.
Vietnam (1)	A Mandatory Minimum Energy Performance Standard for CFL has been in place since 1999. To complement this, the UNDP implemented and GEF financed Vietnam - Energy Efficiency Public Lighting (VEEPL) Project (VEEPL) project is aimed at building both technical and policy support for transition to more energy efficient public lighting. UNEP presently supports Vietnam to promote a large scale market transformation towards efficient lighting with GEF financial assistance.

Sources: (1) UNEP *en.lighten* country lighting assessments; (2) interviews for this study.

Table 5. Rest of world countries with efficient lighting policies in place.

Rest of World (Source)	Efficient Lighting Policies in Place
Argentina (2) (4)	2003: Programa de Calidad de Artefactos Electricos para el Hogar (PROCAEH) – CFLs. Secretariat of Industry, Commerce and Mining, IRAM, Insituto Argentino de Normalización ("Argentine Standards Institute"). January 2009: Law #26,473 bans import and sale of incandescent lamps >25W as of 31 December 2010. PRONUREE decree #140/07 implements efficiency, technical and quality requirements for CFLs and a mandatory labelling system.
Australia (4)	AS/NZS 4847.2-2010: Self-ballasted lamps for general lighting services, Part 2, MEPS (2 nd Edition).
Bolivia (2)	Articulating a legal framework to phase out gradually the import of incandescent lamps, through customs tax increases for incandescent lamps and decreases for efficient lamps. Plans to establish quality standards and technical regulations through a certification and verification institution.
Brazil (2) (4)	Etiquetagem Resp/010 Luz Regulamento de Avaliacao da Conformidade de Lampadas Fluorescentes Compactas com Reator Integrado,13-05-2004, p 20. National Institute of Metrology, Standardization and Industrial Quality (INMETRO). Decree #1,007 of December 31, 2010, established MEPS based on the Energy Efficiency Law. Begins June 30th 2012 with the phase out of incandescent lamps of >150 W and ends 2016 with >25W lamps. Mandatory label: Stamp Procel de Economia de Energia (Energy Efficiency Stamp) for CFLs.
Chile (2) (4)	Banned incandescent lamps in January 2011. National Energy Efficiency Certification and Labelling Program, 2005. Normas NCh 3020 Of.2006 de Eficiencia energética - Lámparas fluorescentes compactas, circulares y tubulares de uso doméstico - Clasificación y etiquetado. IEC 60969/2001 - Lámparas con balasto incorporado para iluminación general – Requisitos de desempeño. Fuente Legal - Decretos N° 298 de 2005 y N° 399 de 1985, y sus modificaciones del Ministerio de Economía, Fomento y Reconstrucción.
China, Hong Kong (4)	CFL MEPS as of 2009.
China, Peoples Republic (4)	Revising CFL MEPS.
China, Taipei (4)	CNS 14125
Colombia (2) (4)	Rational and Efficient use of Energy: MEPS for CFLs. RETILAP, Reglamento Técnico de Iluminación y Alumbrado Público. ("Technical Regulation of General and Public

Rest of World (Source)	Efficient Lighting Policies in Place
	Lighting”). Resolution 180540, March 30, 2010, p. 48.
Costa Rica (2)	Law #7447 Regulation of the Efficient Use of Energy establishes MEPS for CFLs.
Cuba (2)	Banned import and sales of incandescent lamps, in 2005. Ministry of Basic Industry of Cuba endorsed Resolution #136, 2009, established CFL requirements.
Ecuador (2)	2010 Resolution, External Commerce and Investment Council of Ecuador (COMEXI) prohibits import of 25W to 100W incandescent lamps for residential use and eliminates customs tax for A-type CFLs. Technical Ecuadorian Regulation RTE INEN 036 “Energy Efficiency, Compact Fluorescent Lamps: Energy Performance Ranges and Labelling” permits commercialization of only A and B types of CFLs.
European Union (4)	COMMISSION REGULATION (EC) No 244/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional household lamps. “DIRECTIVE 2010/30/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products.” (EC 2010)
Ghana (4)	Ghana Standard GS 324:2003: L.I. 1815 Energy Efficiency Standards and Labelling (Non Ducted Air Conditioners and Self-Ballasted Fluorescent Lamps) Regulations, 2005.
Honduras (2)	Banned the import of incandescent lamps as of 1 January 2010. The Law on the Rational Use of Energy will establish the labelling of efficient appliances.
India (4)	IS 15111: 2002 Self Ballasted Lamps for General Lighting Services, Part I 1 Performance Requirements. BIS issued Amendment No.1 in April 2003 for Certificate Marking.
Mexico (2)	Official Mexican Regulation of December 2010 (NOM- 028 – ENER – 2010 Energy Efficiency of Lamps for General Use), bans >100W incandescent lamps for the residential sector as of December 2011; >75W as of December 2012; 40W and 60W as of December 2013; all by 2015. Official Mexican Norm sets minimum quality and security standards for CFLs (NOM-017-ENER/SCFI-208).
Korea, Republic of (4)	CFL MEPS.
Lebanon (3)	Energy Conservation Law supports use of CFLs. National Energy Efficiency Action Plan (2011-2015) will ban import of incandescent lamps by end of 2012.
Nicaragua (4)	NTON 10-008-08, January 29, 2009.

Rest of World (Source)	Efficient Lighting Policies in Place
Peru (2)	Plans to eliminate incandescent lamps by 2018.
South Africa (4)	ICS 29.140.30. VC 9091 Ed. 1. Single-capped fluorescent lamps. Published by Government Notice No. R. 348 (Government Gazette No. 33152) of 7 May 2010 [Amendment published by Government Notice No. R. 1229 (Government Gazette No. 33897) of 24 December 2010]. Effective dates 1 February and 1 August 2011. Annex AA of SANS 60969, Self-ballasted lamps for general lighting services – Performance requirements.
Tunisia (3)	Phase-out of incandescent lamps adopted in 2007, includes: consumption tax on incandescent lamps to reach 50 % in 2011; Prohibiting the local production of incandescent lamps (completed in 2010); and, gradual phase-out: 2011: incandescent lamps $\geq 100W$; 2012: lamps 75W & 60W; and, 2013: 40W & 25W.
Uruguay (2)	April 1, 2010, mandatory efficiency labels for CFLs (Decreets numbers 429/009 and 428/009). A mandatory label for incandescent lamps is expected in 2012. Label will establish MEPS.
United Kingdom (4)	See European Union, above. Also, 09/30204072 DC BS EN 62612. Self-ballasted LED-lamps for general lighting services > 50 V. Performance requirements.
United States of America (4)	Energy Independence and Security Act of 2007, section 321, Efficient Light Bulbs.

Sources: (1) en.lighten country lighting assessments; (2) UNEP/OLADE 2011; (3) UNEP MENA 2011; (4) PILESLAMP, forthcoming.

5 The en.lighten initiative: Objectives and Partnership Program

5.1 Objectives

The UNEP en.lighten initiative was established and launched in 2009 to promote, accelerate and coordinate global efforts to push for efficient lighting. It seeks to accelerate the global commercialization and market transformation of efficient lighting technologies by working at global level and provide support to countries. In doing so it aims at strengthening capacities among governments, private sector and civil society to lead successful lighting market transformation programs.

Electricity for lighting is responsible for 19% of total end use electrical consumption and for 6% of global greenhouse gas (GHG) emissions. This equals to the combined emissions from Germany and Japan. Over the next 20 years [from 2005 to 2025] global electricity consumption for lighting is expected to increase by 60% (IEA 2006). Shifting to efficient lighting technologies would cut the world share of electricity used for lighting from 19 to 7%. This would save enough electricity to close 705 of the world's 2 670 coal-fired plants. (Brown 2009)

Activities aimed at phasing out inefficient technologies have been increasingly introduced in recent years, yet market forces are not sufficient to achieve rapid lighting market transformation, especially with the urgent need to reduce emissions posed by climate change. Experiences throughout the world point to the need to coordinate global efforts and provide technical support to assist countries in introducing efficient lighting transformation programs.

5.2 The en.lighten Global Partnership Program, Country Support and Outcomes

The United Nations Environment Programme (UNEP) is the overall coordinator of the en.lighten initiative. The Global Environment Facility (GEF) Earth Fund provides financial support, Philips Lighting B.V. , OSRAM AG and the National Lighting Test Centre of China provide specific industry level expertise. A Project Steering Committee composed of project partners and collaborating agencies including UNDP, UNIDO, the World Bank and other relevant partners provides strategic guidance and overall support for project implementation.

The en.lighten initiative website offers news, resources such as the regional reports and country lighting assessments. The en.lighten Global Partnership is expected to deliver the following key outcomes through a multi-stakeholder and participatory process:

- A consensus based roadmap for global lighting market transformation providing a global pathway to phase out obsolete technologies and introduction of new energy efficient ones, including key policy and technical decisions to orient country action;
- A set of guidelines for harmonization efforts to be undertaken on global quality, performance-based standards and certification procedures for energy-efficient lighting products;



- A comprehensive toolkit based on examples of national best practice and experiences, to promote market transformation at national level, with key factors for success and identified risks;
- Guidance and training materials for governments, private sector and civil society on various lighting related topics (standards development, certification, verification, communication and awareness raising, consumer and environmental protection, recycling, etc.);
- Country lighting assessments offered to interested countries providing key information outlining technology options, economic savings and GHG reduction potential that could be gained with efficient lighting;
- Support to national and regional level strategies and policy decisions reflecting the international consensus policy and at quality enhancement level; and,
- A model mercury impact reduction and end of life treatment strategy.

To ensure that the transition to efficient lighting is effective and self-sustaining the en.lighten initiative is committed support partner countries joining the Global Partnership to design and implement a cohesive set of national and regional actions – known as the *integrated policy approach* to efficient lighting, including:

- 1) **Minimum Energy Performance Standards (MEPs)** – establish basic parameters to ensure the efficiency and quality of products. MEPs constitute the cornerstone of a successful and effective transition.
- 2) **Supporting Policies and Mechanisms** – help restrict the supply of inefficient lighting and promote the demand for MEPS- compliant products. These mechanisms, developed in accordance with a country's existing situation and requirements, include: Regulations, Economic and market-based mechanisms, Fiscal mechanisms and incentives, Information, communication and voluntary actions
- 3) **Monitoring, Verification and Enforcement (MVE)** – discourages the distribution of non-compliant products through: inspections, product testing, accreditation, fines and/or other relevant means.
- 4) **Environmentally Sustainability and Sound End of Life Approaches** – setting maximum hazardous content limits to safeguard health and the environment; guidelines on the use of lighting products; as well as, plans for the collection, environmentally sound disposal and/or recycling of bulbs. This will be adapted to unique country requirements.

Ongoing en.lighten task forces include:

- Country lighting assessments, market data and analyses;
- Policy, regulation and finance;
- Consumer, environmental protection and recycling; and,
- Off-grid lighting.



Regional stakeholder meetings and draft en.lighten reports to date include:

- Latin America and the Caribbean. Santo Domingo, Dominican Republic, August 2011.
- Middle East and North Africa. Beirut, Lebanon: September, 2011.
- Southeast Asia. Singapore: November, 2011.

Declarations of intent were issued at the first two meetings. See press releases in Appendix B.

The desired outcome of the regional stakeholder meetings is to extend The Global Efficient Lighting Partnership Program to more countries. This is an unparalleled opportunity to work with UNEP en.lighten and other countries to achieve a coordinated transition to efficient lighting. Participation can assist countries to identify mutual barriers and may reveal opportunities to combine resources to set more aggressive goals. Coordinating regional activities encourages the availability of high quality products at acceptable prices and helps build a self-sustaining market for efficient lighting.

6 Estimated Benefits of the Phase Out of Inefficient Lamps in Different Countries of Southeast Asia

Southeast Asian countries have great diversity in country sizes, populations, urbanization, development and electricity production and access. Consequently, the individual benefits from the phase out of inefficient lamps within a specific country vary. However, *all* countries within the region would be able to significantly reduce lighting energy consumption with a payback period on all the investment for transformation of less than two years, often substantially shorter, as shown in Table 6.

By replacing all inefficient incandescent GLS with CFLs, Southeast Asia could obtain annual energy savings of 16.52 TWh, approximately 3% of the 2009 base case. On average, the region would garner annual energy plus cost savings of 74%. Some countries would benefit greatly from these savings. In particular, Indonesia could save over 10 TWh by converting to efficient lamps.

Annual carbon dioxide emissions for the region total 971 Mt. After transitioning to efficient lighting, nearly 12 Mt of emissions could be avoided, for a close to 3% annual savings. Individual countries may not have large emissions savings, but the benefits that could accrue to the region could be significant. In the future, as the region continues to develop and support a larger population, installing efficient lighting now could help achieve regional climate change goals.

Regional annual financial savings from transitioning to efficient lamps total could exceed 1.6 billion USD, at a roughly equivalent cost, yielding an amortization time of one year on average. Countries that could achieve a faster amortization include Cambodia, Malaysia, Philippines and Singapore.

Two recent en.lighten regional meetings have found significant opportunities to phase out inefficient lamps.

“In the 20 countries from Latin America and the Caribbean analyzed, 4% of total electricity consumption would be saved if incandescent lamps were substituted with CFLs. This totals US\$4 billion per year of savings for consumers in energy bills, and the equivalent carbon emissions of 4 million cars.”
(UNEP, 4 August 2011)

“In the 19 countries from the Middle East and North Africa analyzed, electricity consumption is over 925 TWh producing about 1.994 million tons of CO₂ per year. Phasing out inefficient lighting in the region would save nearly 31.8 TWh of electricity (an average of 5.5%) and slash 19.9 Mt of CO₂. This is equivalent to removing about 5 million vehicles off the road.”
(UNEP, 30 September 2011)

Table 7 compares the opportunities for savings in Southeast Asia and Latin America/Caribbean and the Middle East/North Africa.

Table 6. Lighting energy use and savings estimates: before and after phase-out of inefficient incandescent lamps, by country, 2009 base year, assuming 100% replacement with CFLs.

Factors	Total Population	Annual Energy Savings with Efficient Lamps	Annual Energy and Cost Savings	Total National Annual CO2 Emissions (before transition)	Annual CO2 Emissions Avoided with Efficient Lamps	Annual CO2 Emissions Avoided	Annual Financial Savings	Estimated cost of transition to efficient lighting	Amortized time of transition cost
Units	(Millions)	(TWh)	(%)	(Mt/year)	(Mt/year)	(%)	(USD million)	(USD million)	(years)
Brunei (3)	0.4	0.02	77	3.5	0.01	0.3	2.0	1.5	1.0
Cambodia (1)	15.0	0.50	73	4.4	0.60	13.0	76.0	49.0	0.6
Indonesia (1)	232.5	10.20	73	377.2	8.00	2.1	1015.0	1051.0	1.0
Laos (1)	6.4	0.20	77	1.4	0.20	5.8	16.0	16.0	1.0
Malaysia (1)	27.9	0.90	77	177.0	0.60	0.3	101.0	75.0	0.7
Myanmar (1)	50.5	0.30	65	12.4	0.10	0.7	18.0	31.0	1.7
Philippines (1)	93.6	1.70	77	71.8	0.80	1.2	180.0	117.0	0.6
Singapore (3)	5.08	0.09	77	3.6	0.04	1.2	9.0	5.9	0.6
Thailand (1)	68.1	0.90	73	226.0	0.50	0.2	65.0	100.0	1.5
Timor-Leste (2)	1.2	0.01	77	0.2	0.01	5.2	1.1	2.0	1.7
Vietnam (1)	89.0	1.70	73	93.6	1.00	1.1	174.0	180.0	1.0
Total	589.7	16.52	75	971.1	11.86	2.8	1,657	1,628	1.0

Sources: (1) UNEP en.lighten country lighting assessments; (2) forthcoming en.lighten country lighting assessment; (3) authors' estimates, based on (1) and (2).

Table 7. Comparison of three regional lighting savings profiles: Southeast Asia, Latin America/Caribbean; and Middle East/North Africa.

Region	Total Population (2010)	Total Annual Energy Savings with Efficient Lamps	Total Annual CO2 Emissions (before transition)	Total Annual CO2 Emissions Avoided with Efficient Lamps	Average Annual CO2 Emissions Avoided	Total Annual Financial Savings	Total Estimated Cost of Transition	Amortized time of transition cost
Units	(Millions)	(TWh)	(Mt/year)	(Mt/year)	(%)	(USD million)	(USD million)	(years)
Southeast Asia	589.7	16.52	971.1	11.86	2.8	1,657	1,628	1.0
Latin America & Caribbean (1)	569.8	37.4	1391.6	16.4	1.2	4,329	3,332	1.0
Middle East & North Africa (2)	508.4	31.8	1994.4	20.0	1.8	2,252	2810	1.7

Sources: (1) UNEP/OLADE 2011; (2) UNEP MENA 2011.



7 National Initiatives in the Southeast Asian Region that Encourage Transitions to Efficient Lighting

The information in this section comes from publicly available data and information published by governments, the private sector, international organizations and researchers. The authors distributed a short questionnaire to experts and institutions in Southeast Asia. (See Appendix C.) Respondents also reviewed information that had already been collected by the authors, to assure accuracy.

All eleven countries investigated in this study have begun to address the issue of inefficient lighting. The extent of their efforts varies, with Indonesia, the Philippines, Thailand and Vietnam being the most active. The formal phase-out of inefficient lighting has been announced in Malaysia and the Philippines. Laos and Thailand state that they intend to phase out inefficient lighting in the future. Vietnam intends to gradually restrict and remove products not meeting performance requirements.

Most countries have performance testing standards in place, but only Indonesia and Thailand have mandatory minimum energy performance standards. Eight countries have either mandatory or voluntary labels in place for at least some lighting products. Awareness raising campaigns on energy efficiency and conservation have been implemented in all but Myanmar and Timor Leste, but in some cases no information is available on the extent to which these activities specifically included energy efficient lighting.

Philippines, Thailand, Timor Leste and Vietnam have had bulk distribution programs for CFLs. End-of-life initiatives for the collection, recycling or disposal initiatives for lighting products have been implemented only in Thailand, which regulates the disposal of CFL waste from commercial and industrial premises. A pilot lamp waste management facility with a capacity of six million lamps per year will be procured under the Philippine Energy Efficiency Project (PEEP). National lighting testing facilities are available in six countries: Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam.



Table 8. Standards, labels, quality and sustainability approaches to promote efficient lighting, by country.

Country	Mandatory Minimum Energy Performance Standards	Labels		Energy Performance Testing Standards	National Lighting Testing Laboratory	Sustainable End of Life
		Mandatory	Voluntary			
Brunei				x		
Myanmar			x	x		
Cambodia				x		
Indonesia	x	x		x	x	
Malaysia			x	x	x	
Philippines		x		x	x	planned
Singapore			x	x	x	
Thailand	x		x	x	x	x
Vietnam			x	x	x	

Table 9. Supporting policies and mechanisms to promote efficient lighting, by country.

Country	Energy Efficiency Building Code	Subsidies/ Soft Loans	Tax Credits/ Tax Reduction	Voluntary Agreements	Bulk Distribution	Awareness Campaigns
Brunei	x					x
Cambodia						x
Indonesia	voluntary	x				x
Laos						x
Malaysia	x		x			x
Philippines		x			x	x
Singapore	x	x	x			x
Thailand	x	x		x	x	x
Timor Leste					x	
Vietnam	x	x			x	x



7.1 Brunei Darussalam

The overall energy efficiency goal of Brunei Darussalam is to reduce energy intensity by 25% in 2030 with 2005 as the base year. Their energy efficiency and conservation Strategic Plan aims to improve the energy efficiency and conservation of Brunei by promoting and implementing energy efficiency and conservation practices and activities. It includes components to introduce energy efficiency labelling for electrical equipment and appliances and to promote the use of energy efficient lighting.

Brunei has made strides in the promotion and awareness of energy efficiency and conservation through the Energy Division of the Prime Minister's Office since its establishment in 2005 and the importance of switching to energy efficient lighting in achieving this goal has been acknowledged. However, no information has been identified on whether Brunei has an intention to phase-out inefficient lighting. (Energy Department Prime Minister's Office, Brunei Darussalam, 2011).

Brunei participates in the ASEAN-Japan, *Promotion on energy efficiency and conservation (PROMEEC)* program activities. However, no details of specific activities, or the extent to which they included lighting themes, are available.

The Energy Labelling and Standards Task Force (ELSTF) in the Energy Division of the Prime Minister's Office formed in September 2008 to further promote energy efficiency and conservation practices in Brunei. It comprises representatives from the Energy Division, Prime Minister's Office, the Department of Technical Services, Public Works Department and the Department of Electrical Services.

7.1.1 Regulatory and Control Mechanisms

7.1.1.1 Test Method and Performance Standards

Brunei has been a member of the IEC Affiliate Country Programme since 2001 but does not take part in either TC34 (Lamps and Related Equipment) or SC34A (Lamps). However, in 2010, Brunei adopted six IEC test method standards relating to the safety and performance specification of lighting products, including performance specifications for double- and single-capped fluorescent lamps and ballasts for tubular fluorescent lamps. These are now in their introductory phase and will become mandatory in March 2012.

7.1.1.2 Building Codes

In March 2008, it was announced that the Energy Division of the Prime Minister's Office would work with the Ministry of Development to incorporate energy, efficiency and conservation features into the existing National Building Code, including provision for encouraging the design of buildings with efficient use of natural lighting. No information is available on the current status of this initiative.

7.1.2 Support, Information and Voluntary Action

Information on energy efficiency and conservation is continuously disseminated through briefings and talks, seminars and workshops, booklets and posters, the official website and the media. Funding is provided by the government and the private sector, for the Energy Week annual event, EEC-related workshops and EEC initiative awards.



However, limited information regarding the specific activities undertaken and the extent to which they incorporated lighting themes is available.

7.1.2.1 Energy Labelling

Brunei's Energy Labelling Scheme is intended to inform consumers about the level of energy efficiency of an electrical product and thereby encourage these better informed consumers to invest in energy efficient appliances for long-term gains. The scheme is operated by the Energy Labelling and Standards Task Force (ELSTF) and is designed to harmonize with other schemes in the region with similar electrical operating parameters and climatic conditions. It was launched in May 2008 on a voluntary basis for single-phase non-ducted room air conditioners. It is intended that the scheme will be extended to other products at a later stage, although no information is available on whether this is likely to include lighting products.

7.1.2.2 Awareness Raising

During Energy Week in September 2007, a total of 10,000 CFLs were distributed to the public as part of Brunei's general awareness raising activities to encourage the use of these lamps.

7.2 Cambodia

Cambodia currently has no plans to phase-out incandescent/low efficiency lamps. However, energy efficiency and conservation is considered an important component of sustainable energy development in Cambodia and there is intent to develop a national strategy to address this. Lighting is seen as a major opportunity for demand side management and some measures are in place to regulate lighting products.

7.2.1 Regulatory and Control Mechanisms

There are no voluntary or mandatory standards, rules or regulations regarding the use of energy or sale of energy efficiency products. (Phimphachanh 2010) However, a regulatory framework exists for the *Safety Label for Electric and Electronic Household Products* which could facilitate this.

In September 2006, the Ministry of Industry, Mines and Energy adopted Prakas No. 1003, *Determination of types of electrical and electronic products to be complied with Cambodian industrial standards as mandatory standards*, which determines that the types of electrical and electronic products produced in the country and imported from foreign countries to use and market in Kingdom of Cambodia shall comply with the mandatory standards specified in the Prakas. It further specifies that manufacturers and companies that produce or import the products listed shall use the Cambodian standard mark on their products after receiving a license for its use from the Ministry of Industry, Mines and Energy before marketing in Kingdom of Cambodia.

These mandatory standards have been established by adopting the relevant IEC test method standards. This includes performance specifications for double-capped fluorescent lamps and tungsten filament lamps for general lighting service; safety requirements for tungsten filament and self ballasted lamps for general lighting service (CFLs); and general requirements for luminaires (lighting chains).



7.2.2 Support, Information and Voluntary Action

The shortage of appropriate information is a significant barrier to demand side management for energy efficiency and the importance of good information programs is appreciated. As early as 1996, the Ministry of Industry, Mines and Energy produced an awareness newsletter and provided information to consumers during energy use surveys. However, the government is unable to financially support an extensive publicity and information program related to energy efficiency. Activities have been undertaken where external funding is available.

7.2.3 Promoting and Demonstrating Energy Conservation in Siem Reap, Cambodia

The main objective of this project, funded under the Energy and Environment Partnership - Mekong, is to raise awareness on energy efficiency and energy conservation in the context of climate change and sustainable development, and to demonstrate the practical feasibility of simple energy conservation measures by installing solar water heaters in selected sites and distributing CFLs to the general population.

While the technologies of CFLs and solar water heaters are not new, their use in Cambodia is not widespread as their benefits are relatively unknown among the general public. Knowledge transfer is achieved through workshops, public awareness campaigns and providing information on a website. (Energy and Environment Partnership – Mekong, 2011)

7.2.4 Regional Programs

Cambodia participates in the ASEAN-Japan, *Promotion on Energy Efficiency and Conservation (PROMEEC)* program activities. No details are available for specific activities undertaken, or the extent to which they included lighting themes. Similarly, it has been reported that Cambodia receives information through the Asian Development Bank and (on capacity building) from the ASEAN Centre for Energy (ACE). Details of this information and how it is disseminated are not available.

7.3 Indonesia

According to the en.lighten Country Lighting Assessment, “The government of Indonesia is currently strengthening existing major CFL promotional programs. Currently no mandatory performance standards for CFL or other lamp types exist however a voluntary labelling program based on a locally derived lumen/watt based energy efficiency index entered into force in 2008.”

Indonesia’s National Energy Conservation Master Plan (2005) - RIKEN (Rencana Induk Konservasi Energi Nasional) states that Indonesia’s goal is to decrease energy intensity by around 1% per year on average until 2025. As explained in the National Energy Management Blueprint - PEN (2006), the goal of RIKEN is to realize this energy saving potential through energy efficiency and conservation measures. The action plan to achieve this objective contains several elements of relevance to lighting:

- Mandatory energy conservation of government office buildings.



- State-owned energy service company (ESCO).
- Energy labelling program.
- Energy efficient lighting program in the residential sector.

Although significant policies and regulations related to energy conservation are in place in Indonesia and the Government is currently strengthening existing major CFL promotional programs, no information was identified on whether Indonesia has the intention of phasing out inefficient incandescent lamps.

7.3.1 Regulatory and Control Mechanisms

7.3.1.1 Test Method and Performance Standards

Indonesia is a full member of IEC, with the National Standardization Agency of Indonesia (BSN) operating as the National Committee. They are observers at TC34 (Lamps and Related Equipment) and SC34A (Lamps). Indonesia promotes the adoption of international standards, such as ISO and IEC, in revising the existing and developing new National Standards of Indonesia (SNI) and promotes participation in international standards development. Indonesia adopted the IEC test method standards for the performance requirements of tungsten filament lamps for domestic and similar public lighting, single-capped fluorescent lamps, ballasts for tubular fluorescent lamps and self-ballasted lamps for general lighting services (CFLs). Indonesia is a member of both BRESL and lites.asia. Indonesia has minimum energy performance standards for magnetic ballasts and fluorescent and incandescent lamps based on the SNI standards.

7.3.1.2 Mandatory Energy Labelling

The Ministerial Regulation No 6/2011 on Energy Efficiency Labelling on CFL was issued in April 2011 (expected to come into force 18 months from the date of enactment) and mandates that all CFLs must carry the new energy efficiency label. To qualify for the label manufacturers/importers must issue a Declaration of Conformity stating that their product complies with the regulations and submit it to the Directorate General of New-Renewable Energy and Energy Conservation (DGNREEC) of the Ministry of Energy and Mineral Resources.

7.3.1.3 Building Energy Codes

As detailed in *Government Regulation No. 36/2005, Law No. 28/2002 on Buildings*, all buildings must comply with existing standards. This includes an SNI standard for lighting in buildings. Energy building standards have yet to be mandated. However, voluntarily energy conservation and efficiency measures in commercial buildings are widely implemented.

7.3.1.4 Mandatory energy conservation of government office buildings

Government departments and agencies and regional governments must implement best practice energy saving measures as explained in the government's guidelines and directives on energy saving in government buildings. Also, biannually they must report monthly energy use in buildings to the National Team on Energy and Water Efficiency. No information is available on the details of this initiative, but it is likely these measures would include energy efficient lighting.

7.3.2 Economic/Market-based Instruments

The state-owned ESCO (established in 1986) is expected to take a leading role in providing energy conservation related services, particularly to industry. The government expects its ESCO to maintain forefront expertise in the field of energy efficiency and conservation in Indonesia, and to encourage a greater role for private-sector ESCOs in the future. No information is available on whether the facility has been applied to lighting projects.

7.3.3 Fiscal Instruments and Incentives

7.3.3.1 Energy efficient lighting program in the residential sector

The lighting program in the residential sector is primarily demand-side management (DSM), in addition to energy savings. There are two lighting programs - the Caring Program (Program Perduli) - a program of the state owned electricity company (PLN) and the Brightness Program (Program Terang) - a government program. The programs provide subsidized, and in certain cases, free CFLs to eligible households.

7.3.4 Support, Information and Voluntary Action

The 'National Energy Efficiency Movement' implemented by the Ministry of Energy and Mineral Resources promotes energy conservation awareness through seminars and workshops, talk shows, public advertisements, brochures and leaflets; it is directed to households, specific industries and transport. The state-owned electricity company PLN promotes energy conservation in electricity use. Other institutions that promote awareness include the Agency for the Assessment and Application of Technology (BPPT). No information is available on the extent to which lighting themes are included in this activity.

7.3.5 Voluntary Label

SNI 04-6958-2003, *Household and similar electrical appliances - Energy rating labels*, provides for a universal voluntary energy label. To date, the only lighting product to which this has been applied is fluorescent ballasts.

7.3.6 Sustainability/End-of-life Treatment Initiatives

There is no regulation regarding the disposal of CFLs in Indonesia and CFLs are not collected for recycling in Indonesia. No information is available on the end-of-life collection, recycling or disposal initiatives for other lamp types. (Indonesia PFAN 2010)

7.3.7 Monitoring, Verification and Enforcement Activities

Technical regulation is through the Indonesian regulators (with the National Standardization Agency of Indonesia (BAN) as the Notification Body and enquiry point. (Indonesia PFAN 2010.)

7.3.8 Product Quality Testing Capacities

The national laboratory, Sucofindo, has been offering inspection services since 1956. No information is available on lamp testing capabilities.

The Agency for the Assessment and Application of Technology (BPPT) is a non-departmental government institution under the coordination of the Ministry of Research and Technology which has the task of carrying out government duties in the

field of assessment and application of technology. No information is available on their capabilities with respect to lamp testing.

The Energy Technology Center (B2TE) is one of the leading centers of energy technology development. Its objective is to encourage the growth of the energy industry and the implementation of energy technologies that are efficient, reliable and environmentally friendly for solving national problems. No information is available on their capabilities with respect to lamp testing.

The National Accreditation Body of Indonesia (KAN) awards accreditation to certification bodies and third party Conformity Assessment Bodies are involved in certification, inspection, testing and calibration. (Indonesia PFAN 2010)

7.3.9 Production/Manufacturing of Lamps

Indonesia's fluorescent lamp exports (of all types) had a 2009 trade value of nearly 115 million USD. Indonesia's fluorescent lamp imports for 2009 had a value of nearly 100 million USD, thus creating a trade surplus. Major trading partners for exports are Japan, Malaysia and Philippines; major partners for imports are China, Singapore and Japan.

In 2009, Indonesia exported shipments valued over 39.6 million USD of incandescent and tungsten incandescent lamps worldwide, including to regional partners Malaysia, Philippines, Singapore, Thailand, Timor Leste and Vietnam. (UN COMTRADE 2011)

Sixteen companies manufacture CFLs in Indonesia, producing around 40 million CFLs per year, or 20% of its market demand. So far only one company, Panasonic, exports CFLs (to Japan) producing around 15 to 20 million CFLs annually. Of these 16 companies, 14 produce brands that participate in the current energy labelling scheme and are tested against the current standards, SNI 04-6958-2003, *Household and similar electrical appliances - Energy rating labels*. (Manoppo 2007)

7.4 Laos

Although there is currently no formal strategy or policy for national energy efficiency and no legislation, regulation or guidelines for the promotion of energy efficiency and conservation, Laos intends to implement the phase-out of incandescent lamps. Laos intends to seek financial support from the Asian Development Bank and World Bank for this activity, but no details regarding the status or timescales are available.

To date Laos has conducted activities to promote energy efficiency and conservation under such programs as the ASEAN-Japan, *Promotion on energy efficiency and conservation (PROMECC)* program activities and the Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS). These activities include raising awareness on energy saving and organizing training, seminars and workshops. However, no details on specific activities undertaken or the extent to which they include energy efficient lighting themes are available.



Laos has no manufacturing capability for lamps and imports the majority of their lamps from Thailand, China and Vietnam. Laos does not have national performance standards but does specify the IEC test method standards for lamp or lighting products.

7.5 Malaysia

According to the en.lighten Country Lighting Assessment, “At the UNFCCC COP-15 in December 2010, the Malaysian Government committed to reduce carbon intensity by 40% by 2020. The phase-out of incandescent lamps, to be implemented in two phases, is a cornerstone of this policy. The first phase, from January to December 2011, involves stopping all production, import and sales of >100 W bulbs. The second phase, from January 2012 till the end of 2013, will see an end to the production, import and sales of all other light bulbs.”

The Utilisation Objective of Malaysia’s Energy Policy (1979) sought “to promote the efficient utilization of energy and the elimination of wasteful and non-productive patterns of energy consumption”. To speed up the implementation of energy efficiency and conservation initiatives, the Ministry of Energy, Green Technology and Water is in the final stages of preparing an Energy Efficiency Master Plan setting clear goals and targets to coordinate and implement programs in a systematic and holistic manner.

7.5.1.1 The Ninth Malaysia Plan (2006–2010)

This plan includes strategies for promoting and improving energy efficiency. Under the current plan initiatives aimed at the commercial sector may be relevant to lighting energy efficiency:

- Energy efficiency requirements under the Code of Practice on the Use of Renewable Energy and Energy Efficiency in Non-Residential Buildings
- 10% reduction of electricity use in all government buildings
- Showcase of Low Energy Office (LEO) and Zero Energy Office (ZEO) buildings to promote energy efficiency in buildings through demonstration.
- Residential initiatives contain a strong energy efficient lighting focus:
- Dissemination of information and awareness to create a voluntary behavioural shift of residential energy users.
- Promotion on the sale of energy efficient lighting. Greater emphasis will be placed on energy efficiency under the Tenth Malaysia Plan (2011-2015).

7.5.2 Phase-out of Incandescent Lamps

In March 2010, the Minister of Energy and Water, Datuk Peter Chin Fah Kui, announced the intention to stop all production, import and sales of incandescent light bulbs by or before January 2014, as part of efforts to save power and to help cut greenhouse gas emissions. (Kui 2010)

The main objective of implementing such a policy is to promote the use of more energy efficient lamps such as CFLs, fluorescent tubes, halogen lamps and LED lamps in place of the inefficient incandescent lamps. The implementation of the policy will be carried out in two phases:



- Phase 1 will stop the production, importation and sale of incandescent lamps with a specification of 100 watts and above within a period of one year from Jan 1 to Dec 31, 2011.
- Phase 2 will stop the production, importation and sale of all types' incandescent lamps over the period 2012 to 2014.

7.5.3 Regulatory and Control Mechanisms

7.5.3.1 Test Method and Performance Standards

Malaysia is a full member of the IEC, with the Department of Standards Malaysia operating as the National Committee. They are observers of TC34 (Lamps and Related Equipment) and SC34A (Lamps). Test method standards and a minimum energy performance standard are in place for ballasts for fluorescent lamps.

7.5.3.2 10% reduction of electricity use in all government buildings

The Ministry of Energy, Green Technology and Water is conducting energy audits in the top seven energy users in the government sector to estimate the real saving potential and to formulate a plan to achieve the stipulated target. Although no specific information is available, this is likely to include an energy efficient lighting element.

7.5.3.3 Building Codes

The Code of Practice on the Use of Renewable Energy and Energy Efficiency in Non-Residential Buildings (MS1525:2007) is a code that provides design recommendations for the energy efficiency of non-residential buildings. It provides criteria and minimum standards for energy efficiency in the design of new buildings, retrofitting of existing buildings and methods for determining compliance with these standards. MS1525:2007 is incorporated in the Green Building Index Malaysia (GBI Malaysia). Although no specific information is available, it is likely that energy efficient lighting forms a component of this.

7.5.4 Fiscal Instruments and Incentives

7.5.4.1 Malaysian Tax Scheme for Energy Efficiency Improvements

Under the Malaysian tax scheme for energy efficiency improvements companies that import energy efficient lighting products are eligible for a sales tax exemption on the purchase of locally manufactured energy efficient lighting (amongst other energy efficient household appliances). The scheme also provides financial incentives for:

- Companies providing services for energy efficiency improvement.
- Companies that make capital expenditures to improve their energy consumption.
- Owners of buildings with a Green Building Index Certificate.
- Buyers of buildings and residential properties awarded GBI certificates from real property developers.

These may all include elements relevant to energy efficient lighting.



7.5.5 Support, Information and Voluntary Action

7.5.6 Eco-Labeling Scheme

The SIRIM QAS International Eco-Labeling Scheme provides for independent testing and verification against preset criteria before the organization can use the mark on its product, packaging and promotional materials to indicate that it is an environmentally-friendly product. The scheme has product criteria available for energy saving electronic ballasts and fluorescent lamps.

7.5.6.1 Demonstration Projects

Showcase of Low Energy Office (LEO) and Zero Energy Office (ZEO) buildings to promote energy efficiency in buildings through demonstration. The first LEO building of the Ministry of Energy, Green Technology and Water was built in 2004 and the Green Energy Office of Pusat Tenaga Malaysia was built in 2008. Although no specific information is available, it is likely that energy efficient lighting forms a component of this.

7.5.7 Sustainability/End-of-life Treatment Initiatives

In Malaysia, there are no national recycling initiatives for fluorescent tubes and CFLs. However, at least one organization has acquired a drum top crusher for fluorescent lamps, which captures the mercury contained in the lamps while recovering the glass and metal for recycling (Kualiti Alam Sdn Bhd, 2009).

7.5.8 Monitoring, Verification and Enforcement Activities

The Eco-labelling scheme contains provision for spot checking of products.

7.5.9 Product Quality Testing Capacities

7.5.9.1 SIRIM QAS International Sdn. Bhd.

SIRIM QAS International Sdn. Bhd. is the leading certification and testing body in Malaysia and has achieved wide recognition nationally and internationally. It has received accreditation for:

- ISO 9001, QS-9000 and ISO 14001 by the United Kingdom Accreditation Service (UKAS), the UK National Accreditation Body.
- ISO 9001 and ISO 14001 by the Department of Standards Malaysia (DSM), the Malaysian National Accreditation Body.
- Testing laboratories under the Malaysian Laboratory Accreditation Scheme (SAMM) ISO/ IEC 17025 by Department of Standards Malaysia (DSM), the Malaysian National Accreditation body.

7.5.9.2 SIRIM Berhad - National Metrology Laboratory (NML)

SIRIM is empowered by the National Measurement System Act 2007 to be the National Measurement Standards Laboratory and the country's Custodian of Weights and Measures. As such, the SIRIM National Metrology Lab is the keeper of Malaysia's Primary Physical Standards of Measurement. SIRIMs National Metrology Laboratory (NML) is also entrusted with the critical role of providing metrological support to the national measurement infrastructure. It is a member of the Metre Convention, Asia Pacific Metrology Programme, Asia Pacific Legal Metrology Forum and International

Organisation of Legal Metrology. The NML is also a signatory of the global Mutual Recognition Agreement (MRA) on National Measurement Standards and Calibration Certificates issued by National Metrology Institutes, which allows us to establish the national measurement standards. Their measurement and calibration services cover the needs of all industries.

7.5.10 Production/Manufacturing of Lamps

Malaysia has manufacturing capacity for LED lighting, fluorescent lighting, incandescent bulbs, interior lighting and road lighting. Penang is a major global centre for packaging of LED chips.

Malaysia's fluorescent lamp exports (of all types) had a 2009 trade value of 3.5 million USD. Malaysia's fluorescent lamp imports for 2009 had a value of nearly 26 million USD, thus creating a trade deficit. Major trading partners for exports are Hong Kong, Singapore and Egypt; major partners for imports are China, Indonesia and Thailand.

In 2009, Malaysia exported shipments valued over 1.4 million USD of incandescent and tungsten incandescent lamps worldwide, including to regional partners Indonesia, Myanmar and Singapore. (UN COMTRADE 2011)

7.6 Myanmar (Burma)

Myanmar has no plans at present to phase-out incandescent/low efficiency lamps but the country has taken some steps towards the regulation of lights and lighting products.

Test method and performance standards are in place for fluorescent and tungsten filament lamps and a voluntary label is also in place for these products (displaying information on brand, watt and voltage). Electrical inspection undertaken by the Electrical Inspection Department identifies if a product does not meet the labelling requirements. Without certification from the Electrical Inspection Department, the manufacturers cannot register their trademark (with the Trademark Registration Department) and cannot advertise their products. The national Electrical Inspection Laboratory only has capabilities to test physical characteristics (watt, current, and insulation resistance).

Energy efficiency and conservation awareness is currently not very high in Myanmar due to the subsidized energy pricing system. However, due to population growth and changes in the economic system, the demand for energy has increased. Thus energy conservation measures and improvement of the efficiency of equipment are becoming essential. (Asia Trade Hub, 2011) Myanmar is a signatory of the Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS), although it is not known if they have undertaken any relevant activities under this umbrella.

Myanmar has manufacturing capacity for fluorescent lamps, tungsten filament lamps and energy saving lamps. However, the factory can produce only glass tubes and do assembly with other imported parts. This can supply only a small proportion of the domestic market, with most of the remaining products being imported from China.



7.7 Philippines

According to the en.lighten Country Lighting Assessment, “The Philippines has become one of the first Asian countries to ban incandescent lamps.” Department Administrative Orders (DAOs) are used as the legislative basis for regulation concerning energy efficiency in lighting products.

In 2005, the Government of the Philippines with GEF support initiated the Philippine Efficient Lighting Market Transformation Project (PELMATP) to move towards efficient lighting by integrating various energy efficient lighting programs and practices into standards, labelling programs and promotional activities. PELMATP successfully completed its activities in June 2011 having met its objectives on energy savings (7,366 GWH equivalent) and greenhouse gas emission reduction (3.98 million tonnes of CO₂).

Building on PELMATP achievements, the ADB-supported Philippine Energy Efficiency Project (PEEP) was initiated in 2009. In February 2008, as a result of these activities, the President of the Philippines called for a ban on incandescent lamps by 2010 and there is currently an initiative in the House of Representatives, particularly from the Committee on Ecology, to develop and pass a bill into law to phase-out inefficient lamps in the country.

7.7.1.1 Philippine Energy Efficiency Project

The Philippine Energy Efficiency Project (PEEP) is a field demonstration of lighting efficiency in 35 government buildings through the use/retrofit to T5s and electronic ballasts from T12 and magnetic ballasts, 2,008 units streetlights, Baguio City park lights, 159 traffic intersections (incandescent to LEDs), one lamp waste management facility, establishment of a green building rating system, expansion of Energy Labelling Program to include televisions, larger refrigerators and washing machines. PEEP also includes a communication and social mobilization component for information dissemination. PEEP will continue its project implementation until the first quarter of 2013.

Due to the success of PELMATP, the number of CFLs for free distribution under PEEP has been scaled down from 13 million to 8.6 million. Five million CFLs have been distributed and another 3.6 million is planned to be procured by the last quarter of 2011.

There is a proposal to expand the government lighting retrofit to include 140 more government buildings and to increase the number of traffic intersections to an additional 88. Approval is expected by October 2011.

7.7.2 Regulatory and Control Mechanisms

7.7.2.1 Test Method and Performance Standards

The Philippines is a full member of IEC and its membership is represented by the Philippine National Committee of the IEC (PNE-IEC), an industry organization fully supported by the Bureau of Product Standards of the Department of Trade and Industry. They have a license agreement to use IEC publications, attend the IEC General

Meetings, Technical Committee Meetings and take part in other related IEC Regional meetings and workshops. They are a participating member of SC34A (Lamps) and observer member of TC34 (Lamps and Related Equipment) and SC34D (Luminaire). The Philippines uses IEC Standards in their entirety and also with modifications in energy efficiency applications.

In support of the announced ban on incandescent lamps, Minimum Energy Performance Standard, PNS 2050-6:2010, Lamps and related equipment –energy performance requirements – Part 6: Incandescent lamps for domestic and similar general lighting purposes, was developed in 2010 but has yet to be promulgated. There may be a need to review it to harmonize it with regional/international standards for phase-out initiatives.

7.7.2.2 Mandatory Labelling

Mandatory labelling is in place for CFLs, double- and single-capped fluorescent lamps and electronic and magnetic ballasts. The implementing guidelines of the standards and labelling programs for fluorescent lamp ballasts and CFLs were signed in late 2002, with labelling of CFLs beginning in 2002 and that for ballasts in September 2003.

7.7.2.3 Energy Efficiency Mandate for Government Buildings

Administrative Order 183 signed by then President Gloria Macapagal-Arroyo mandated government offices, state universities and colleges, and other instrumentalities of government to use energy efficient lighting, particularly T8s and electronic ballasts in their offices.

7.7.3 Economic/Market-based Instruments

7.7.3.1 Energy Service Companies (ESCOs)

Some Government support for ESCOs has historically been provided but this has now ceased under PEEP. However, the Government continues to accredit ESCOs.

7.7.3.2 Efficient Building Initiative

The PEEP includes provision for extending government retrofit, CFL distribution and public lighting.

7.7.4 Fiscal Instruments and Incentives

Both PELMATP and the PEEP included significant subsidy elements with the free distribution of CFLs.

7.7.5 Support, Information and Voluntary Action

7.7.5.1 Efficient Lighting Initiative (ELI) Program – Philippines

ELI activities in the Philippines officially commenced in May 2000, with a budget of \$2.5 million, and were completed in three years. ELI Philippines implemented a consumer awareness strategy on the benefits of energy efficient lighting and supported institutional capacity building toward market transformation to promote efficient lighting.



7.7.5.2 Communication and Social Mobilization/Communication for Efficient Lighting

Under PEEP, Terms of Reference are being developed for a provider of a communications service towards the promotion of efficient lighting and other energy efficiency initiatives in everyday life.

7.7.5.3 Market Information

In support of ongoing work, a market survey on commercial and consumer use of CFLs was conducted under the PELMATP. However, the results of this are not yet available.

7.7.6 Sustainability/End-of-life Treatment Initiatives

PEEP will procure a pilot lamp waste management facility with a capacity of 6 million lamps per year. Funding for its operation will be provided through the institutionalization of Extended Producer Responsibility (EPR) i.e. manufacturers will be liable for the costs of managing their products at end of life. The system to be instituted will include collection, transport and recycling/recovery of mercury. This initiative is intended to create a viable business model for lamp waste management for replication throughout the country.

7.7.7 Monitoring, Verification and Enforcement Activities

The Regional Operations Group (ROG) of the Department of Trade and Industry is tasked with enforcement activities for regulated products. No information on the specific activities undertaken is available.

The Philippine Product Safety and Quality Foundation (PPSQF) is non-stock/non-profit foundation that works closely with Philippine Industries and the Bureau of Product and Standards in upholding and promoting Safety and Quality and conducts regular market surveillance activities of regulated products.

7.7.8 Product Quality Testing Capacities

7.7.8.1 Energy Research and Testing Laboratory Services

The Energy Research and Testing Laboratory Services is the Philippines national lighting test laboratory. It is an integral part of the Department of Energy's effort to explore and develop indigenous energy resources and to promote energy efficiency by providing quality and timely analytical and technical services with the best trained, motivated personnel using state-of-the-art equipment. It formulates policies, plans and programs in support of the upstream and downstream activities of the agency and promotes energy efficiency and conservation, through laboratory research, geochemical, and physical/calibration testing of lighting/lighting systems and household appliances. Testing capabilities include:

- Lamps (CFL, linear, circular, incandescent) – power input, light output, efficacy, lumen maintenance, average life, CRI, CCT, start up time, run up time, switching withstand
- Ballast – ballast efficacy factor
- Luminaire – luminaire efficiency



7.7.8.2 Bureau of Product Standards Laboratory Testing Center (BPSTC)

BPSTC conducts safety testing for lamps and related equipment listed under mandatory certification.

7.7.8.3 Scientific Environmental and Analytical Laboratory and Services, Inc. (SEALS)

SEALS conduct safety and performance testing (except ballast) for lamps and related equipment listed under mandatory certification.

7.7.8.4 Integrated Institute of Electrical Engineers Foundation

IIEEF conducts safety (for linear and CFLs) and performance tests for lamps and related equipment, including ballasts, listed under mandatory certification

7.7.9 Production/Manufacturing of Lamps

There is very little lamp manufacturing activity in the Philippines except for one incandescent bulb manufacturing company with no domestic distribution. Philippines's fluorescent lamp exports (of all types) had a 2009 trade value of less than one million USD. Philippines's fluorescent lamp imports for 2009 had a value greater than 9 million USD, thus creating a trade deficit. Major partners for imports are China, Indonesia and Japan.

In 2009, Philippines exported shipments valued over 13.6 million USD of incandescent and tungsten incandescent lamps worldwide, including to regional partner Thailand. (UN COMTRADE 2011)

7.8 Singapore

The Sustainable Singapore Blueprint (2009) sets a target of achieving a 35% energy intensity improvement by 2030. Energy intensity is defined as total energy consumed per dollar of GDP. This is a voluntary and unilaterally implemented goal, which would result in a reduction in Singapore's energy consumption from the business-as-usual level.

Energy efficiency is Singapore's key strategy to mitigate greenhouse gas emissions and also to improve Singapore's economic competitiveness, energy security, and environmental sustainability. Singapore currently does not have any existing policies or regulations to ban or phase out incandescent lamps.

7.8.1 Regulatory and Control Mechanisms

7.8.1.1 Test Method and Performance Standards

A test method standard is in place for the particular requirements for DC supplied electronic ballasts for general lighting. There is currently no legislation mandating minimum energy performance standards or energy labelling requirements for lamps or lighting products. However, Minimum Energy Performance Standards (MEPS) for household air-conditioners and refrigerators were implemented in September 2011 and the Ministry of the Environment and Water Resources/National Environmental Agency will be exploring the possibility of extending MEPS to other appliances, such as lighting, in the future.



7.8.1.2 Building Control Regulations

“Code of practice for energy efficiency standard for building services and equipment” provides minimum energy-efficiency requirements for new installation and replacement of systems and equipment in buildings, and replacement of components of systems and equipment in buildings. Also covers the criteria for determining compliance with these requirements. It applies to air-conditioning and heat rejection equipment, water heaters, motor drives and high efficiency lighting used in buildings.

The Building Construction Authority (BCA) has established the Envelope Thermal Transfer Value (ETTV) standard and minimum efficiency requirements for commercial air conditioners and a maximum lighting power budget.

7.8.1.3 Code for Environmental Sustainability of Buildings

The Building Construction Authority (BCA) established the Code for Environmental Sustainability of Buildings. This Code sets out the minimum environmental sustainability standard for buildings and the administrative requirements. This Code has largely adopted the BCA Green Mark’s (see *Support, Information and Voluntary Action* section below) criteria as the compliance method in assessing the environmental performance of a building. The codes and standards under the Code for Environmental Sustainability of Buildings that have relevance to lighting are:

- Code of Practice for Artificial Lighting in Buildings
- Code of Practice for Lighting of Work Places - Indoor

7.8.2 Economic/Market-based Instruments

7.8.2.1 Energy Service Companies

The Singapore Government provides accreditation for Energy Service Companies (ESCOs) through the ESCO Accreditation Scheme. The objective of the scheme is to enhance the professionalism and quality of energy services offered.

7.8.3 Fiscal Instruments and Incentives

A few incentive schemes administered by NEA stimulate more efficient lighting.

7.8.3.1 Energy Efficiency Improvement Assistance Scheme

The Energy Efficiency Improvement Assistance Scheme (EASe) encourages companies in the manufacturing and building sectors to carry out detailed studies on their energy consumption, also known as energy appraisals, and identify potential areas for energy efficiency improvement.

7.8.3.2 Grant for Energy Efficient Technologies

The Grant for Energy Efficient Technologies (GREET) is aimed at encouraging owners and operators of industrial facilities to invest in energy efficient equipment or technologies.

7.8.3.3 Design for Efficiency Scheme

The Design for Efficiency (DfE) Scheme aims to encourage investors in new facilities in Singapore to integrate energy and resource efficiency improvements into manufacturing development plans early in the design stage.



7.8.4 Support, Information and Voluntary Action

Various schemes targeting both residential products and the commercial sector have been implemented in support of improved energy efficiency.

7.8.4.1 Singapore Green Labelling Scheme

The Singapore Green Labelling Scheme (SGLS) is a voluntary scheme launched in May 1992 by the Ministry of the Environment. The scheme applies to most products, except food, drinks and pharmaceuticals and includes provision for CFLs and solid state LEDs.

The Green Label can be used on products which meet the eco standards specified by the scheme. It is recognized as a member of the international Global Ecolabeling Network (GEN), allowing certification by mutual recognition of SGLS endorsed products by other members of the network.

7.8.4.2 Energy Smart Label

The Energy Smart Building Labelling Programme, developed by the Energy Sustainability Unit (ESU) of the National University of Singapore (NUS) and the NEA, aims to promote energy efficiency and conservation in the buildings sector by according recognition to energy efficient office and hotel buildings, as well as retail malls. Buildings that are in the top 25 percentile in terms of energy efficiency of the total building cohort are awarded with a certificate and an Energy Smart Label. In addition to its energy performance, the building's indoor environmental conditions such as air quality, thermal comfort, ventilation and lighting level are taken into consideration when evaluating a building for the award.

7.8.4.3 Building Construction Authority Green Mark Scheme

The Building Construction Authority (BCA) Green Mark Scheme is a green building rating system launched by the BCA in 2005 to evaluate a building based on its environmental impact performance includes lighting as a key component of the Scheme. From 2008, all new and existing buildings with gross floor area (GFA) above 2000 m² that are undergoing major retrofitting works must meet the Green Mark Certified standard.

7.8.4.4 Green Mark Incentive Scheme

The Green Mark Incentive Scheme was launched in 2006 to encourage building developers to achieve higher Green Mark ratings. New and retrofitted buildings with a GFA above 5000 m² that have achieved ratings of Green Mark Gold and above will be awarded monetary incentives.

7.8.4.5 Awareness Raising

A public campaign – the 10% Energy Challenge – was launched in April 2008 and aims to educate households on ways they can reduce energy consumption at home.

7.8.5 Monitoring, Verification and Enforcement Activities

Enforcement activities are undertaken by the Standards, Productivity and Innovation Board (SPRING Singapore). The regulatory regime consists of two phases – pre-market approval and post-market surveillance. There is a regulator intervention prior to the entry of the regulated products into the market. The controlled goods have to go through a structured process of approval, which starts with testing and ends with



labelling. After entry into the market, SPRING Singapore conducts regular visits to shops and retail outlets to ensure that only registered controlled goods are displayed or offered for sale. Registration of controlled goods is based on certification by designated Conformity Assessment Bodies.

7.8.6 Product Quality Testing Capacities

Currently two laboratories, TUV SUD PSB Pte Ltd and the National Metrology Centre (NMC), provide tests for lamps and lighting products.

TUV SUD PSB has the capability to test and certify luminaires and lamps (CFLs and integral LED lamps).

NMC has the capability to measure and provide standards calibration for most of the photometric (luminous intensity, flux, luminance, illuminance, colour, colour temperature, and colour rendering index), radiometric (spectral irradiance), electrical and thermal properties of lamps and lighting.

7.8.7 Production/Manufacturing of Lamps

Singapore has manufacturing capacity for fluorescent lamps and LED systems. Singapore has at least one major facility for packaging of LED chips.

Singapore's fluorescent lamp exports (of all types) had a 2009 trade value of 6.4 million USD. Singapore's fluorescent lamp imports for 2009 had a value of nearly 26 million USD, thus creating a trade deficit. Major trading partners for exports are other countries in Asia, including Indonesia and Malaysia; major partners for imports are China, Germany and the Netherlands.

In 2009, Singapore exported shipments valued over 22.7 million USD of incandescent and tungsten incandescent lamps worldwide, including to regional partners Brunei Darussalam, Cambodia, Indonesia, Malaysia, Philippines, Thailand and Vietnam. (UN COMTRADE 2011)

7.9 Thailand

Thailand has been working actively towards the phase-out of inefficient lighting since the 1990s, with the introduction of voluntary labelling in 1994 and a collaborative agreement with industry running from 1993 to 1995. A range of activities has continued since then, including the introduction of the first Minimum Energy Performance Standards in 2004.

The extensive market transformation project, the *Incandescent Lamps Phase Out Program*, operated by the Electricity Generating Authority of Thailand (EGAT) from 2007-2010 used a variety of tools (distribution of free lamps and subsidies, awareness raising campaigns and labelling) to promote the permanent use of high efficiency and good quality CFLs in place of incandescent lamps for general lighting service. Partly supported by the Energy Conservation Fund it focused on a market-based approach without mandatory enforcement.

As a result of this project, the market barrier of high initial cost of CFLs has been gradually reduced (from 120 Baht in 2006 to 96 Baht in 2010 for <1 W CFLs) and the number of CFLs carrying the energy efficiency label has increased (from 3 million in 2006 to 7.7 million in 2010), suggesting that customer awareness has been raised.

7.9.1 Regulatory and Control Mechanisms

7.9.1.1 Test method and performance standards

Thailand has been a full member of the IEC (International Electrotechnical Commission) since 1991, with the Thai Industrial Standards Institute (TISI) operating as the National Committee and determining the national policy concerning the activities of the IEC. They are participating members of TC34 (Lamps and Related Equipment) and SC34A (Lamps). Most Thai Industrial Standards (TIS) use IEC standards as references. Their commitment to the process of harmonizing international standards is further demonstrated through their membership of BRESL and lites.asia.

Minimum Energy Performance Standards (MEPS) and High Energy Performance Standards (HEPS) are in place in Thailand for:

- Electronic and magnetic ballasts for fluorescent lamps.
- Double-capped fluorescent lamps.
- Self-ballasted lamps for general lighting service (CFLs).

Thailand has test method standards in place for:

- Incandescent lamps.
- Electronic and magnetic ballasts for fluorescent lamps.
- Double- and single- capped fluorescent lamps.
- Self-ballasted lamps for general lighting service (CFLs).

7.9.1.2 Building Codes and Labelling

A new lighting element has been included in the Thailand mandatory building codes, although no further information is available on the scope of this. In addition, a pilot project by the Department of Alternative Energy Development and Efficiency (DEDE) incorporates lighting elements into the voluntary building labelling scheme, the evaluation criteria for which includes day lighting design and use of lighting control systems for energy saving. Again, no further information is available on the scope of this.

7.9.2 Economic/Market-based Instruments

7.9.2.1 Household Energy Credits

The Department of Alternative Energy Development and Efficiency (DEDE) Energy Fund offers personal loans (at 0%) to the general public who are interested in changing to use energy efficiency household electrical appliances, including those carrying the energy efficiency label and those items identified by the Ministry of Energy for energy conservation in household and manufacturing sites.



7.9.3 Fiscal Instruments and Incentives

Fiscal incentives have been used to good effect in Thailand through the *Incandescent Lamps Phase Out Program*, which gave away 800,000 CFLs to stimulate public recognition and included the supply of low-priced CFLs (with generic EGAT packaging) with one year warranty at convenience stores countrywide in cooperation with suppliers participating in the program.

7.9.4 Support, Information and Voluntary Action

Support, information and voluntary action have been a significant component of Thailand's activities to date.

7.9.4.1 Public Campaigns and Advertising

Public awareness raising campaigns and advertising were a major thread of EGAT's *Incandescent Lamps Phase Out Program*. Examples of these activities (and those carried out by the Department of Alternative Energy Development and the Efficiency and Energy Policy and Planning Office) are: production of a series of television commercials on energy saving methods and benefits to be gained; dissemination of energy conservation issues through various types of media – newspapers, magazines, energy talks via TV programs, etc.; energy mobile units undertaken by Regional Energy Offices; energy camps for students, plays and cultural shows based on energy conservation themes and the establishment of energy information centers to disseminate materials, posters, and other printed matter on issues related to energy conservation and renewable energy.

7.9.4.2 Collaborative Agreements

Under EGAT's *Low Efficiency Fluorescent Lamps Phase-out Program* (1993-1995), a collaborative agreement, made in September 1995, with major local manufacturers to cease production of 'fat' tubes (40W, 20W) saw the transformation of the market to thin tube fluorescent lamps (36W, 18W) with no direct incentives to manufacturers or consumers.

7.9.4.3 Voluntary Labelling Programs

Energy Efficiency Labelling No. 5 Programme: Thailand operates voluntary labelling programs for several lamps and lighting products:

- The Energy Efficient Compact Fluorescent Lamps Program, which came into effect in 2001.
- The Energy Efficient Double-capped Fluorescent Lamps Program, which came into effect in 2009 for T5 lamps.
- The Energy Efficient Lighting Luminaires Program, which came into effect in 2004 for T8 lamps and was extended to include T5 lamps in 2010.
- The Energy Efficient Ballast Program - Magnetic Ballasts for Fluorescent Lamps, which came into effect in 1998.

The *Thai Green Label Scheme*, which was formally launched in August 1994 by the Thailand Environment Institute (TEI) in association with the Ministry of Industry, includes provision for electronic ballasts for fluorescent lamps, fluorescent lamps and CFLs. Additionally, a study is underway to investigate the feasibility of a voluntary labelling program for LEDs.



7.9.4.4 Market Information

In support of ongoing work, EGAT conducted a market survey by distributing questionnaires to consumers living in/out of municipality areas countrywide between May and October 2010 (feedback was received on 60% of the 28,700 questionnaires distributed). The survey investigated the type and number of lamps used per household, consumer attitudes towards CFL quality and price, the reasons for switching from incandescent lamps and the consideration criteria when purchasing CFLs.

7.9.5 Sustainability/End-of-life Treatment Initiatives

Disposal of CFL waste from commercial and industrial premises is regulated under the Hazardous Act 2535, which require permission for removal and disposal of the waste. The waste must be transported and disposed of through specialized means and techniques. The regulation is enforced by the Dept. of Industrial Works. No regulation applies to the disposal of CFLs from domestic consumers and lamps are usually disposed of as part of the municipal solid waste stream. Thai-Toshiba is the only manufacturer at present which has the facility to recover mercury from used CFLs back to their manufacturing process. Their Fluorescent Lamps Recycle Project is supported by the government as a demonstration site.

7.9.6 Monitoring, Verification and Enforcement Activities

Spot checks of products carrying the energy efficiency label are carried out by the Electricity Generating Authority of Thailand (EGAT). Random models are purchased from electric appliances shops and department stores countrywide and sent to the government-owned laboratory at the Thai Industrial Standards Institute (TISI) to be tested for compliance against the relevant test method standard. If the average test result doesn't comply with the standard ($\pm 5\%$), EGAT will call back all distributed labels of the unqualified models and forbid those models from participating in the energy efficiency labelling program for at least one year.

7.9.7 Product Quality Testing Capacities

The government-owned laboratory at the Thai Industrial Standards Institute (TISI) is the accredited laboratory for lighting products. A private accredited laboratory, Intertek, also provides facilities for testing lighting products.

7.9.8 Production/Manufacturing of Lamps

Thailand has manufacturing capability for incandescent, linear fluorescent, CFLs and LEDs. Thailand's fluorescent lamp exports (of all types) had a 2009 trade value of 47 million USD. Thailand's fluorescent lamp imports for 2009 had a value of 28 million USD, thus creating a trade surplus. Major trading partners for exports are Republic of Korea, Malaysia and Australia; major partners for imports are China, Japan and Indonesia.

In 2009, Thailand exported shipments valued over 29.9 million USD of incandescent and tungsten incandescent lamps worldwide, including to regional partners Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines and Vietnam. (UN COMTRADE 2011)



7.10 Timor Leste

No information is available on Timor Leste's intent to phase-out inefficient lighting. However, several initiatives undertaken to improve the country's lighting stock have been identified.

7.10.1.1 Power Sector Priority Investment Project (PSPPI)

Under Power Sector Priority Investment Project financed by the Trust Fund for East Timor (TFET)² more than 27,600 CFLs were distributed free-of-charge by April 2006, to electricity consumers who have acquired prepayment meters as a means to reduce peak loads, improve energy efficiency, and reduce costs. The program was administered by EDTL (Electricidade de Timor Lorosae) and TFET funding of \$90,000 was used to distribute three CFLs to each EDTL customer participating in the pre-payment meter program. (Ministry of Transport, Communication and Public Works, 2005).

7.10.1.2 CFL Replacement Program in Same

In 2008, a privately funded program in Same distributed CFLs at no cost in replacement for incandescent lamps. The objective was a self-sustaining 100% replacement program to relieve the burden on the town's generator and remove the need for power rationing. However, the poor performance of the replacement CFLs, coupled with the high purchase costs of these lamps, meant that the benefits of the replacement program were not realized and the participants reverted to incandescent lamps on the premature failure of the replacement CFLs. (Cooper 2011)

7.10.1.3 World Bank Energy Services Delivery Project

The World Bank Energy Services Delivery Project has a component to distribute energy CFLs as direct replacements for traditional incandescent lamps in Dili, with the intention of increasing the availability of power to meet the needs of both existing and new customers in Dili. However, it has been reported that the CFL components of the project are not expected to achieve their objectives. (World Bank 2007)

7.11 Vietnam

According to the en.lighten Country Lighting Assessment, "A Mandatory Minimum Energy Performance Standard for CFL has been in place since 1999. To complement this, the UNDP implemented and GEF financed Vietnam Energy Efficiency Public Lighting (VEEPL) Project (VEEPL) project is aimed at building both technical and policy support for transition to more energy efficient public lighting. As of 2010 UNEP will support Vietnam to promote a large scale market transformation towards efficient lighting with GEF financial support."

The Vietnam National Energy Efficiency Program (VNEEP) was released in 2005 and sets a comprehensive program of work (for the period 2006—2015) to promote energy efficiency in Vietnam. Several of the six components of the program of work contain elements that are of relevance to energy efficient lighting:

Component 2: Education and Information Dissemination;

² A multi-donor trust fund that has supported reconstruction and development activities since early 2000



- Public awareness enhancement on energy efficiency and conservations (EE&C);
- Integrate EE&C in to the education system;
- Develop pilot models for 'EE&C in the household' movement.

Component 3: High Energy Efficiency Equipment;

- Develop standards and provide energy efficiency labels for selected products;
- Technical assistance to domestic producers on energy efficiency compliance.

Component 4: EE&C in Buildings;

- Improving capacity in EE&C and conducting EE&C in building design and management;
- Develop pilot models and disseminate EE&C management activities in building Operation.

Vietnam does not have any specific plan or policy to completely eliminate inefficient lighting products, but in future policy makers will gradually restrict and remove those products that do not meet performance requirements.

7.11.1 Vietnam Energy Efficiency Public Lighting Project

The Energy Efficiency Public Lighting (VEEPL) project is aimed at building both technical and policy support for transition to more energy efficient public lighting. VEEPL seeks to assist local governments to promote and implement new and efficient lighting systems through innovative delivery mechanisms, impacting appropriate regulations for the public lighting systems, facilitating standards for street lighting and schools, providing technical assistance to local manufacturers, and developing mechanisms to extend lighting service to new areas.

7.11.2 Phasing out Incandescent Lamps through Lighting Market Transformation in Vietnam

The GEF through the United Nations Environment Programme financed the project commenced in 2010 with the objective to promote a large scale market transformation towards efficient lighting. The project is made up of four components:

- Local lighting industry capacity enhancement program
- Improved QA/QC framework
- Energy saving lamps market transformation and consumer education and awareness
- National policy and institutional support program towards phasing-out of incandescent lamps and promotion of energy saving lamps

7.11.3 Regulatory and Control Mechanisms

7.11.3.1 Test Method and Performance Standards

Vietnam is an associate member of the IEC, with the Directorate for Standards, Metrology and Quality (STAMEQ) operating as the National Committee. However, they do not take part in TC34 (Lamps and Related Equipment) and SC34A (Lamps). Since 2006, it has been a priority to adopt IEC standards as Vietnamese standards (TCVNs). Their commitment to the process of harmonizing international standards is further demonstrated through their membership of BRESL and lites.asia.

Vietnam currently has test method standards (adopted in their entirety from the appropriate IEC standards) in place for lighting products, including for the performance requirements and safety specification of:

- Tungsten filament lamps for domestic and similar general service lighting.
- Double- and single-capped fluorescent lamps.
- Ballasts for fluorescent lamps.
- Self-ballasted lamps for general lighting service.

In addition, Vietnam has national standards in place for lighting products, including:

- High efficiency lighting products – Part 2: Methods for determination of energy performance.
- Compact fluorescent lamps – Energy efficiency.
- Electronic ballasts for fluorescent lamps – Energy efficiency.
- Electromagnetic Ballasts – Energy Efficiency.
- Tubular Fluorescent Lamps – Energy Efficiency.

7.11.3.2 Building Codes

The Vietnam Energy Efficiency Building Codes (No. 40/2005/QD-BXD) introduces minimal requirements that need compliance in design and construction to improve the energy efficiency of existing extensions and new buildings and to minimize loss of energy used in all types of buildings, and improve thermal comfort and visual conditions. This includes regulations for the systems of outdoor and indoor lighting. Vietnam's commitment to the process of harmonizing international standards is further demonstrated through their membership of BRESL and lites.asia.

7.11.3.3 Energy Labelling

Under Component 3 of the Vietnam National Energy Efficiency Program, the Vietnam government carried out a labelling program for three appliances-T8/36W fluorescent tubes, T5/32W fluorescent tubes and electronic ballasts.



7.11.4 Economic/Market-based Instruments

7.11.4.1 CFL Promotion Program (2004 – 2007)

Electricity of Vietnam (EVN), with assistance from the World Bank and GEF, launched a CFL program to procure and sell 1,000,000 CFLs to rural residential customers over a 3-year period (2004—2007).

The program was implemented in two stages, with competitive procurement (using the World Bank's International Competitive Bidding process) of 300,000 lamps in Stage 1 and 700,000 in Stage 2. This bulk procurement resulted in a substantially lower price (\$1.07 in Stage 1 and \$0.98 in Stage 2) compared to prevailing market prices ranging from \$2.50 to \$3.00 for high quality CFL. The lamps were distributed over an 18 month period by EVN through its local offices and sold to customers at a price of about \$1.56 per lamp.

As a result of this project electricity bill at household reduced 15.2% (about 28.5 billion VN dong/year), the return on investment was 8.8 months, with a benefit/cost ratio of 7.2 and most of the customers (92%) of the customers were satisfied with the quality of the CFLs.

7.11.4.2 CFL Promotion Program (2007 – 2010)

A second CFL promotion program was proposed for 2007—2010. However, no information is available on whether this was implemented.

7.11.4.3 Manufacturer Support

Under Component 3 of the Vietnam National Energy Efficiency Program, the Vietnam government implemented two programs to support lighting manufacturers in the technology transition from incandescent lamps to CFLs.

7.11.5 Support, Information and Voluntary Action

Support, information and voluntary action have been a significant component of Vietnam's activities to date. Voluntary labelling is in place in Vietnam for CFLs, linear fluorescent lamps and electronic ballasts.

7.11.5.1 Awareness Raising

The purpose of the dissemination program in Component 2 is to increase the public awareness of the definition of EE&C and support the penetration of energy efficient appliances into the domestic retail market. In recent years, the EE&C promotion and dissemination program has been appearing frequently in the media. Four projects were carried out in 2007 and six projects were implemented in 2008—2009. The projects are mainly focused on communication via public media, radio, television, newspapers, and other public relations activities. Almost all projects in Component 2 have completed the proposed tasks, including Vietnam television and radio, the contest for energy efficient buildings, and provision of EE&C information to the school education system at all levels. No information is available on the extent to which these activities incorporated energy efficient lighting themes.

Vietnam participates in the ASEAN-Japan, *Promotion on energy efficiency and conservation (PROMEEC)* program activities and it is reported that EE&C activities have



been undertaken under this umbrella. However, no details of specific activities, or the extent to which they included lighting themes, are available.

7.11.6 Product Quality Testing Capacities

Testing capability for lighting products exists in research, product quality inspection and production facilities in Vietnam:

- Research facilities include the Institute of OSH Viet Nam, Viet Nam Science Center, Hanoi University of Technology
- Product quality inspection facilities include The Quatest 1, 2, 3 Test Laboratories, located in North, Central and South of Viet Nam
- Production facilities include JSC Thermos Bulbs Rang Dong (Ha Noi), Dien Quang Company (Ho Chi Minh City), and Philips Company (Ho Chi Minh City)

7.11.7 Production/Manufacturing of Lamps

Vietnam's fluorescent lamp exports (of all types) had a 2009 trade value of 5.5 million USD. Vietnam's fluorescent lamp imports for 2009 had a value of 4.8 million USD, thus creating a small trade surplus. Major trading partners for exports are Venezuela, Japan and Cambodia; major partners for imports are China, Thailand and Japan.

Vietnam has manufacturing capability for CFLs with three main manufacturers producing 29 million lamps for the domestic market per year, with another one million being produced by other manufacturers (based on 2009 figures). One manufacturer also produces around 30 million lamps for export.

In 2009, Vietnam exported shipments valued over 35.1 million USD of incandescent and tungsten incandescent lamps worldwide, including to regional partners Indonesia, Malaysia and Thailand. (UN COMTRADE 2011)



8 General Conclusions for Southeast Asia Region

The results of this initial survey of countries in the Southeast Asia region show a significant diversity among countries. While some countries have strong experience and resources to support a transition to efficient lighting, others have yet to develop all the necessary elements and capacities required. However, overall, four key historical and current activities have set the Southeast Asia region on the road to effective transition to efficient lighting:

- Local commitment in many countries to realize the potential savings from energy efficient lighting leading to a large number of pilot actions and roll-out of larger programs developing appropriate local capacities, market regulation, and information to the consumer;
- Some countries have professionals active in international organizations that develop and harmonize lighting standards, and, there are groups in the region that welcome government, industrial and not-for-profit professionals who are ready to engage in peer-to-peer discussions and activities;
- The region has lighting manufacturing facilities and trade partnerships that are slowly forming the basis for a more robust local lighting economy; and,
- A history of support from multilaterally-funded efforts to assist developing countries introduce efficient lighting so that they can be prepared to phase out inefficient lighting;

8.1 Key strengths and weakness of the region across the four elements required for Phase-out

Summarizing the information from Section 7, overall the Southeast Asia Region has many of the elements needed to support a transition to efficient lighting (refer to table 10). This detailed analysis can be drawn together to examine regional strengths and weakness in each of the four elements required for effective and sustainable phase-out.

8.1.1 Regulatory framework

Almost all the countries in the region have at least some framework for the development and implementation of test methodologies and mandatory standards and/or labelling. In particular, Indonesia, Malaysia, Philippines and Thailand have comprehensive systems, with Cambodia, Singapore and Vietnam having moderately well advanced processes.

8.1.2 Supporting policies

All countries in the region have initiated at least some policies supporting the promotion of more efficient lighting products. These have ranged from basic promotional programmes, through voluntary promotional programmes, to major fiscal support actions such as large scale subsidy programmes covering tens of millions of lamps. Again, the countries with the most experience of implementing such measures are Indonesia, Malaysia, Philippines and Thailand with significant activity in Vietnam and slightly less so in Cambodia and Singapore.

8.1.3 Monitoring, verification and enforcement

Once more, all countries in the region studied appear to have at least some degree of testing capability and a number have some level of quality assurance and/or regulatory



enforcement programmes in place. However, from the information available, it appears that overall this capacity may be limited. While these limitations vary by country, all countries have limitations in one or more of the following areas:

- **Systematic capacity:** structures are in place in a limited number of countries that enable the monitoring of products (and the associated product declarations) either during production or sale. However, in the majority of countries these are not comprehensive and may only cover, for example, safety or products registered under voluntary labelling/endorsement programmes;
- **Infrastructural Capacity:** while all countries have reported testing capacity of some nature, the number and quality of test laboratories may need expansion, or new facilities may need to be set up, to accommodate the volume of testing that is likely to be required to protect the consumer and the integrity of the phase-out programme; and,
- **Intellectual capacity:** some countries lack enough well-trained professionals to be able to plan and implement phase-out programs, testing, and follow-up enforcement.

8.1.4 Sustainable End of life

Within the region, only Thailand and the Philippines (planned) have any kind of systematic programme which considers effective end of life solutions for lighting products. Thus, significant knowledge and skills have to be developed to enable each country to have the capacity to develop end of life solutions suitable to their local situations.

8.2 Other regional considerations

8.2.1 Existing multilateral engagement

In their efforts to transform their lighting market, a number of countries in the region have already taken advantage of the financial and technical advisory services on offer from multilateral institutions. For example, Table 11 lists the Global Environment Fund (GEF) supports efforts to address climate change and environmental issues via a grant program. Several recent awards from GEF focus on lighting projects in Southeast Asia.

Table 10. Summary of Policies and Capabilities That Could Support the Transition to Efficient Lighting, by Country

Country	Regulatory & Control Mechanisms (a)	Economic & Market-based Instruments (b)	Fiscal Instruments & Incentives (c)	Support, Information & Voluntary Action (d)	Sustainability & End-of-life Approaches (e)	Monitoring, Verification & Enforcement (f)	Product Quality & Testing Capacities (g)	Production & Manufacturing (h)	Relative Readiness (i)
Brunei				X			X		limited
Cambodia	X			X			X		moderate
Indonesia	X	X	X	X		X	X	X (F, I)	strong
Laos				X			X		limited
Malaysia	X		X	X		X	X	X (F, I)	strong
Myanmar				X			X	X (F)	limited
Philippines	X	X	X	X	planned	X	X	X (I)	strong
Singapore			X	X		X	X	X (F, I)	moderate
Thailand	X	X	X	X	X	X	X	X (F, I)	strong
Timor-Leste		X		X			X		limited
Vietnam		X	X	X			X	X (F, I)	moderate
Southeast Asia Region (j)	moderate	moderate	strong	strong	limited	moderate	moderate	strong	moderate

Explanatory notes:

a. Regulatory and Control Mechanisms includes: minimum energy performance standards, mandatory labelling and certification; technology prohibition; energy codes for building; and, energy efficiency obligations and quotas.

b. Economic market-based instruments includes: cooperative procurement; energy service performance contracting; bank loans; instalment payments; and, financial leasing.

c. Fiscal Instruments and Incentives includes: taxation (increases or exemptions); subsidies; and grants and rebates.

d. Support, Information and Voluntary Action includes: awareness raising and education; detailed billing and disclosure; voluntary certification and labelling; public leadership and demonstration; and, voluntary and negotiated agreements.

e. Sustainability/End-of-life includes treatment initiatives such as collection, recycling and disposal.

f. Monitoring Verification and Enforcement includes activities in legal systems.

g. Product Quality Testing capacities includes national or accredited capacities and facilities, and, energy performance testing standards.

h. Production/Manufacturing includes lamps, fluorescent (F) and incandescent (I).

i. For discussion purposes only, and subject to comment by each country: If a country has regulatory and control mechanisms in place, plus three or more of the other readiness indicators (in the remaining columns), then the authors assign a "strong" rating; if a country has either regulatory and control mechanisms, and two or more readiness indicators, or, a total of four or more readiness indicators, then a "moderate" rating; and, if less than four indicators, a "limited" rating.

j. As in (i) above, if the region has six or more countries with a readiness indicator, then the authors assign a "strong" rating; if four or more, then a "moderate" rating, and if less than four, a "limited" rating.

F, I respectively indicate fluorescent and incandescent lamp production capability.

Table 11. GEF-Funded Lighting Projects in Southeast Asia, as of September 2011.

GEF ID	Country	Climate Change: Full-size Project, Name	GEF Agency	GEF Grant (USD)	Co-financing Total (USD)	Project Status
1103	Philippines	Efficient Lighting Market Transformation Project (PELMATP)	UNDP	3,130,655	12,020,000	Project Completed
1106	Vietnam	Energy Efficiency Public Lighting Project (VEEPL)	UNDP	3,000,000	12,383,000	IA Approved
3755	Vietnam	Phasing out Incandescent Lamps through Lighting Market Transformation in Vietnam	UNEP	3,025,000	7,750,000	CEO Endorsed
519, 1439	Global / Philippines	Efficient Lighting Initiative (Tranche I & ELI)	IBRD/IFC	15,000,000	35,000,000	IA Approved, Completed

8.2.2 Regional engagement with standards and other lighting bodies

Countries in Southeast Asia have strong relationships with international organizations which research and develop lighting knowledge, standards and publications, as noted in Table 12. Having a strong professional lighting community with these international links encourages information exchange and peer-to-peer discussions that are invaluable for harmonizing efforts to phase out inefficient technology while increasing the adoption of quality lighting.

Table 12. Southeast Asian country membership in international organizations and partnerships related to lighting.

	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam
International Electrotechnical Commission (IEC)						
Overall national status	Full member	Full member	Full member	Full member	Full member	Associate Member
National body	National Standardization Agency of Indonesia	Standards Malaysia	Bureau of Product Standards	SPRING	Thai Industrial Standards Institute	Directorate for Standards, Metrology and Quality
IEC-technical committee 34, lamps	Observer	Observer	Participating	Observer	Participating	
International Commission on Illumination (CIE)						
Overall national status		National Committee		Associate National Committee		
National body		Malaysian CIE National Committee		CIE National Committee of Singapore		
Asia Lamp Compact (ALC)						
			Department of Energy, Philippines; and, Philippines Lighting Industry Association		Electricity Generating Authority of Thailand	

8.2.3 Production and Trade

Countries in Southeast Asia have established intraregional and worldwide trade in fluorescent lamp products, as shown in Table 13. Trade flow data collected by the United Nations Division of Statistics documents that a significant number of fluorescent lamps are manufactured in and exported from Southeast Asia. In 2009, exports from selected countries accounted for more than 182 million lamps with a trade value of over 177 million USD. The region imports slightly more fluorescent lamps than it exports: 191 million lamps imported, with a trade value of 194 million USD.

Having regional trade in lamps bodes well for phase-out programs because manufacturers can participate in local stakeholder meetings, adjust their output of products to meet future needs for efficient lamps, and increase local economic growth by exporting efficient lamp products to countries that lack local manufacturing capacity. If import tariffs are a barrier to adopting efficient lighting, then having local manufacturing of efficient lighting keeps costs lower for the country. For government agencies that must enforce efficient lamp legislation, having local manufacturing means that inspections can be conducted on a regular basis, with less expense than if the inspections were to take place in other countries, or, than if the agency had to pay a third party in another country to conduct inspections.

Table 13. Fluorescent lamp trade flows: imports and exports, by country, 2009. Note that this data includes, but is not limited to, CFLs, and that it is limited to data for shipments of value greater than USD 5 000. (UN COMTRADE 2011)

Country	Trade Value of Imports	Units of Lamps Imported	Top Three Import Trade Partners	Trade Value of Exports	Units of Lamp Exports	Top Three Export Trade Partners
	<i>USD million</i>	<i>million</i>	<i>Countries providing lamps, in descending order of trade value</i>	<i>USD million</i>	<i>(million)</i>	<i>Countries receiving lamps, in descending order of trade value</i>
Cambodia	1.14	0.77	Vietnam; China; Singapore			
Indonesia	99.54	67.79	China; Singapore; Japan	114.75	75.44	Japan; Malaysia; Philippines
Malaysia	25.72	37.54	China; Indonesia; Thailand	3.50	4.24	China (Hong Kong SAR); Singapore; Egypt
Philippines	9.17	22.35	China; Indonesia; Thailand	0.03	0.52	Other countries in Asia
Singapore	25.92	28.56	China; Germany; Netherlands	6.44	5.18	Other countries in Asia; Indonesia; Malaysia
Thailand	27.99	30.30	China; Japan; Indonesia	47.17	93.54	Republic of Korea; Malaysia; Australia
Vietnam	4.79	3.26	China; Thailand; Japan	5.47	3.60	Venezuela; Japan; Cambodia
Region	194.26	190.59		177.35	182.51	

Countries in Southeast Asia also have mineral reserves and mines that contain “rare earth” materials critical for efficient lamp manufacturing. These materials include elements that are used in the phosphors that enable high quality white light to be emitted from fluorescent lamps and LED lamps. Indonesia, Malaysia and Vietnam are sources of rare earths materials; Malaysia and Vietnam soon will have new rare earth refining and mining facilities. (Tung 2011; Asia Sentinel 2011; Bradsher 2011).



In addition to the promising economic future for production and export of fluorescent lamps from the region, policy makers must also consider the impact that incandescent lamp phase out programs worldwide may have on incandescent lamp production and export from Southeast Asian countries. Indonesia, Vietnam and Thailand in 2009 each exported incandescent lamps with values of 30 to 40 million USD; Singapore and the Philippines 2009 exports of incandescent lamps were valued at 23 million USD and 14 million USD respectively. The major trading partners for exports of all incandescent lamps from Southeast Asian countries in 2009 were Republic of Korea, importing total value of 28 million USD; Indonesia, 15 million USD; USA, 13 million USD; Japan, 8 million USD; and, Germany, 7 million USD. (UN COMTRADE 2011)

The value of domestic production and consumption of lamps, both fluorescent and incandescent, is not available through the authors' resources. This would be a topic for each country to examine via its internal manufacturing data resources.



9 Effectively and Sustainably Achieving Southeast Asia's Transition to Efficient Lighting

With several decades of efficient lighting programs completed, all stakeholders in the transition to efficient lighting in Southeast Asia could draw upon a wealth of information available on appropriate lighting technologies, best practices, and most importantly, a history of measurement and evaluation studies that point the way toward “what works” and how much can be achieved by various methods, within a given period of time.

To be effective, and to ensure sustainable results, key players in the region must quickly review and choose the strategies that will be a match with their own countries' needs, situation and resources. The en.lighten initiative offers a convenient and rapid way for countries to access the regulatory or voluntary-based elements that they may be missing, or have a weakness in, without having to recreate what has already been established by efforts in other countries.

During the recent UNEP/GEF en.lighten regional consultations in Latin America and Caribbean and in Middle East and North Africa, participants learned that they can find models for effective programs in their own and in other regions. The readers of this draft report and the participants in the November 2011 consultation in Singapore will have the opportunity to consider various methods that could help them achieve rapid results. Issues that could be discussed include:

- How can the more experienced countries in the region share their knowledge and advice with less experienced countries? Who are the key people who can help transfer knowledge? What support is needed for an effective knowledge exchange?
- What physical facilities are available in the region that might be utilized to speed the qualification of efficient lighting products for use across the region? Are these facilities set up to provide intra-regional services? If not, what would make it attractive and feasible for these facilities to expand their services?
- If the best-match models for transition to efficient lighting are found outside of the Southeast Asia region, what relationships could be furthered to enhance technology and knowledge transfer? Is there a role for multilateral institutions to play in facilitating this transfer?
- Can the countries, or groups of countries, in this region, team up to aggregate their purchasing power and offer a harmonized market for efficient lamp providers? Are there import/export barriers that could be lowered to encourage wider and faster distribution of efficient lighting products? If so, how could existing pacts facilitate changes to the import/export barriers?



- Could the region or specific countries in the region collaborate to offer one or more CDM programs that would attract financial and technical support from other countries?

Brainstorming and collaborating to address these and other topics could lead to agreements that would lay out a framework and timeframe for Southeast Asian countries to “leapfrog” over low-efficiency lighting directly to high-efficiency lighting. The en.lighten Global Partnership will provide its members with expertise and technical resources, such as the forthcoming policy toolkit and guide to develop successful and integrated transition strategies. The creativity documented in other regions of the world is a testament to how a great deal can be accomplished with modest means, and rapidly. Phase out programs ensure that efficient lighting will endure and will bring the regions millions of lighting users the benefits of modern technology.



10 Southeast Asia: Strong and Ready to Transition to Efficient Lighting

With strong population and economic growth forecast for Southeast Asia, efficient lighting offers a rapid and accessible means for the region to achieve societal and environmental benefits. Leaders in the region could build on the following strengths to accelerate the region's emerging efficient lighting market.

- All of the 11 countries included in this study participate in international climate change agreements. This level of interest and commitment is a promising precedent for participating in UNEP's en.lighten Partnership.
- All have policy or programmatic structures in place that either presently regulate lamps, or could be expanded to do so in the future. This bodes well for rapidly making a transition to efficient lighting.
- The region has an existing infrastructure for international collaboration, with lighting harmonization activities ongoing. Collaboration and harmonization can help aggregate the regional market to ensure that good quality products are available at reasonable cost.
- Multilateral institutions (including Asian Development Bank, Global Environment Fund, United Nations and World Bank) already have invested in—and might be able to support new—lighting efficiency programs in member countries in the region. These institutions together with private sector investors are exploring the prospects for high efficiency lighting product manufacturing and distribution facilities in the region's developing countries.
- Several countries are expanding or planning lighting manufacturing, quality testing and collection/recycling facilities for many types of lamps. Notably, the region hosts globally important manufacturing centers for LEDs. These investments will help the region's economy grow as the global lighting market expands. Having regionally-located facilities also ensures that local programs can address and benefit from all phases of the life cycle of emerging lighting technologies.
- As a global carbon economy develops, with its large population, urbanization and strong growth, Southeast Asia could be an attractive area for wealthy countries and investors to explore through CDM or other market-based climate change mitigation programs.

Joining the UNEP/GEF en.lighten Global Partnership would help each country leverage international resources and signal a readiness to bring the benefits of efficient lighting to every household, preserve the region's unique environmental assets and tackle climate change. Given that the Southeast Asia region has moderate strengths at present to transition to efficient lighting by phasing out inefficient lamps, we suggest that countries consider the en.lighten Partnership benefits as a way to strengthen the four "pillars", or essential structures and activities that are needed to support a sustainable transition. Specifically, the region needs to strengthen its:

- Regulatory Framework and Standards
- Supporting Policies and Mechanisms



- Measurement, Verification and Enforcement
- Sustainable End of Life Approaches

Also, within the en.lighten Global Partnership, Southeast Asian countries may find opportunities to share and learn best practices from their peers worldwide, choosing program models that are appropriate for their social, political and economic situation, identifying new partners with whom they can cooperate, and aggregating their efforts to achieve sustainable and significant successes in efficient lighting.

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Resources, Organizations and Activities

Asia Lighting Compact (ALC): www.asialighting.org/

- Manila Compact: www.asialighting.org/asian-harmonised-standards/alc-cfl-spec/14-sample-data-articles/98-the-manila-compact.html

Asia Pacific Economic Cooperation (APEC)

- APEC Energy Working Group: <http://www.apec.org/Home/Groups/SOM-Steering-Committee-on-Economic-and-Technical-Cooperation/Working-Groups/Energy>
- APEC Peer Review Mechanism on Energy Efficiency (PREE): <http://www.apec.org/en/Groups/SOM-Steering-Committee-on-Economic-and-Technical-Cooperation/Working-Groups/~media/1C1231950B6B4E7999338ECF6FFB61B2.ashx>
- Compendium of Energy Efficiency Policies of APEC Economies. Japan: Asia Pacific Energy Research Centre: <http://www.iecej.or.jp/aperc/CEEP/CEEP-all.pdf>

Asian Development Bank (ADB)

- Database and Development Indicators: www.adb.org/statistics
- Energy for All: <http://www.adb.org/clean-energy/energyforall-initiative.asp>
- Renewable Energy, Energy Efficiency, and Climate Change (REACH): <http://www.adb.org/Clean-Energy/reach.asp>

Association for Southeast Asian Nations (ASEAN),

- Agreement on the ASEAN Harmonized Electrical and Electronic Equipment Regulatory Regime (AHEEER): <http://www.asean.org/6669.htm>
- Center for Energy: www.aseanenergy.org/

Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS): www.acmecs.org

Barrier Removal to the Cost-Effective Development and Implementation of Energy Efficiency Standards and Labelling (BRESL): www.bresl.com

Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC): www.bimstec.org

Collaborative Labelling and Appliance Standards Program (CLASP): www.clasponline.org

ELI Quality Certification Institute (ELI QCI): www.efficientlighting.net

International Commission on Illumination (CIE): www.cie.co.at

International Electrotechnical Commission (IEC), Technical Committee 34, Lamps and Related Equipment: http://www.iec.ch/dyn/www/f?p=103:7:0:::FSP_ORG_ID:1235



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United Nations

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- United Nations Environment Program (UNEP): www.unep.org
- UNEP en.lighten Initiative: www.enlighten-initiative.org/
- UN Framework Convention on Climate Change (UNFCCC)

US AID, Southeast Asia Regional Initiative for Energy (SARI/Energy): www.sari-energy.org

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