UNEP

Achieving the Global Transition to Energy Efficient Lighting Toolkit

United Nations Environment Programme

Disclaimer
The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the United Nations Environment Programme concerning the legal status of any country, territory, city or area or of its authorities, or concerning delimitation of its frontiers or boundaries. Moreover, the views expressed do not necessarily represent the decision or the stated policy of the United Nations Environment Programme, nor does citing of trade names or commercial processes constitute endorsement.

The information contained within this publication is for general guidance on matters of interest only, and may be subject to change without notice. While we have attempted to ensure that the information has been obtained from reliable sources, the UNEP/GEF en.lighten initiative is not responsible for any errors or omissions, or for the results obtained from the use of this information. All information is provided on an “as-is” basis with no guarantee of completeness, accuracy, timeliness or of the results obtained from the use of this information, and without warranty of any kind, express or implied, including, but not limited to warranties of performance, merchantability and fitness for a particular purpose.

In no event will the en.lighten initiative, its related corporations, contributors, or the partners, agents or their respective employees have any liability to you or anyone else for any act and conduct in connection with or related to the information provided herein. This disclaimer applies to any damages or liability and in no event will the en.lighten initiative be liable to you for any indirect, consequential, exemplary, incidental or punitive damages, including lost profits, even if the en.lighten initiative has been advised of the possibility of such damages.

ISBN: 978-92-807-3238-2

Table of Contents

Overview

Section 1- Making the Case

Section 2 - Selecting and Implementing Energy Efficient Lighting Policies

Section 3 - Financing the Transition to Energy Efficient Lighting

Section 4 - Ensuring Product Availability and Conformance

Section 5 - Safeguarding the Environment and Health

Section 6 - Communications and Engagement

Acknowledgments

Lead Authors:

Michael Bender-Mercury Policy Project/Zero Mercury Working Group
Alicia Culver-Responsible Purchasing Network
Raffaella Donadio-Business Solutions Europa
Axel Donzelli-Business Solutions Europa
Laura Fuller-UNEP, Division of Technology, Industry and Economics
Ned Groth-Mercury Policy Project consultant
Sian Hughes-Business Solutions Europa
Zura Nukusheva-UNEP, Division of Technology, Industry and Economics
Giuseppe Petito-Business Solutions Europa
Luigi Petito-Business Solutions Europa
Gerald Strickland-Energs, Climate, Energy & Environment Consulting
My K. Ton- International Energy & Environment Consulting
Eric Uram-Mercury Policy Project consultant

Special Thanks to:

UNEP would like to thank the following individuals and organizations for their valuable comments, advice and provision of data: Thorsten Schulz; Iciar Parera Bermudez-Entropia Consultora Social y Cultural; Chris Granda-Grasteu Associates; Andreas Hoffmann-Green Light New Orleans; Brian Holuj-US Department of Energy; Elena Nekhaev-The World Energy Council, ADEME and Motiva Services Oy.

UNEP Project Steering Committee:

Marcel Alers-UNDP
Benoit Lebot-UNDP
Morgan Bazilian-UNIDO
Wolfgang Gregor
Alfred Haas-OSRAM AG
Noah Horowitz – Natural Resources Defense Council
Richard Hosier-The World Bank
Shuming Hua-National Lighting Test Centre
David Rodgers-The Global Environment Facility
Yamina Saheb-International Energy Agency
Lars Stühlen-OSRAM AG
Harry Verhaar- Philips Lighting

UNEP en.lighten team:

Myriam Arras-Nobecourt
Kathryn Conway
Laura Fuller
Gustau Mañez Gomis
Edu Hassing
Zura Nukusheva
Javier Otero
Michael Scholand
Jing Wang

Design by:

Benjamin Walker- Touraine Design Studio

The en.lighten Global Taskforce Members:

Andreas Adam-OSRAM AG
Tanzeed Alam-The World Wide Fund for Nature
Peter Banwell-Energy Star Program, U.S. EPA
Barry Bredenkamp- National Energy Efficiency Agency, South Africa
Anton Brummelhuis-Philips Lighting
Michael Cavallo-Clinton Climate Initiative
Francesca Cerni-UNEP Basel Convention
Juan Miguel T. Cuna-Department of Environment and Natural Resources, The Philippines
Lv Fang-PILESLAMP
Otmar Franz-OSRAM AG
Takehiko Fukushima-Ministry of the Environment, Japan
Rajiv Garg-UNEP, Southeast Asian Climate Change Network
Sandeep Garg- Bureau of Energy Efficiency, India
Ted Glenny-Philips Lighting
Wolfgang Gregor-OSRAM AG
Hans Peter Grieneisen-Instituto Nacional de Metrologia, Brazil
Kalle Hashmi-Swedish Energy Agency/NLTC
Noah Horowitz-Natural Resources Defense Council
Manoranjan Hota-Ministry of Environment and Forests, India
Shuming Hua-National Lighting Test Centre, China
Raquel Huliganga-Philippines Department of Energy
Stuart Jeffcott- Jeffcott Associates Ltd.
Rachel Kamande-European Environmental Bureau
Leon Konings-Philips Lighting
Elena Lymberidi-Settimo-European Environmental Bureau
Kees van Meerten-Philips Lighting
Attila Mórotz-European Lamp Companies Federation
Eugenie Nadezhdin-Russian Energy Agency
Desiree Montecillo Narvaez-UNEP DTIE Chemicals
Georg Niedermeier-OSRAM AG
Iain Notman-UK Department for Environment, Food and Rural Affairs
Sergia de Souza Oliveira-Ministry of the Environment, Brazil
David Piper-UNEP DTIE Chemicals
Philipp Plathner-OSRAM AG
Pablo Reali-DINAMA/UNEP/UNIDO/Basel Convention, Uruguay
Marion Reiser-OSRAM AG
Ashok Sarkar-The World Bank
Stephan Singer-The World Wide Fund for Nature
Melanie Slade-Department of Climate Change and Energy Efficiency, Australia
Lars Stühlen-OSRAM AG
Shyam Sujan-Electric Lamp and Component Manufacturers Association of India
Yangzhao Sun-Ministry of Environmental Protection of China
Andras Toth-European Commission DG Energy
Edouard Toulouse-European Environmental Citizens Organization for Standardization
Roberto González Vale-Ministry of Basic Industry, Cuba
Susan Wingfield-UNEP Basel Convention
Aiming Zhou-Asian Development Bank
Georges Zissis-Université Paul Sabatier

Executive Summary

In most developing countries, the gap between electricity supply and demand is increasing rapidly. Countries must consider the high cost of new power generation and increasing fuel prices when making policy choices. Climate change and the need for utilizing existing resources sustainably, requires immediate action to reduce carbon emissions. According to the International Energy Agency, lighting accounts for approximately 19% of global electricity consumption[1]. Improvements in energy efficiency help to reduce electricity demand, consumption and associated greenhouse gas emissions. The transition to energy efficient lighting is a straightforward and cost-effective approach to addressing climate change.

With recent advances in lighting technology, the most efficient lamps use one-fifth of the energy to produce the same amount of light as the least efficient lamps. They also can last up to 35 times longer[2]. Most of the lighting in the domestic sector in developing countries is still supplied by inefficient lamps and many countries throughout the world have yet to transition to efficient lighting. This may be due to many factors including: uncertainty on the part of governments about how to begin a phase-out programme; a lack of information about alternative products; capacity issues; scepticism about the potential benefits of efficient lighting; and the lack of the necessary resources to effectively implement a transition.

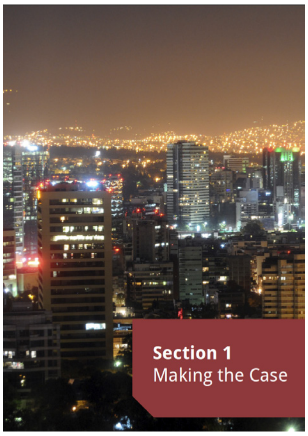
The Energy Efficient Lighting Toolkit was developed to present a concise set of options and policy suggestions to countries and interested stakeholders. It provides efficient lighting best practices and case studies from programmes throughout the world. It addresses technology, policy, consumer and environmental protection issues. It enables a country to select relevant information and guidance and apply these to suit local or regional conditions.

The Toolkit was conceived as a means to promote an integrated policy approach. This will ensure that areas sometimes overlooked in national phase-out programmes will be considered and implemented to support a national strategy. Am integrated policy approach encompasses: minimum energy performance standards; supporting policies; monitoring, verification and enforcement; and, environmentally sound management.

The Toolkit was developed by a large group of lighting efficiency experts from over 20 countries including individuals from; governments, the private sector, civil society and international organizations, all of whom are qualified to deliver examples and key suggestions based on energy efficient lighting transformation efforts that have been implemented, or are currently in progress, around the world. The Toolkit will be reviewed and updated approximately yearly after its release to integrate new developments, perspectives and emerging best practices.

Section 1: Making the Case

Efficient lighting programmes involve the widespread replacement of existing lighting products and thus, must overcome a variety of barriers:



- Financial barriers are due primarily to the higher initial cost of energy efficient lighting products, relative to inefficient products
- Market barriers may include the lack of availability of low-cost, high quality, efficient lighting products due to low demand; lack of local production and/or high import costs or tariffs; and inadequate promotion of energy efficient lighting products
- Information barriers result from a low degree of awareness and information about energy efficient lighting among professionals, trade partners and the public
- Regulatory institutional barriers involve a lack of government interest or resources; insufficient enforcement of policies; the need for more qualified personnel; lack of capacity; corruption; priority on increasing supply rather than on reduction of consumption; and lack of comprehensive national and/or local energy policies
- Technical barriers include the lack of resources and infrastructure such as recycling and testing facilities; and, problems with electrical power supply (including outages, brown-outs, power surges and voltage variations)
- Environmental and health risk perception barriers include concerns about quality of light; possible exposure to electromagnetic fields (EMFs) and possible exposure to hazardous materials that may be contained in the electronics or other lamp components, including mercury (Hg) in discharge lamps

The first step in deciding whether a country would benefit from phasing out inefficient lighting is to understand how much electricity is currently being consumed nationally by lighting, and what potential savings a move towards efficient lighting presents. Such an assessment provides the necessary data to support the cost and benefit analyses and effective policies.

In addition to energy and emissions savings, more efficient lighting offers additional benefits for governments and consumers. By using more efficient lighting, consumers pay less in lighting energy costs; valuable electricity generating capacity is freed to assist in productive economic development at very low cost; and governments benefit from reduced energy imports and increased energy security. There are four main areas of benefit to using energy efficient lighting, beyond the direct benefits of energy and cost savings: political, economic, environmental and societal.

1. "Light's Labour Lost: Policies for Energy-Efficient Lighting, in Support of the G8 Plan of Action." International Energy Agency, OECD, 2006.
2. U.S. Environmental Protection Agency (EPA) Draft 2 Version 1.0 ENERGY STAR Product Specification for Lamps, July 6, 2012. The minimum life for non-decorative (general illumination) LED lamps is 25,000 hours for consumer sector and for 35,000 hours for commercial sector products.

To understand the benefits of energy efficient lighting and its impact on society and the natural environment, it helps to understand the fundamentals of lighting technology and the basic differences between inefficient lamps and their energy efficient alternatives. The technology focus of the Toolkit is primarily single-ended, omnidirectional lamps used for ambient illumination. It does not address directional lamps or special purpose lamps but rather focuses on three general categories of light sources:

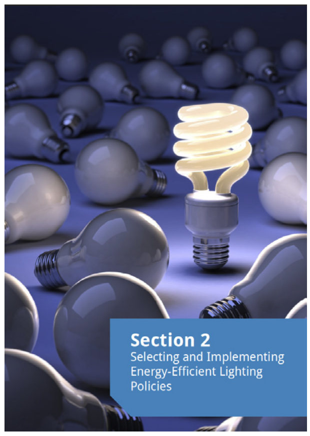
- Metal filament lamps - incandescent and tungsten halogen
- Compact fluorescent lamps (CFLs)
- Light emitting diode (LED) lamps

To provide countries with estimates of potential energy and financial savings and greenhouse gas (GHG) emission reductions, the en.lighten initiative prepared Country Lighting Assessments. These estimates are based on replacing inefficient lamps with efficient products of equivalent light output for residential, commercial/industrial and street lighting applications. They present information in a way that can be easily understood and used by stakeholders who are considering or developing National Efficient Lighting Strategies.

Developed and emerging countries around the world have set up energy efficient lighting programmes to address the dual issues of environmental and energy security. Case studies presented in this Toolkit offer fact-based information on best practices in lighting technology, policy, and consumer and environmental protection. Countries that embark on a transition can consider additional resources available from the en.lighten initiative, such as the Global Efficient Lighting Partnership Programme. The en.lighten initiative recognizes that there is not a '"one size fits all' approach to promoting an effective transition to efficient lighting. The information in this Toolkit should be considered by each country and adapted as appropriate to national circumstances.

Section 2: Selecting and Implementing Energy Efficient Lighting Policies

There are a wide range of tools for designing and implementing energy efficient lighting programme available to policymakers:



- Regulatory and control mechanisms - laws and implementation regulations that require certain devices, practices or system designs to improve energy efficiency
- Economic and market-based instruments - market mechanisms initiated and promoted by regulatory incentives which may contain elements of voluntary action or participation
- Fiscal instruments and incentives - mechanisms that impact prices, such as taxes aimed at reducing energy consumption or financial incentives to overcome upfront costs
- Support, information and voluntary actions - initiatives that aim to persuade end users to change their behaviours by providing information and examples of successful implementation

Minimum energy performance standards (MEPS) are regulatory tools that increase the average energy efficiency of individual product classes. They contribute to the phasing out of the least efficient products in a market by setting the minimum levels of energy efficiency that a product in a given class must meet before it can be sold. MEPS provide the most cost-effective policy option for phasing out inefficient lighting products and replacing them with more energy efficient options. When effectively applied, MEPS, in conjunction with supporting policies, encourage manufacturers to improve the efficiency of their products or to introduce more efficient replacements. Before MEPS are adopted, cost/benefit analyses must be performed to ensure that the associated rules and regulations provide a positive economic benefit to the nation or market that implements them. MEPS should be developed in consultation with all of the stakeholders involved in the manufacture and sale of the products to which they apply. Other tools used to encourage a transition to efficient lighting include: technology prohibition; certification and labelling of products; energy efficiency obligations; and building energy codes.

While there is a wide range of policy tools for designing and implementing energy efficient lighting programmes, effective options for the phase-out of inefficient lamps should primarily focus on the residential market, where the adoption of energy efficient lighting tends to be slower due to cost and information barriers.

For the residential market, policy options include:

- Minimum energy performance standards (MEPS)
- Mandatory labelling and certification
- Voluntary certification and labelling
- Cooperative procurement, subsidies, rebates and giveaways
- Tax increases or exemptions
- Awareness raising, promotion and education
- Instalment payments or on-bill financing

MEPS are the most sustainable option for achieving high levels of energy efficiency and for phasing out inefficient lamps. To be effective, MEPS must be carefully implemented. Performance levels and programme requirements must be developed with stakeholders' input to obtain maximum buy-in and participation. Once implemented, MEPS programmes need to be monitored, evaluated, updated, and revised, as necessary. The most important factor for programme success is a functional system of monitoring, control, and testing facilities capable of ensuring enforcement and full compliance of products (see Section 4).

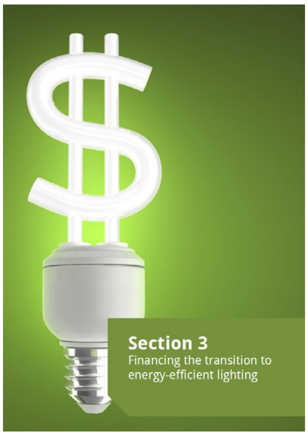
The success of any efficient lighting programme depends on the selection and combination of other policies to meet the specific needs of a country and the particular objectives of a phase-out scheme. Other policy options should be used to support the implementation of MEPS in order to reduce the use of inefficient lamps while promoting the demand for MEPS-compliant high efficiency lamps. An integrated policy approach positions MEPS as the cornerstone of a sustainable national efficient lighting strategy.

Lack of information for consumers and limited availability of products are two main barriers to improving lighting energy efficiency. Policy options to address these obstacles and to support MEPS implementation include labelling and certification, as well as cooperative procurement and subsidies, rebates and giveaways. The labelling of efficient lighting products – either voluntary or mandatory – and product certification provide end users with clear and trustworthy information to overcome awareness and decision barriers. The implementation of bulk or cooperative procurement and subsidies, rebates and giveaways can complement existing lighting distribution channels to increase awareness and rapid introduction of energy efficient lamps.

Labelling and certification programmes as well as procurement, subsidy, rebate and giveaway initiatives should include strong stakeholder engagement, lighting industry collaboration, and industry incentives to participate and promote more efficient products. The design of these programmes must take into account the impacts on manufacturers and retailers; address the issue of fair competition; and promote quality products to avoid unintended consequences in the market. It is important to thoroughly identify the technical criteria for energy efficient lamps and to support a long-term, self-sustaining energy efficient lighting market.

New policy initiatives should take into account the design of similar programmes around the world, and involve the establishment of monitoring, verification and enforcement regimes to control compliance and reduce instances of non-compliance with MEPS, labelling, and procurement requirements. As lighting products tend to be a commonly traded commodity, it may be practical to align MEPS with trading partners, or work towards regional harmonization.

Section 3: Financing the Transition to Efficient Lighting



Implementing a national efficient lighting strategy requires significant funding to overcome market barriers and to establish supporting infrastructure. Resources, primarily financial, but also human, technological and institutional, are required to effectively implement an integrated policy approach. Identifying and securing financial resources to support a national efficient lighting strategy and complementary activities such as communication campaigns and compliance programmes can be difficult for developing countries that lack an energy efficiency infrastructure. However, experiences from many countries show that investments in energy efficient lighting can be highly cost-effective.

Early and thorough planning and analysis efforts focusing on finance and resource requirements are essential to allow for a national discussion and agreement on significant issues such as; funding sources, cost-sharing arrangements; and, the type and duration of resources required for a comprehensive phase-out programme. These issues are much more difficult to address once a programme is under way, and may increase costs or create delays that can affect the programme momentum.
Early and thorough planning may also allow governments the option of securing more than one source of funding and apply each to a suitable component of an integrated approach. For example, multilateral funding can help expansion of policies; bilateral funding can be applied towards MEPS development; voluntary carbon market funding can be used for complementary activities such as giveaway or rebates. Environmentally sound management funds could be sourced internally, through extended producer responsibility approaches or other voluntary or regulatory means.

For countries with resource constraints, regional or international cooperation offers the potential to gain additional resources and to provide access to additional capacities to support a national phase-out initiative. Elements of a phase-out programme, such as MEPS, testing capabilities, market verification of compliant products, and even consumer labelling or energy performance standards, can lend themselves to a regional or bilateral approach when countries share common borders, trade, or language.

Regional or bilateral cooperation to increase the adoption of high quality, energy efficient lighting products can provide countries and regions with ways to reduce common implementation costs while increasing the potential to mitigate the effects of climate change and enhance international collaboration. In addition, regional recycling systems can be the optimal solution in cases where national approaches are not financially viable to support the recycling of lamps in one single country.

Many governments cite the lack of funding and underdeveloped infrastructure as barriers to initiating a national transition to energy efficient lighting. Clearly, the initial resource outlay for such a conversion is significant, especially for those countries that have not yet committed resources towards basic investments in energy efficiency. Without adequate resources to support the implementation of phase-out policy approaches and critical complementary activities such as compliance measures, the effectiveness of a phase-out programme can be compromised.

Experiences from other nations demonstrate that the transition to energy efficient lighting has been highly cost-effective. Argentina, Brazil, Cuba and South Africa highlight the fact that what is needed in the beginning is not necessarily funding, but rather the political will to commit to a transition to energy efficient lighting. Nevertheless, a successful transition requires both long-term policy commitment as well as investments in institutions and systems at each implementation level.

Investing in four areas will ensure a successful and integrated policy approach:

- Development of MEPS
- Design and implementation of supporting policies
- Establishing measurement, verification and enforcement scheme
- Establishing environmentally sound management for lighting products

National conditions and approaches to phase-out programmes vary therefore; a detailed country-specific cost/benefit analysis will be required to help identify resource and funding requirements as well as available domestic resources. Governments that secure more than one funding resource can allocate each to a suitable component. The case studies noted in the Toolkit describe programmes around the world which can provide references for agencies that are responsible for identifying and securing sources of funding.

Some governments regard energy efficiency as a priority for energy security. Accessing external sources of funding for energy efficient lighting projects requires that governments provide a strong, long-term national commitment to a cost-effective strategy, to persuade funding agencies to commit sufficient resources. Countries need to develop integrated and sustainable national efficient lighting strategies that demonstrate to donors that they are genuinely committed to implementing a comprehensive transition.

Section 4: Ensuring Product Availability and Conformance

National policies and programmes that support the phase-out of inefficient lighting significantly improve energy efficiency, reduce electrical demand and reduce greenhouse gas (GHG) emissions. Monitoring, verification and enforcement (MVE) schemes increase compliance and are an essential part of a national efficient lighting strategy. MVE activities directly support a country's MEPS.

Compliance activities protect the market from products that fail to perform as declared or required; guarantee hat consumer satisfaction is in line with their expectations; and, ensure that policymakers, government regulators, programme administrators and other officials meet their programme objectives. Compliance activities also protect suppliers by ensuring that they are all subject to the same programme entry conditions.

Without continuous compliance procedures, non-compliant products compromise the effectiveness of efficient lighting programmes and policies. For example, the results of recent international and regional surveys indicate that a savings of over 4,000 TWh (equivalent to over 2,000 $MtCO_2$), may be lost due to non-compliant products being sold between 2010 and 2030, throughout all energy efficient programmes on a global basis . These studies emphasize the need to improve MVE structures and practices in most countries and that investment in these procedures has been shown to be highly cost-effective. Beyond MEPS, labelling of products, particularly efficient lamps, and rigorous MVE are favoured by many governments that encourage the entry of more energy efficient lighting products into their marketplace.

When developing MVE policies and programmes, the issues that need to be addressed include:

- Establishing the rationale for and value of MVE and its related objectives for the lighting sector
- Determining essential elements of an MVE implementation such as programme entry conditions and various options for handling non-compliant products in the market
- Policy recommendations, policy options and priorities for policymakers and programme managers
- Implementing and integrating with standards and labelling programmes
- Developing and strengthening laboratory testing capacity and regional cooperation to increase the effectiveness while reducing costs

MVE testing and laboratory infrastructure for lighting requires significant effort and investment since lamps are available in many models and thus, there needs to be frequent testing of numerous types. Regional cooperation on GHG emissions reduction provides considerable opportunity to improve enforcement through the sharing of test capacities and the results of testing and verification. Sharing essential programme information can enhance the ability and skills of countries to monitor, verify, and enforce energy efficiency regulations. Cooperation promotes best practices while lowering costs. The increased adoption and use of high-quality, efficient lamps helps countries increase energy efficiency and improves international collaboration on common clean energy challenges and GHG emissions reduction.

Successful MVE implementation requires long-term policy commitment, as well as investments in training and support at each implementation level. The UN has recognized the global threat associated with the proliferation of low-quality goods that are, generally in breach of technical regulations and intellectual property rights, sold at prices that exclude fair competition. These products can pose serious threats to human health and safety as well as generate pollution and contribute to environmental degradation.

At the country level, MVE is about measuring and ensuring compliance for energy efficient lighting products. This is especially critical to maximize the potential for energy savings and for the effective elimination or phase-out of the most inefficient lighting products by a MEPS programme. To counter the existence of poor product quality products, a country's policy response should be to strengthen market surveillance to ensure that non-compliant lamps are removed from the market through enhanced collaboration with regulators, public authorities acting in cooperation with industry, civil society stakeholders and others. This requires training for new programme managers and highlights the need for information sharing, inter- and intra-agency, and utilizing a checklist approach in order to avoid simple mistakes.

At the regional level, governments and lighting suppliers can work together to develop a common, harmonized approach to maximize available resources. Stakeholders within a region can work together and coordinate actions to increase MVE effectiveness. The sharing of information, harmonization of standards, and cross-border cooperation can result in a regional quality control system that significantly increases end user confidence.

Section 5: Safeguarding the Environment and Health

Environmentally sound management incorporates the concept of life-cycle management, provides regulators with a suitable framework to analyse and manage the performance of goods and services in terms of their impact on the environment. Life-cycle management can reduce a product's carbon, material and water footprints, and improve social and economic performance. To optimize the life-cycle benefit of lamps, it is important to minimize the environmental impacts that occur during each phase of a lamp's life. The Toolkit focuses on:

- Production – summarizes the various production techniques for metal filament (incandescent) lamps, CFLs and LED lamps and focuses on hazardous substances, as the production phase is a natural point of intervention for hazardous substance regulators in the product life-cycle. Emphasis is placed on regulating the level of mercury in CFLs.
- Usage – focuses on the environmental impact of lamps during the usage phase and health and safety aspects of lighting including the steps to take in case of breakage
- End-of-life – focuses on the end-of-life management of spent lamps, highlighting current regulatory frameworks, examples of best practices in establishing, managing and financing end-of-life collection; recycling and environmentally sound management; and disposal of mercury-added lamps

From a life-cycle perspective, phasing out inefficient incandescent lamps and replacing them with CFLs and LED lamps reduces CO2 emissions and mercury pollution from fossil fuel burning. However, because CFLs contain mercury, a more integrated policy approach is required, one that follows the principles of pollution prevention and environmentally sound management. This approach includes maximizing energy efficiency and lamp life and minimizing toxicity at the design and manufacturing stages, while instituting the sustainable management of spent lamps.

This is consistent with global international policies that reduce and safely manage hazardous waste, such as the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, and the on-going Intergovernmental Negotiating Committee's efforts to prepare a legally binding agreement on reducing mercury pollution.

Potential concerns about mercury-added lamps have resulted in viable methodologies and good practices for the environmentally sound management of spent lamps. Collection and recycling systems coupled with technologies that capture and securely contain mercury can be effective. Further processing to recover mercury and recycle other lamp components is manageable and affordable if an appropriate system is designed and properly implemented.

Regulators can explore and adopt approaches that encourage the collection and recycling of mercury-added lamps. These approaches should be adapted to national conditions. If effectively designed and managed, they can also create jobs in the collection and recycling industry. To succeed, environmentally sound management programs require sustainable funding, adequate legislation, the implementation of a comprehensive collection scheme, and community participation. Communication and on-going awareness campaigns are required to increase and then maintain compliance.

During the transition to CFLs and LED lamps interested parties may voice concerns about the potential impact of these products on health and the environment. CFLs do not release mercury, unless the lamp is broken during installation, storage or transportation. Mercury releases from broken CFLs can be minimized by providing the public with information on how to prevent breakage and properly clean up and dispose of broken CFLs. The amount of mercury entering the environment from CFLs can be further minimized when the mercury is recovered from spent lamps.

Raising awareness among consumers about high-quality, low mercury lighting products will help guide their purchasing decisions. Ensuring good quality lamps in the market and verifying their compliance with maximum mercury limits will minimize health and safety risks. When introducing new lighting-related laws, regulators should ensure adequate compliance with existing health and safety laws.

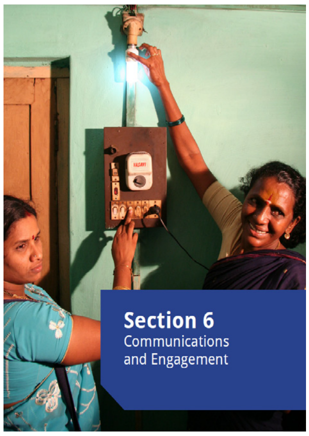
Countries are encouraged to adopt standards to gradually reduce and limit the amount of hazardous substances such as mercury, without compromising light output or life expectancy of lamps. The European Union RoHS Directive is considered as international best practice in setting hazardous substance requirements, reducing the potential for exposure to six hazardous substances during the manufacture, transportation, storage, use, and end-of-life management of lamps.

Policy makers should consider regulations that limit the content of mercury and other hazardous substances in lamps. Limits should be set in line with the international best practice standards, aiming for progressively lower levels of mercury in CFLs. Limits should be reviewed regularly and adjusted to account for technical progress.

By following the Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury, mercury emissions from spent lamps can be virtually eliminated. Governments can fund these programmes taking into account a number of scenarios. Extended producer responsibility systems where all stakeholders share in the responsibility have proven to be the most cost-effective.

Environmentally sound management of lamps should be an essential element of any national efficient lighting strategy. To succeed, programmes require adequate legislative frameworks, sustainable funding and a supervised design approach combined with broad-based community participation and support. Communication and on-going awareness campaigns are also essential to ensure the success of an integrated policy approach.

Section 6: Communication and Engagement



Energy efficiency is one of the most important issues on a country's agenda. Promoting energy efficient lighting can greatly reduce peak energy loads and better utilize existing capacities without having to build new, expensive generation facilities. The rationale behind a communications campaign varies between countries where climate change considerations directly or indirectly are key drivers and other countries where energy supplies are crucial.

The basic elements of efficient lighting communications campaign inlcudes:

- Designing a campaign
- Setting the objectives and duration of the campaign
- Understanding the audiences
- Communicating to government, institutions, businesses, the public and the media
- Crafting messages
- Implementation, monitoring and evaluation

Awareness-raising communications campaigns support national efficient lighting strategies and promote lighting energy efficiency policies and programmes. Changes in end user behaviour can lead to energy savings as high as 20%. Changes in energy conservation, lifestyle, awareness, low-cost actions, and small investments all contribute to overall savings. When properly conducted, public awareness and education campaigns help energy efficient lighting programs gain momentum in the marketplace. They also reinforce the long-term effects of other related energy efficiency measures. In addition to providing end users with knowledge about specific energy efficiency issues and their environmental and financial impact, they can help to promote general acceptance and create a positive public environment for energy efficiency.

Energy efficiency improvements and related market transformation require informed consumers and awareness among all segments of society, as well as the provision of fcustomized information, education and training for selected stakeholders. Assessing the aims of a communications initiative and intended audience message from the outset, helps to establish clear goals and objectives, and identifies the resources (time, personnel, and funding) required. Each campaign must account for the cultural and social attitudes of the region as they apply to energy efficiency. Additionally, to ensure their effectiveness, campaigns should be designed based on research results, such as market surveys, and should involve a large number of stakeholders.

Public awareness campaigns are usually designed and implemented by government agencies or NGOs and may also involve private companies. The messages communicated in countries with capacity issues, promote the fact that investments in improving energy efficiency are usually a more cost-effective solution than investments in new generation capacity. In progressive energy markets, the provision of energy services, including energy efficiency campaigning, helps to build positive company image. It is important to consult with industry stakeholders when designing a programme to ensure that the key messages are compatible.

To be effective, a public information campaign must be adapted to its specific audience, deliver a credible and understandable message, and create a social context that leads to the desired outcome. Effective promotion of energy efficient products relies heavily on an appropriate education and awareness strategy. Promotional activities raise awareness among potential purchasers, as well as sellers and service providers, and work best when they demonstrate the full range of benefits attributable to the energy efficient lighting products, not just their energy saving benefits.

The success of any communication and awareness raising campaign depends on its design, especially with regard to planning, implementation and evaluation. The design phase of any such campaign should follow a rational approach of answering – in an integrated manner – the 'why, who, when, how, what' aspects of the campaign.

Planning is crucial for implementing a communications campaign. Campaign managers and implementers must have a good understanding of the local market needs, driving forces and the prevailing market conditions. Goals and objectives need to be balanced with available resources and attention must be paid to the timing of the activities. Ideally, campaigns should be based on market segmentation which allows for better focus, the use of targeted media and more efficient use of resources. Extended campaigns with a repetition of key messages are more effective than singular campaigns. Campaign resources can be augmented and enhanced by cooperation with partners, suppliers, retailers and other stakeholders.

The process of awareness-raising must meet and maintain the mutual needs and interests of the stakeholders. An integrated approach to a communications campaign helps to reach all identified target groups and to account for socio-economic factors, language and access to media. The audience might consist of not only the general population or specific demographic groups, such as low-income households, but also include the supply-side stakeholders such as; manufacturers, trade associations, equipment distributors, retailers, or sales cooperatives. Target group requirements need to be completely understood, communication channels need to be chosen carefully, and messages must be adapted appropriately.

Given the complexity and multitude of lighting energy-use patterns and target groups to be addressed, a focused and tailored approach is needed because success depends on the engagement of all those involved. Each stakeholder has a role to play in understanding and delivering the important efficient lighting message which will ultimately lead to a successful national transition to energy efficient lighting.

Glossary

average life: the average of the individual lives of the lamps subjected to a life test, the lamps being operated under specified conditions and the end of life judged according to specified criteria. (IEC)

ballast: a device connected between the supply and one or more discharge lamps which serves mainly to limit the current of the lamp(s) to the required value. (IEC)

benchmark testing: a complete check of products available in the market on a systematic and regular basis.

bulb: transparent or translucent gas-tight envelope enclosing the luminous element(s) (IEC)

calibration: set of operations which establishes, by reference to standards, the relationship which exists, under specified conditions, between an indication and a result of a measurement. (IEC)

cap and trade program: a market-based approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants. A central authority (usually a government) sets a limit or "cap" on the amount of a pollutant that can be emitted. This is allocated or sold to firms in the form of emissions permits. The transfer of permits is referred to as a "trade."

certified emission reduction (CER): a Kyoto Protocol unit equal to 1 metric tonne of CO_2 equivalent. CERs are issued for emission reductions from CDM project activities. (UNFCCC)

check testing: a preliminary assessment of products to determine which are likely to fail a full verification test.

Clean Development Mechanism (CDM): allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol, Article 12 (Annex B Party) to implement an emission-reduction project in developing countries.
(ref: http://unfccc.int/kyoto_protocol/items/2830.php)

Conformité Européenne marking (CE Marking): states that a product is assessed before being placed on the market and meets EU safety, health and environmental protection requirements. Used in European Economic Area ("EEA", consisting of the 27 EU Member States, and the EFTA countries Iceland, Liechtenstein and Norway). Per DECISION No 768/2008/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 July 2008 on a common framework for the marketing of products, and repealing Council Decision 93/465/EEC.

colour rendering: effect of an illuminant on the colour appearance of objects by conscious or subconscious comparison with their colour appearance under a reference illuminant. (IEC)

colour rendering index (CRI): measure of the degree to which the psychophysical colour of an object illuminated by the test illuminant conforms to that of the same object illuminated by the reference illuminant, suitable allowance having been made for the state of chromatic adaptation. (IEC)

compliance: conforming to a rule, such as a law, policy, specification or standard. Also, fulfillment by countries/businesses/individuals of emission reduction and reporting commitments under the UNFCCC and the Kyoto Protocol. (UNFCCC)

correlated colour temperature (CCT): the temperature of the Planckian radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions. Unit: K (IEC)

cost-plus model: a pricing model, also known as mark-up pricing, where the cost of the product is calculated and then a proportion of this cost is added as mark-up to derive the price.

demand-side management (DSM): the modification of consumer demand for energy through various methods such as financial incentives and education.

dimmer: a device in the electric circuit for varying the luminous flux from lamps in a lighting installation. (IEC)

directional lamp: a lamp having at least 80% light output within a solid angle of π sr (corresponding to a cone with angle of 120°). (EC)

discharge lamp: lamp in which the light is produced, directly or indirectly, by an electric discharge through a gas, a metal vapour or a mixture of several gases and vapours. (IEC)

distribution loss: loss of electrical energy during transmission over the distribution grid between the power station and the consumer, mainly as a result of the resistance of the electrical cables.

efficacy: see luminous efficacy

emissions trading: One of the three Kyoto mechanisms by which an Annex I Party may transfer Kyoto Protocol units to, or acquire units from, another Annex I Party. An Annex I Party must meet specific eligibility requirements to participate in emissions trading. (UNFCCC)

end of life: when a product's usefulness has ended.

energy intensity: a measure of total primary energy use per unit of gross domestic product. (IEA)

enforcement strategy: a set of responses to incidents of non-compliance, coupled with a progressive action plan for their application.

extended producer responsibility: a strategy designed to promote the integration of environmental costs associated with goods throughout their life cycles into the market price of the products.

fluorescent lamp: a discharge lamp of the low pressure mercury type in which most of the light is emitted by one or several layers of phosphors excited by the ultraviolet radiation from the discharge. Note: These lamps are frequently tubular and, in the UK, are then usually called fluorescent tubes. (IEC)

full procedure verification test: a test where all procedures for measurements and records stipulated in the entry conditions for an accreditation scheme have been followed.

green investment fund: a mutual fund or other investment vehicle that will only invest in companies that are deemed socially conscious in their business dealings or which directly promote environmental responsibility.

greenhouse gases (GHGs): The atmospheric gases responsible for causing global warming and climate change. The major GHGs

greenhouse gases (GHGs): The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH4) and nitrous oxide (N20). Less prevalent --but very powerful -- greenhouse gases are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6). (UNFCCC)

halogen: elements in Group VIIA of the periodic table, including fluorine, chlorine, bromine and iodine.

heavy metals: elements with a specific gravity that is at least five times the specific gravity of water. Some heavy metals are required by living organisms, including humans, but some are dangerous to health or to the environment and some may cause corrosion. Note: not a standardized definition.

illuminance (at a point of a surface): quotient of the luminous flux $d\Phi v$ incident on an element of the surface containing the point, by the area dA of that element. (IEC)

illumination: application of light to a scene, objects or their surroundings so that they may be seen. (IEC)

incandescent (electric) lamp: lamp in which light is produced by means of an element heated to incandescence by the passage of an electric current (IEC)

installed generating capacity: sum of the maximum load-carrying capacity of the generation facilities that are connected to a transmission or distribution system.

interim life test: test conducted at a specified point during the rated lifetime of a lamp.

Kyoto Protocol: an international agreement linked to the UNFCCC, adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. The Kyoto Protocol sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions that amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.
(ref: http://unfccc.int/kyoto_protocol/items/2830.php)

laboratory accreditation: procedure by which an authority formally recognizes that an organization is competent to carry out specific tasks.

lamp: source made in order to produce an optical radiation, usually visible. Note: This term is also sometimes used for certain types of luminaires. (IEC)

lamp cap (lamp base-US): that part of a lamp which provides connection to the electrical supply by means of a lampholder or lamp connector and, in most cases, also serves to retain the lamp in the lampholder.
Note 1: The term base is also used in both the United Kingdom and the United States of America to denote an integral part of a lamp envelope which has been so shaped that it fulfils the function of a cap. It may engage either a holder or a connector, depending on other design features of the lamp- and holder system.
Note 2: The cap of a lamp and its corresponding holder are generally identified by one or more letters followed by a number which indicates approximately the principal dimension (generally the diameter) of the cap in millimetres. (IEC)

leasing: process of obtaining the use of certain fixed assets via a series of contractual and periodic payments.

life (of a lamp): the total time for which a lamp has been operated before it becomes useless, or is considered to be so according to specified criteria.
Note: Lamp life is usually expressed in hours. (IEC)

life test: test in which lamps are operated under specified conditions for a specified time or to the end of life and during which photometric and electrical measurements may be made at specified intervals. (IEC)

light emitting diode: solid state device embodying a p-n junction, emitting optical radiation when excited by an electric current. (IEC)

lumen (lm): SI unit of luminous flux: Luminous flux emitted in unit solid angle (steradian) by a uniform point source having a luminous intensity of 1 candela. (IEC)

lumen depreciation: luminous flux lost at any selected, elapsed operating time, expressed as a percentage of the initial output. Converse of lumen maintenance.

lumen maintenance (luminous flux maintenance factor): ratio of the luminous flux of a lamp at a given time in its life to its initial luminous flux, the lamp being operated under specified conditions.
Note: This ratio is generally expressed in per cent. (IEC)

luminaire: apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply. (IEC)

luminous efficacy: quotient of the luminous flux emitted by the power consumed by the source. unit: lm * W-1 ; symbol: $\eta v;\eta$ (IEC)

luminous flux: quantity derived from radiant flux Φe by evaluating the radiation according to its action upon the CIE standard photometric observer. Unit: lm (IEC)

luminous intensity (of a source, in a given direction): quotient of the luminous flux $d\Phi v$ leaving the source and propagated in the element of solid angle $d\Omega$ containing the given direction, by the element of solid angle

$$I_v = \frac{d\Phi_v}{d\Omega}$$

unit: cd = lm · sr $^{-1}$. (IEC)

maximum mercury content: maximum amount of mercury added to gas discharge lamps to enable their operation.

mercury (Hg): a metallic element, the only one that is liquid at room temperature.

metal filament lamp: incandescent lamp whose luminous element is a filament of metal (IEC)

minimum energy performance standards (MEPS): regulatory measures specifying minimum efficiency levels acceptable for products sold in a particular country or region. MEPS define what products can be marketed and which ones should be eliminated.

omnidirectional lamp: emits light in all (or near to all) directions.

peak energy demand: period in which electrical power is expected to be provided for a sustained period at a significantly higher than average supply level.

performance contracting: means of raising money for investments in energy efficiency, based on future savings. Money that will be saved as a result of the introduction of a new energy efficient technology is used to offset the cost of financing, installing and operating that technology.

performance indicator: quantifiable measurement, agreed to beforehand, by which the performance, efficiency or achievement of a person, project or organization can be assessed.

photometry: measurement of quantities referring to radiation as evaluated according to a given spectral luminous efficiency function, e.g. V(λ) or V'(λ). (IEC)

power factor: under periodic conditions, ratio of the absolute value of the active power P to the apparent power S:

$$\lambda = \frac{|P|}{S}$$

Note: Under sinusoidal conditions, the power factor is the absolute value of the active factor. (IEC) power quality: characteristics of the electric current, voltage and frequencies at a given point in an electric power system, evaluated against a set of reference technical parameters. Note: These parameters might, in some cases, relate to the compatibility between electricity supplied in an electric power system and the loads connected to that electric power system. (IEC)

product life, lifetime: see rated lifetime

radiometry: measurement of the quantities associated with radiant energy. (IEC)

rated lifetime: measure of the declared lifetime of a lamp, in operating hours. Generally, the time after which 50% of a specified number of lamp units cease to operate.

rated luminous flux (of a type of lamp): the value of the initial luminous flux of a given type of lamp declared by the manufacturer or the responsible vendor, the lamp being operated under specified conditions. Unit: lm.

Note 1: The initial luminous flux is the luminous flux of a lamp after a short ageing period as specified in the relevant lamp standard.

Note 2: The rated luminous flux is sometimes marked on the lamp. (IEC)

rated power (of a type of lamp): the value of the power of a given type of lamp declared by the manufacturer or the responsible vendor, the lamp being operated under specified conditions. Unit: W.

Note: The rated power is usually marked on the lamp. (IEC)

rated voltage or rated voltage range: nominal voltage/range of voltage at which a piece of electrical equipment is designed to operate.

rating (of a lamp): the set of rated values and operating conditions of a lamp which serve to characterize and designate it. (IEC)

rebound effect: behavioural responses to the introduction of new, more efficient, technologies whereby consumers use the product in question more frequently or for longer because of its increased efficiency. This results in a reduction in the beneficial effects of the new technology

registration verification: process of confirming that registered products meet the requirements of a programme's entry conditions

relamping: replacement of the removable lamp in a luminaire. May describe replacement of inefficient lamps with more efficient lamps.

retrofit: to add a component or accessory to a product to replace the component or accessory installed when the product was initially manufactured or installed.

revolving loan fund: source of money from which loans are made for multiple small business development projects where the central fund is replenished as individual projects pay back their loans, creating the opportunity to issue other loans to new projects.

screening: see check testing

self-ballasted lamp: a discharge lamp with the ballast integrated into the unit.

self-certification: practice of submitting information about one's product in a formal statement rather than being obliged to ask a third party to do so.

SI unit: any of the units adopted for international use under the Système International d'Unités.

special purpose lamp: designed for specific applications and not suitable for general illumination.

spectral power distribution: power per unit area per unit wavelength of an illumination (radiant exitance), or more generally, the per-wavelength contribution to any radiometric quantity (radiant energy, radiant flux, radiant intensity, radiance, irradiance, radiant exitance, or radiosity)

spectral radiant density: amount of light per time interval (spectral radiance) coming from all directions and absorbed by a specific volume.

spectral resolution: separating light into its separate components.

start-up time: amount of time it takes for a lamp to reach stabilized light output after being switched on.

stress test: process of determining the ability of a product to maintain a certain level of effectiveness under unfavourable conditions.

third party certification: verification by an independent and competent third party of the manufacturer or supplier's claim of conformity.

transformer: apparatus for reducing or increasing the voltage of an alternating current.

transmission and distribution loss: electric power transmission and distribution losses include losses in transmission between sources of supply and points of distribution and in the distribution to consumers, including pilferage. (WB)

tungsten filament lamp: incandescent lamp whose luminous element is a filament of tungsten (IEC)

tungsten halogen lamp: gas-filled lamp containing halogens or halogen compounds, the filament being of tungsten (IEC)

ultraviolet radiation: optical radiation for which the wavelengths are shorter than those for visible radiation.

Note: For ultraviolet radiation, the range between 100 nm and 400 nm is commonly subdivided into: UV-A 315.to 400 nm; UV-B 280 to 315 nm; UV-C 100 to 280 nm. (IEC)visible radiation (light): any optical radiation capable of causing a visual sensation directly.

Note: There are no precise limits for the spectral range of visible radiation since they depend upon the amount of radiant power reaching the retina and the responsivity of the observer. The lower limit is generally taken between 360 nm and 400 nm and the upper limit between 760 nm and 830 nm. (IEC)

voltage: scalar quantity equal to the line integral of the electric field strength E along a specific path linking two points a and b:

$$U_{\mathrm{ab}} = \int_{r_{\mathrm{a}}}^{r_{\mathrm{b}}} E \cdot \mathrm{d}r$$

where $\boldsymbol{r}_a$ and $\boldsymbol{r}_b$ are the position vectors for a and b, respectively, and dr is the vector line element. (IEC)

voltage fluctuation: a series of voltage changes or a continuous variation of the r.m.s. or peak value of the voltage.
Note: Whether the r.m.s. or peak value is chosen depends upon the application, and which is used should be specified. (IEC)

voltage surge: a fast, short duration increase in the voltage of a system.

voluntary carbon market: term used to collectively describe the organizations and individuals that voluntarily buy and retire carbon credits to offset the carbon emissions caused by some or all of their activities.

wavelength: distance in the direction of propagation of a periodic wave between two successive points at which the phase is the same. Unit: m   Symbol: λ .
Note 1: The wavelength in a medium is equal to the wavelength in vacuo divided by the refractive index of the medium. Unless otherwise stated, values of wavelength are generally those in air. The refractive index of standard air (for spectroscopy : t = 15 °C, p = 101 325 Pa) lies between 1.000 27 and 1.000 29 for visible radiations.
Note 2: λ = v/v, where λ is the wavelength in a medium, v is the phase velocity in that medium, and v the frequency. (IEC)

References

(EC) The Commission of the European Communities: Official Journal of the European Union. 24.3.2009 L 76/3. Commission Regulation (EC) No 244/2009 of 18 Marach 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for non-directional lamps. Article 2, Definitions, items 5 and 6, directional lamp and non-directional lamp. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:076:0003:0016:EN:pdf

(IEA) International Energy Agency:
http://www.iea.org/glossary/glossary_U.asp

(IEC) International Electrotechnical Commission: Electropedia.
http://www.electropedia.org/iev/iev.nsf/index?openform&part=845

(UNFCCC) United Nations Framework Convention on Climate Change: Definitions.
http://unfccc.int/ghg_data/online_help/definitions/items/3817.php

WB Databank, Indicators: ttp://data.worldbank.org/indicator

Abbreviations and Acronyms

APLAC - Asia Pacific Laboratory Accreditation Cooperation
ASEAN - Association of Southeast Asian Nations
BEE - Bureau of Energy Efficiency
BIS - Bureau of Indian Standards
CADF – Carbon Asset Development Fund
CCT - correlated colour temperature
CDM - Clean Development Mechanism
CE - Conformité Européenne
CER - certified emission reduction
CF - Carbon Fund
CFE - Comisión Federal de Electricidad (Mexico)
CFL - compact fluorescent lamp
CIE - International Commission on Illumination
CIF - Climate Investment Funds (World Bank)
CISPR - International Special Committee on Radio Interference
CLASP - Collaborative Labeling and Appliance Standards Program
CO - carbon monoxide
CO_2 - carbon dioxide
COP - Conference of the Parties (UNFCCC)
CPF - Carbon Partnership Facility
CRI - colour rendering index
CTF - Clean Technology Fund
DH - Moroccan dirham
DSM - demand-side management
EFUP - Environmentally Friendly Use Period (China)
EIP - Electronic Information Products (China)
ELI - Efficient Lighting Initiative (International Finance Corporation)
EMF - electromagnetic fields
EU - European Union
FAQ - frequently asked questions
FIDE - Fideicomiso para el Ahorro de Energía Electrica (Mexico)
g - gram
GDP - gross domestic product
GEF - Global Environment Facility
GHG - greenhouse gas
GWh - gigawatt-hour
h - hour
Hg - mercury
IEA - International Energy Agency
IEC - International Electrotechnical Commission
IFC - International Finance Corporation
ILAC - International Laboratory Accreditation Cooperation
INR - Indian rupee
IPCC - Intergovernmental Panel on Climate Change
ISO - International Organization for Standardization
K - Kelvin
kg - kilogram
kWh - kilowatt-hour
L - British pound
LED - light emitting diode
lm/W - lumens per watt (luminous efficacy)
MEPS - minimum energy performance standards
mg - milligram
MMT - million metric tons
MtCO2e - metric tonne carbon dioxide equivalent
MtC - million tons carbon
MVE - monitoring, verification and enforcement
MW - megawatt
MWh - megawatt-hour
MXN - Mexican peso
NAMAs - Nationally Appropriate Mitigation Actions
NO - nitric oxide
NO_x - nitrogen oxygen compounds
OECD - Organization for Economic Co-operation and Development
Pb - lead
RoHS - Restriction of Hazardous Substances Directive
RWF - Rwandan franc
SO_2 - sulphur dioxide
SO_x - sulphur oxygen compounds
t - metric tonne
THB - Thai baht
TJ - terajoule
TWh - terawatt-hour
UAE - United Arab Emirates
UK - United Kingdom
UNDP - United Nations Development Programme
UNECE - United Nations Economic Commission for Europe
UNEP - United Nations Environment Programme
UNFCCC - United Nations Framework Convention on Climate Change
USA - United States of America
USD - United States dollar
UV - ultraviolet
VAT - Value Added Tax
VCS - Voluntary Carbon Standard
VER - voluntary emissions reduction
VND - Vietnamese dong
VOC - volatile organic compound
W - watt
WHO - World Health Organization
WEEE - Waste Electrical and Electronic Equipment Directive

Introduction

A general scientific consensus asserts that the emissions from human activity are altering the earth's climate. We need to act now to reverse this trend. This need for action was recognized globally in 1994 when 192 countries joined an international treaty, the United Nations Framework Convention on Climate Change (UNFCCC), to address the issue of climate change. In 1997, the Kyoto Protocol, an international agreement linked to the UNFCCC, was adopted. It has been ratified by 182 Parties of the Convention to date, and came into force in February 2005. It sets powerful and legally binding targets for 57 industrialized countries for reducing greenhouse gas (GHG) emissions.

Against this background, nations are now looking for opportunities to save energy and reduce GHG emissions. According to the International Energy Agency, lighting in 2005 accounted for 2,650 TWh or 19% of global electricity use per annum, equivalent to the power generated by all the gas-fired power stations in the world. The resulting emissions of 1,889 MtCO per year are equivalent to 70% of world passenger vehicle emissions. Without intervention, emissions will increase as the global population and the general standard of living increases.

The focus on improving the efficiency of electric lighting has the potential to be one of the most significant short-term initiatives to combat climate change. For example, compact fluorescent lamps (CFLs) provide a viable and cost-effective alternative to standard, inefficient incandescent lamps. A CFL uses less than a quarter of the energy and has a much longer rated life than an incandescent lamp. The savings potential from light emitting diodes (LEDs) is also significant. LED lamps still cost more than CFLs but their prices will decrease over time as did the prices of CFLs.

A study commissioned by Vattenfall that maps the global potential and opportunities for reducing the emissions of GHGs indicates that the cost of abatement via improvements in the efficiency of lighting systems is negative[3]. Reducing GHGs will provide a net benefit to society, with the financial benefits outweighing the cost even before considering the value of reduced emissions. The estimates suggest that the introduction of CFLs alone would result in a reduction of energy consumption for lighting of 80% and a global reduction in emissions of 200 MtCOe.

The reduction in energy consumption achieved through the adoption of energy efficient lighting has the potential to reduce demand on a country's electric energy generation infrastructure. This is particularly beneficial where capacity is constrained and outages are common.

Although it is already cost-effective for end users to use a range of energy efficient lighting options rather than standard inefficient lamps, there are still barriers to phasing out inefficient lamps. A transition to efficient lighting may require market interventions, particularly by governments. The term 'phase-out' describes government programmes that aim to displace inefficient lamps with higher efficiency products. Gradual replacement of inefficient products over time ensures that product and lighting quality can be maintained.

1. Global Move to Phase-Out Inefficient Lighting

Around the world, international, regional and national initiatives promote efficient lighting through phase-out programmes. The European Union and most OECD countries, including Australia, Canada, and the United States of America have already established a staged approach to phase-out inefficient lamps using regulatory measures and, in some cases, additional voluntary measures. In 2007, for example, Australian authorities introduced an import restriction on inefficient incandescent lamps used for general lighting purposes. In Latin America, Cuba was the first country to implement regulatory measures to phase-out incandescent lamps (in 2005). Other countries joining this trend include; Argentina (2010), Brazil, China, Colombia (2012), Ecuador (2011), Honduras (2010), and Mexico. Additionally, Uruguay has phased out incandescent lamps in the public sector.

Many developing and emerging countries however, have not initiated a transition and have not realized the economic and climate benefits of efficient lighting. Based on the knowledge gained by previous efficient lighting initiatives, best practices are available to help countries plan and implement National Efficient Lighting Strategies. An integrated policy approach presents an opportunity to ensure that areas usually overlooked in the national resolve to phase-out inefficient lighting such as the formulation of minimum energy performance standards (MEPS), the application of supporting policies, monitoring verification and enforcement (MVE) and environmentally sound management are given ample consideration and hence, have the best chance of implementation.

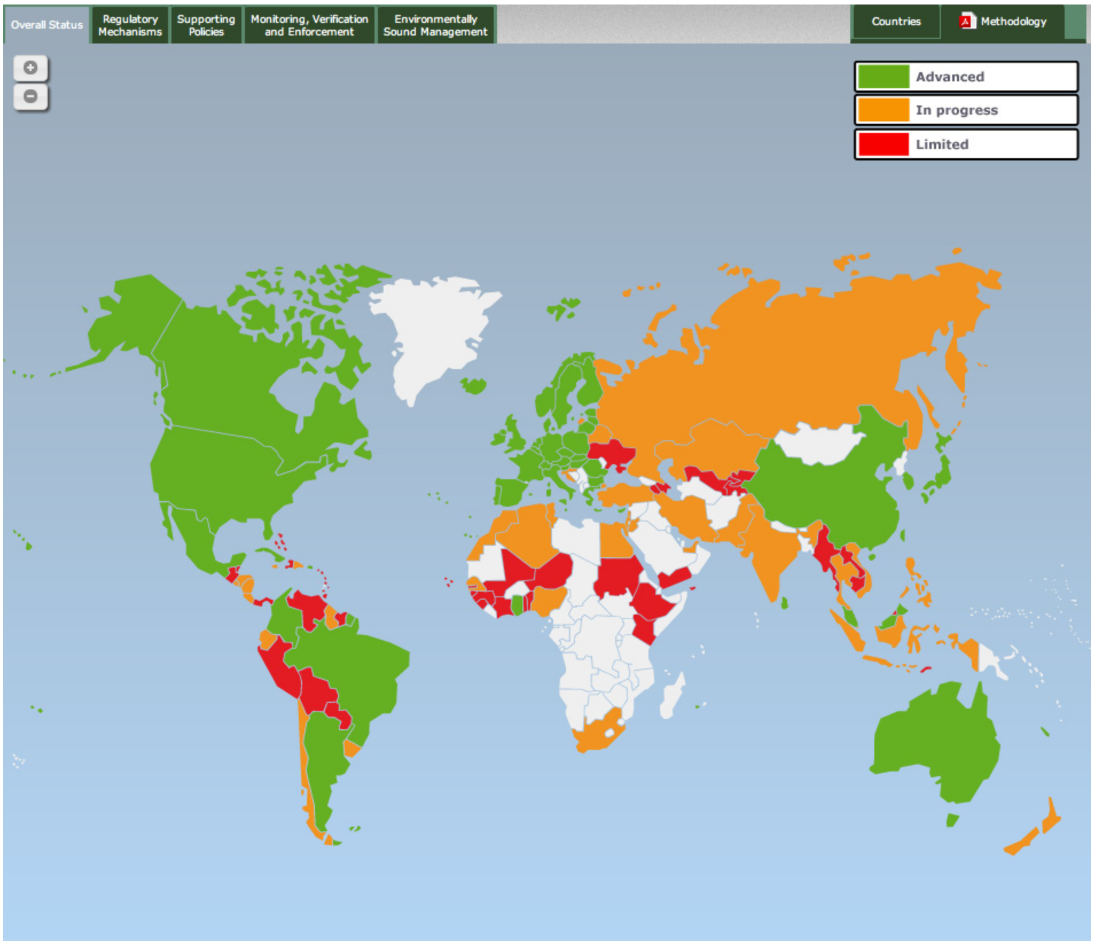
In most cases, the preferred policy approach is to restrict the supply of inefficient lamps through the establishment of MEPS. Lamps that do not meet the minimum requirements are prohibited from the market. Each country may adapt the MEPS approach to its own needs. For example, in the Uruguay Energy Efficiency Plan, mercury-added lamps must be labelled according to energy efficiency performance. Cuba followed a different route with an outright technology ban on all incandescent lamps.

Developing and emerging countries that employ supporting policies may offer promotional and/or giveaway programmes for CFLs. Or, countries, provinces and major cities may distribute efficient lamps at a discounted price. Some of these countries will continue the momentum from distribution programs by instituting MEPS.

The Efficient Lighting Policy Status map developed by the en.lighten initiative provides an online detailed overview of the status of energy efficient lighting policies and successes around the world for the residential sector. The information conveyed for each country

3. Vattenfall (2006). Global Mapping of Greenhouse Gas Abatement Opportunities. http://www.vattenfall.com/en/file/Corporate-Social-Responsibili_84279_8458235.pdf?WT.ac=search_success

includes all elements of an integrated policy approach: regulatory mechanisms; supporting policies; MVE activities; environmental sustainability actions; and other pertinent information. Each country is colour coded and ranked according to the status of policy development. Additionally, the ratings highlight the areas that need to be addressed in order to ensure that countries benefit fully from the financial, energy and environmental benefits associated with efficient lighting.



Toolkit Overview

1. Purpose

This Toolkit is based on best international practices for developing and implementing phase-out programmes and promoting energy efficient lighting. It is designed to assist stakeholders involved in developing National Efficient Lighting Strategies. It is part of a global effort to provide a concise set of multidisciplinary guidelines for regulators, national authorities, non- governmental organizations and a host of other stakeholders upon whom an effective market transformation depends.

2. Scope and Constraints

The Toolkit provides fact-based information on energy efficient lighting best practices encompassing technology, policy, consumer and environmental protection. This first edition of the Toolkit specifically examines the on-grid residential lighting (consumer) sector. The integrated policy approach promoted in the Toolkit also could be applied to other lighting sectors (commercial, industrial and public lighting).

The technology focus is primarily single-ended, omnidirectional lamps used for ambient illumination, such as compact fluorescent and light emitting diode lamps. The Toolkit does not address directional lamps or special purpose lamps.

The en.lighten initiative recognizes that there is not a 'one size fits all' approach to promoting an effective transition to efficient lighting. The information in this Toolkit should be considered by each country and adapted as appropriate to national circumstances. The Toolkit is a dynamic document that will be updated regularly as new information becomes available.

3. Structure

The Toolkit advocates an integrated policy approach to developing National Efficient Lighting Strategies. Six Sections offer a range of best practices and case studies.

1. Making the Case
2. Selecting and Implementing Energy Efficient Lighting Policies
3. Financing the Transition to Energy Efficient Lighting
4. Ensuring Product Availability and Conformance
5. Safeguarding the Environment and Health
6. Communication and Engagement

When establishing a national efficient lighting strategy, facets of existing programmes should be examined to see if they can be adopted to complement national efforts. This may include elements that are already in place, such as existing test and performance standards, labelling schemes, or efficient product endorsement programmes.

Building on and harmonizing with existing resources facilitates faster implementation of policies, reduces the costs of local implementation and, increases the likelihood of success. Harmonizing implementation with other programmes and standards will also encourage enforcement and lead to improved levels of compliance. This, in turn, will increase protection for the end user and reduce the burden on manufacturers and government agencies.

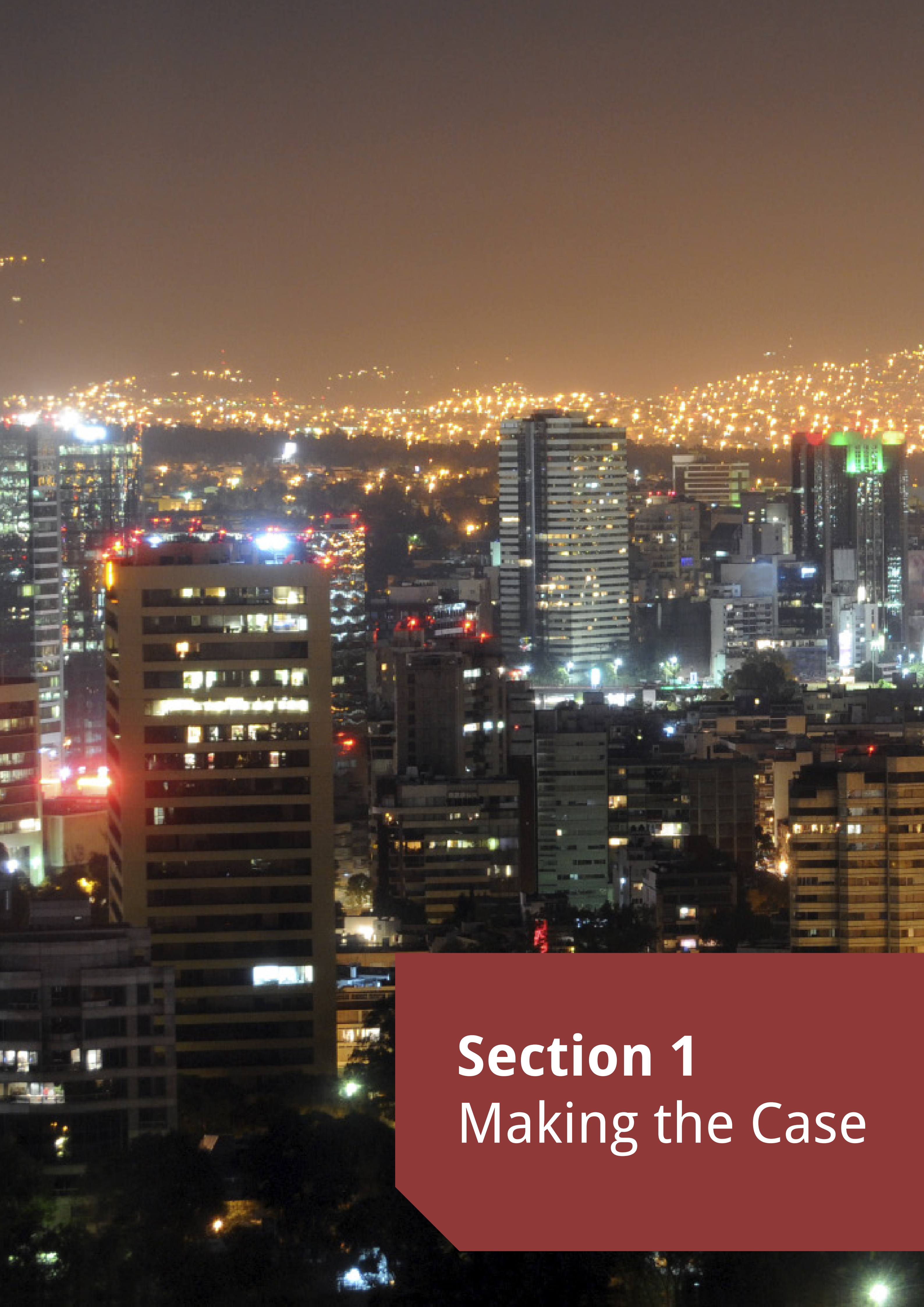
4. The en.lighten initiative

This Toolkit is one of the main deliverables offered by the United Nations Environment Programme (UNEP)/Global Environment Facility (GEF) en.lighten initiative. The en.lighten initiative promotes, accelerates and coordinates global efforts to achieve the transition to energy efficient lighting. It seeks to accelerate the commercialization and market transformation of efficient lighting technologies by working at a global level and providing support to individual countries. It aims to strengthen capacities among governments, the private sector and civil society to establish successful lighting market transformation programmes.

A key element in the structure of the en.lighten initiative is a network of international energy efficient lighting experts and a Centre of Excellence, established in 2010. The Toolkit has benefited from input in the form of comments and recommendations, provided by global expert taskforces which form the Centre of Excellence. They focus on:

- Lighting Policy – including mandatory and voluntary approaches to regulating lighting, finance, standard-setting and compliance;
- Consumer and Environmental Protection – including product safety, environmental impact of efficient lighting alternatives, requirements for end-of-life treatment of CFLs and awareness-raising communication on environmental, health and safety concerns;
- Country Lighting Assessments – demonstrating the potential of efficient lighting globally and in individual countries in the form of financial and energy savings, as well as climate benefits.

UNEP and its Partners also support interested countries in designing and implementing National Efficient Lighting Strategies through its Global Efficient Lighting Partnership Programme. An integrated policy approach ensures that the transition can be sustained by the domestic market without continued external support. Environmentally sound management is also incorporated. The Centre of Excellence provides targeted technical expertise to support the development of these policies to minimize the time and resources required to implement viable National Efficient Lighting Strategies and coordinated regional activities.



Section 1
Making the Case

Table of Contents

Executive Summary

Efficient lighting programmes involve the widespread replacement of existing lighting products and therefore, must overcome a variety of obstacles:

- **Financial barriers** are due primarily to the higher initial cost of energy efficient lighting products, relative to inefficient product
- **Market barriers** may include: the lack of availability of low cost, high quality, efficient lighting products due to low demand; the lack of local production and/or high import costs or tariffs; and inadequate promotion of energy efficient lighting products
- **Information barriers** result from the lack of awareness and information about energy efficient lighting among professionals and the public
- **Regulatory institutional barriers** involve: a lack of government interest or resources; insufficient enforcement of policies; the need for more qualified personnel; limited or no capacity; corruption; priority on increasing supply rather than on reduction of consumption; and lack of comprehensive national and/or local energy policies
- **Technical barriers** include: the lack of resources and infrastructure such as recycling and testing facilities; and problems with electrical power supply (including outages, brown-outs, power surges and voltage variations)
- **Environmental and health risk perception barriers** include: concerns about quality of light; possible exposure to electromagnetic fields (EMFs); and possible exposure to hazardous materials that may be contained in the electronics or other lamp components, including mercury (Hg) in discharge lamps

The first step in deciding whether a country would benefit from phasing out inefficient lighting is to understand how much electricity is currently being consumed nationally by lighting, and what potential savings a move towards efficient lighting presents. Such an assessment provides the necessary data to support a cost and benefit analyses and the development of effective policies.

In addition to energy and emissions savings, more efficient lighting offers supplementary benefits for governments and end users. By using more efficient lighting, consumers pay less in lighting energy costs; valuable electricity generating capacity is freed to assist in productive economic development at very low cost; and governments benefit from reduced energy imports and increased energy security. There are four main areas of benefit to using energy efficient lighting, beyond the direct benefits of energy and cost savings: political, economic, environmental and societal.

To understand the benefits of energy efficient lighting and its impact on society and the natural environment, it helps to understand the fundamentals of lighting technology and the basic differences between inefficient lamps and their energy efficient alternatives. Annex B contains more details on lamps, while Section 5 describes the life cycle and environmental, safety and health considerations for lamps.

The technology focus of the Toolkit is primarily on single-ended, omnidirectional lamps used for ambient illumination. The Toolkit does not address directional or special purpose light sources but rather focuses on three general lamp categories:

- Metal filament lamps - incandescent and tungsten halogen
- Compact fluorescent lamps (CFLs)
- Light emitting diode (LED) lamps

To provide countries with estimates of potential energy and financial savings and greenhouse gas (GHG) emission reductions, the en.lighten initiative has prepared Country Lighting Assessments. These estimates are based on replacing inefficient lamps with efficient products of equivalent light output for residential, commercial/industrial and street lighting applications. They present information in a way that can be easily understood and used by stakeholders who are considering or developing National Efficient Lighting Strategies.

Most developed and emerging countries around the world have set up energy efficient lighting programmes to address the dual issues of the environment and energy security. Case studies presented in this Toolkit offer fact-based information on best practices in lighting technology, policy, and consumer and environmental protection. Countries that embark on a transition can access additional resources available from the en.lighten initiative, such as those realized by countries that have joined the Global Efficient Lighting Partnership Programme. There is not a '"one size fits all' approach to promoting an effective transition to efficient lighting thus, the information in this Toolkit should be considered by each country and adapted, as appropriate, to national circumstances.

Introduction

The most efficient lamps for general illumination in the consumer sector use one-fifth to one-sixth of the electrical power to produce the same amount of light as the least efficient lamps and last us to 35 times longer.[1] While efficient lamps require less power, they also have rated life that is far longer than conventional, inefficient lamps. Technology advances make energy efficient lamps increasingly competitive with less efficient lamps. For example, the price of quality compact fluorescent lamps (CFLs) declined 90% in the past decade. In many markets worldwide, the retail price of a CFL is now between 1.50 USD and 2.50 USD.

The need to reduce the environmental impact of fossil fuel combustion makes a transition to efficient lighting imperative. Nevertheless, there are still many countries throughout the world that have not taken steps towards the transition to efficient lighting. This may be due to many factors including: uncertainty on the part of governments about how to begin a phase-out programme; a lack of information

1. U.S. Environmental Protection Agency (EPA) Draft 2 Version 1.0 ENERGY STAR Product Specification for Lamps, July 6, 2012. The minimum life for non-decorative (general illumination) LED lamps is 25,000 hours for consumer sector and for 35,000 hours for commercial sector products.

about alternative products and processes; capacity issues; scepticism about the potential benefits of efficient lighting; and the lack of the necessary resources to effectively implement a transition.
The first questions governments consider when deciding whether or not to transition to efficient lighting are, “Why should this action be taken?” and, “If a transition to efficient lighting has benefits, what options are available and what challenges will the nation face?” This Section addresses these questions by:

- Defining the direct and immediate benefits of energy efficient lighting
- Describing the political, societal, environmental and economic benefits of efficient lighting
- Summarizing the barriers that many countries face in implementing a national efficient lighting strategy
- Describing how to address these barriers
- Presenting options for a transition to efficient lighting

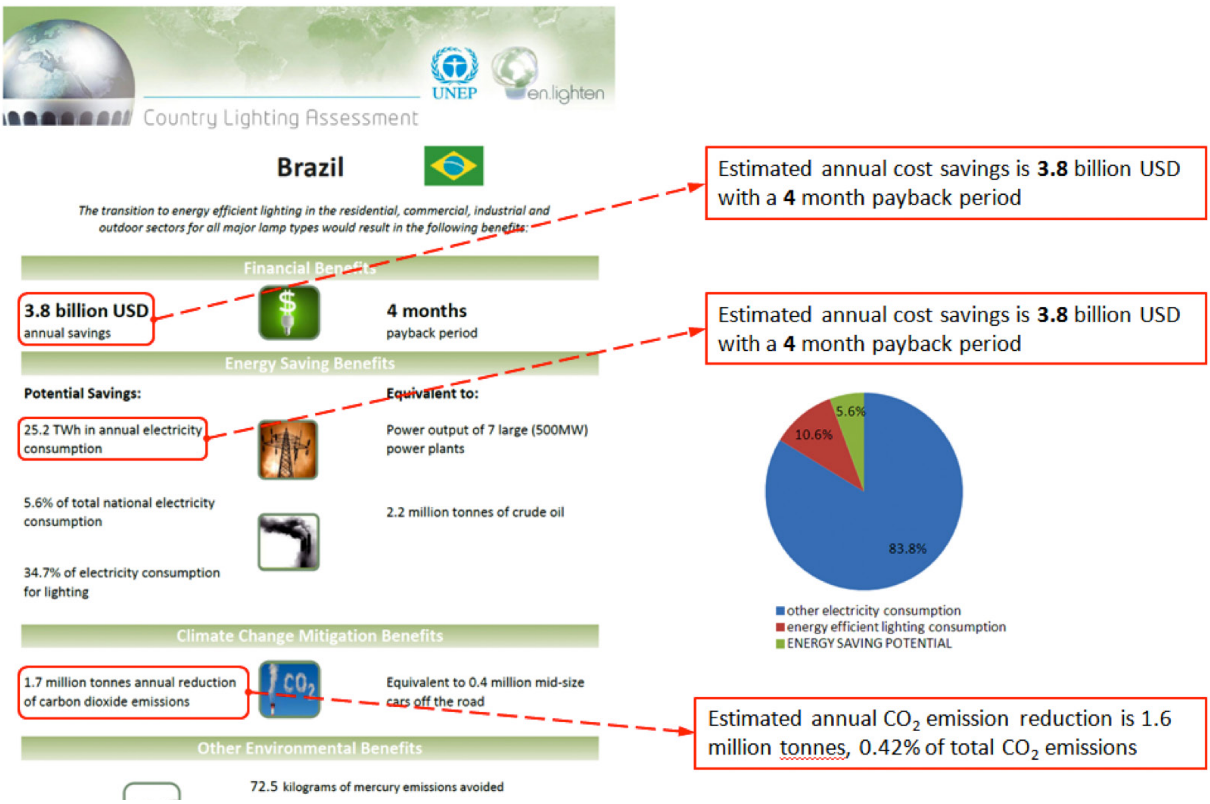
1. The Benefits of Switching to Efficient Lighting

The first step to take when a country makes the decision to benefit from switching to energy efficient lighting is to understand how much electricity is being consumed nationally by lighting, and what potential savings a move towards efficient lighting might represent. Such an assessment provides the necessary data to develop cost and benefit analyses and effective market transforming policies.

To assist countries, the en.lighten initiative has produced Country Lighting Assessments for 150 countries. These Country Lighting Assessments estimate the savings potential of a comprehensive shift to energy efficient lighting and cover the residential, commercial/industrial and outdoor lighting sectors. The assessments incorporate a transition to installed lighting that includes high efficiency products such as light emitting diodes (LEDs) and advanced fluorescent and high intensity discharge lamps. The Country Lighting Assessments deliver information on the potential:

- **Annual cost savings** for the country and payback period for investment in efficient lighting
- **Annual cost savings** benefits, including electricity savings, the percent savings in total national electricity consumption and electricity consumption for lighting consumption
- **Annual CO_2 emission reductions**, including tonnes of CO_2 emissions avoided and the equivalent number of mid-sized cars removed from the road that this represents

Figure 1: Example of a Country Lighting Assessment



Tables 1 and 2 below demonstrate the enormous potential energy savings and CO_2 emission reductions that would result if a country followed an integrated policy approach and switched to more energy efficient lighting. Additional details regarding the contents of the Country Lighting Assessments are provided in Annex A and the methodology describing the calculation process is available on online.

Table 1: Electricity consumption savings (% of total annual energy consumption) from a shift to energy efficient lighting in selected countries (en.lighten, 2012)

Country	Electricity savings (% of total)
Ukraine	12.0%
Haitit	8.5%
Mauritius	8.4%
Armenia	8.0%
Azerbaijan	7.9%
Afghanistan	7.6%
Sierra Leone	7.5%
Mali	7.3%
Libya	7.3%
Nepal	7.2%

Table 2: Potential CO_2 emission reductions (% of total annual CO_2 emission) from a shift to energy efficient lighting in selected countries (en.lighten, 2012)

Country	CO_2 reduction (% of total)
Botswana	6.8%
Isreal	6.6%
Papua New Guinea	6.1%
Lebanon	4.3%
Eritrea	4.1%
Mauritius	3.4%
Zimbabwae	3.1%
Swaziland	3.0%
Kuwait	2.9%
Libya	2.8%

2. Beyond Energy and Cost Savings

In addition to energy and emissions savings, moving to more efficient lighting offers additional benefits for governments and end users. By using more efficient lighting, consumers pay less in lighting energy costs; valuable electricity generating capacity is freed to assist in productive economic development at very low cost; and, governments benefit from reduced energy imports and increased energy security. There are four main areas of advantage to using energy efficient lighting, beyond the direct benefits of energy and cost savings:

- Political
- Economic
- Environmental
- Societal

2.1 Political and Macro-Economic

The political benefits of energy efficient lighting programmes arise primarily from the necessity to establish secure supplies of energy for the future. Over the next five decades, the world population is expected to increase from the current 7 billion to approximately 9 billion. This has led to a projected global energy demand in 2055 that is two and half times greater than the current level[2].

The main short-term political benefit stems from a reduction in peak electricity demand. The power sector in many countries is under severe stress as economic growth, urbanization and electrification lead to ever increasing demand for electricity. Lighting contributes greatly to the peak loads on the electrical system. Most of the lighting in the domestic sector in developing countries is provided by inefficient lamps. Switching to more efficient lighting helps to substantially reduce peak loads and limit the breaks in electricity supply that can lead to a reduction in economic activity and may be politically damaging.

Table 3 gives examples of the reductions in peak demand achieved through relatively small scale incandescent lamp replacement programmes in Vietnam, Uganda, Sri Lanka, South Africa, and India. Thus, even a simple incandescent lamp replacement programme can save enough electricity to either close multiple coal-fired power plants or, at the very least, reduce the capital requirement for future expansion of power generation. This will ultimately lead to a reduction in the cost of supplying electricity.

2. If one assumes an average economic growth rate of 2 per cent per capita per year and an improvement in energy efficiency of 0.8 per cent per annum (This represents an average value observed in many countries over several decades without particular policy effort and is also labelled 'autonomous technological progress').

Table 3: Examples of peak load reduction from CFL programmes[3]

Country	N° of CFLs installed	Reported peak load reduction (in MW)
Vietnam	1 000 000	33
Uganda	800 000	30
Sri Lanka	733 000	34
South Africa	2 700 000	90
India (BELP)	300 000	14

2.2 Economic Benefits for the Consumer

High quality, energy efficient lamps use considerably less energy than the inefficient lamps that they replace, and, they last much longer. If a consumer in a developing country has five 60 W incandescent lamps in their home, and if these are replaced with CFLs, then the consumer could save 40 USD per year with a payback time of just three months (see insert).

Cost savings can be especially important to consumers and governments in developing countries. A South African study showed that lighting makes up 80 per cent of the electricity demand in newly electrified homes. Efficient lighting provides a means to reduce the cost of living thus, helping to alleviate poverty for lower-income households. Furthermore, potential savings are not just limited to the domestic consumer. The impact of energy efficient lighting programmes is usually much greater for industrial and commercial customers.

Annual Developing Country Household Cost Savings from Efficient Lighting*

On average, the switch from an incandescent lamp with a rated light output of 870 lumens at 60 W to a CFL of 15 W with the same light output can result in a typical cost saving of 40 USD per year with a payback period of about three months. These savings and payback figures depend on the price of electricity relative to the price of the lamps but can be realized even in regions where electricity prices are very low. Even if the electricity price is assumed to be 0.05 USD/kWh or lower, the consumer still profits by switching from incandescent lamps to CFLs, because the energy saved is great enough to ensure that the economic saving is still able to cover the initial higher cost of the CFL.

*** Assumptions: an electricity price of 0.10 USD/kWh, five hours of consumption per day, five lamps per household, incandescent lamp lifet of 1000 hours and CFL life of 3000 hours, total cost of 0.75 USD for incandescent lamp and 2.18 USD for CFL.[4]*

2.3 Environmental

2.3.1 Reduced Emissions from Electricity Generation

Although the ultimate effects of human activity on global climate change are difficult to predict, the global scientific community is in general agreement that they could be severe, and that energy use is a major contributor. Because efficient lighting programmes are relatively simple to implement, they represent one of the easiest ways a country can make a positive impact on the global environment (and meet its international commitments) by reducing the generation of greenhouse gas (GHG) emissions from fossil fuel electricity generation. Reducing electricity demand reduces the production of air pollutants such as CO_2, NOx, and SOx and the emissions of other toxic substances such as heavy metals, particulate matter, volatile organic compounds (VOCs), and CO (from electricity generation).

On the basis of the fossil fuel required to generate the electricity to power each type of lamp, it is possible to calculate the GHG and other toxic emissions related to each lamp to evaluate the environmental benefit of efficient lighting.

3. ESMAP. (2009). Large-Scale Residential Energy Efficiency Programs Based on CFLs. Sarkar, A., Singh, J.
4. OSRAM Opto Semiconductors GmbH. (2009). Life Cycle Assessment of Illuminants. A Comparison of Light Bulbs, Compact Fluorescent Lamps and LED Lamps. Regensburg Germany).

Table 4: CO_2 and NOx emissions related to operation of lamps (see below for CO_2 and NOx assumptions)

Environmental impact				Type of lamps			
Emission	Fossil fuel	Emission factor (g/kWh)	Source of emission factor data	Incandescent	Tungsten Halogen	CFL	LED
CO2	Coal	902.00	IEA 2011[5]	902.00	649.40	180.40	126.30
	Oil	666.00		666.00	479.50	133.20	93.20
	Natural Gas	390.00		390.00	280.80	78.00	54.60
NOx	Coal	1.08	IPCC 2006[6]	1.08	0.78	0.22	0.15
	Oil	0.72		0.52	0.14	0.10	0.00
	Natural Gas	0.54		0.11	0.08	0.00	0.00

CO_2

Lamp (wattage)		kWh	kg Coal	Litres Gas	Litres Oil
IL	100 W	1000	500	189365	28
Halogen	72 W	720	360	136342	20
CFL	20 W	200	100	37873	6
LED	14 W	140	70	26511	4

NO_x

Emissions		kg/TJ	g/kWh
NOx (kg/TJ) (NO and NO2)	Coal	300	1.08
	Gas	150	0.54
	Oil	200	0.72

With regard to emissions of heavy metals from the combustion of fossil fuels, mercury is a topic of particular importance because of public health concerns. The true environmental benefits of CFLs are sometimes challenged because they contain a small amount of mercury that is required for operation. Some manufacturers can produce CFLs that require very low quantities of mercury. CFLs require less electricity to operate than do incandescent lamps, so their use reduces the overall mercury emitted that is associated with lighting. For more information on mercury in lamps, see Section 5.

2.3.2 Reduced Water Consumption

Adopting efficient lighting can reduce water consumption. Significant quantities of inland water are used for hydraulic and cooling purposes at coal-fired power stations. In South Africa, for example, each kilowatt-hour generated requires, on average, two litres of cooling water. Replacing 31.5 million incandescent lamps with CFLs would save approximately five million cubic metres of water per year.[5]

2.4 Societal

Energy efficient lighting programmes can provide societal benefits, especially with regard to increased employment opportunities and improved living environments. Combined with an effective assembly and distribution infrastructure and communications programme, efficient lighting programmes can contribute substantial and sustainable improvements in existing economic conditions. The activity can be augmented by basic manufacturing and may be extended to provide comprehensive lighting/maintenance business opportunities. The implementation of a lighting programme could lead to a broad range of locally designed and produced luminaries that are representative of the culture of that particular community. For example, during the implementation of the Efficient Lighting Initiative (ELI) South Africa programme[6], approximately 500 local unemployed community members were contracted to carry out awareness, educational, and distribution activities, and new job opportunities were created for distribution companies at a local level, mainly from the creation of new luminaire manufacturing and assembling companies. In Argentina and Poland[7], as a result of ELI, manufacturers entered the market and established local manufacturing facilities.

Transitioning to efficient lighting requires education and awareness activities targeted towards lighting project designers, installation specialists, wholesalers, retailers, architects, and municipal specialists. These outreach education activities also generate local employment.

5. International Finance Corporation (IFC)/Global Energy Facility (GEF). (2003). Energy Lighting Initiative (ELI) final report, Republic of South Africa.
6. Ibid
7. Birner, S. and Martinot, E. (2003). Market transformation for energy efficient products: lessons from programs in developing countries. Retrieved from: http://martinot.info/Birner_Martinot_EP.pdf

3. Overcoming Barriers to Energy Efficient Lighting

Energy efficient lighting programmes involve the widespread replacement of existing lighting products and so must overcome a variety of obstacles in order to ensure successful implementation:

- **Financial barriers** are primarily due to the higher initial cost of energy efficient lighting products relative to inefficient products
- **Market barriers** include: the lack of availability of low cost, high quality, efficient lighting products due to low demand; lack of local production and/or high import costs or tariffs; and inadequate promotion of energy efficient lighting products
- **Information barriers** include lack of awareness and information about energy efficient lighting among professionals as well as the public
- **Regulatory institutional barriers** include: lack of government interest or resources; insufficient enforcement of policies; the need for more qualified personnel; limited or no capacity; corruption; placing priority on increasing supply rather than on reduction of consumption; and, lack of comprehensive national and/or local energy policies
- **Technical barriers** include: lack of resources and infrastructure such as recycling and testing facilities; and problems with electrical power supply (including outages, brown-outs, power surges and voltage variation)
- **Environmental and health risk perception barriers** include: concerns about quality of light, possible exposure to electromagnetic fields (EMFs), and possible exposure to hazardous materials that may be contained in the electronics or other lamp components, including mercury (Hg) in discharge lamps

3.1 Financial

Financial barriers are primarily due to the higher initial cost of energy efficient lighting products relative to inefficient products. Low-income consumers, especially those in developing countries, might not be able to afford the energy efficient products, and moderate-to-high-income consumers might be reluctant to spend the extra money to purchase the products, because they are not aware of the economic benefits (UNEP 2007).[8]

Financial barriers can sometimes be alleviated or overcome by means of supporting policies such as; tax incentives, subsidies, financial assistance programmes for low-income families, regulatory instruments, and information programmes. These options are covered in greater detail in Section 2, Section 3 and Section 6.

3.2 Market

Market barriers include the lack of availability of low-cost, high quality, efficient lighting products due to low demand. They may also include the shortage of local production and/or high import costs or tariffs. The inadequate promotion of energy efficient lighting products is also a potential obstacle. Market barriers are best addressed by fiscal instruments and incentives, the implementation of product and regulatory standards, economic instruments, and technology transfer mechanisms.

3.3 Information and Awareness

A lack of information and awareness about energy efficient lighting can significantly inhibit the implementation of energy efficient lighting programmes in both developed and developing countries. In developed countries, where energy expenditures tend to represent a small fraction of disposable household income, consumers may ignore the issues involved in energy efficiency, making behavioural or lifestyle changes very difficult to institute.[9] In developing countries, the means and resources of communicating the programme benefits may be limited. Information and awareness barriers can be overcome primarily by means of awareness-raising campaigns and the training of professionals. Section 6 addresses these challenges.

3.4 Regulatory and Institutional

Regulatory and institutional barriers occur primarily in developing countries and include problems such as lack of government interest or resources; insufficient enforcement of policies; need for more qualified personnel; lack of capacity; corruption; priority on increasing supply rather than on reduction of consumption; and, lack of comprehensive national and/or local energy policies[10]. Such barriers are exacerbated in many cases by the need for comprehensive national and local policies and laws to encourage energy efficiency and by the regulation, monitoring, and enforcement of such laws when they do exist. To overcome such regulatory and institutional barriers, it is necessary to develop and improve the implementation of standards, policies, and laws that promote and encourage the use of energy efficient lighting products. This also helps to promote international cooperation and technology transfer.

3.5 Technical

Technical barriers may include the lack of resources and infrastructure such as recycling and testing facilities or problems with electrical power supply (including outages, brown-outs, power surges and voltage variations). These are best tackled by adopting national specifications and practices; creating collaborative arrangements with internationally recognized testing centres; improving

8. UNEP. (2007). Assessment of policy instruments for reducing greenhouse gas emissions from buildings. Retrieved from: http://www.unep.org/themes/consumption/pdf/SBCI_CEU_Policy_Tool_Report.pdf
9. UNEP. (2007). Buildings and Climate Change. Status, challenges and opportunities. Paris. Retrieved from: http://www.unep.org/publications/search/pub_details_s.asp?ID=3934
10. UNEP, CEU. (2007). Assessment of policy instruments for reducing greenhouse gas emissions from buildings. Retrieved from: http://www.unep.org/themes/consumption/pdf/SBCI_CEU_Policy_Tool_Report.pdf

capabilities to control hazardous substances during the manufacture of CFLs; combining compliance practices for lighting with other similar standards and labelling programmes; and setting up collection and recycling operations. These challenges are addressed in Section 4 and Section 5.

3.6 Environmental and Health Risk Perception

Policy makers as well as the public may express concern about the mercury content of CFLs. Potential health-risk concerns voiced about energy efficient lighting also may include: questions about quality of light; long-term effects of production and use; possible exposure to electromagnetic fields during operation of lamps with integrated electronics; and possible exposure to hazardous materials in lamps.

Such concerns commonly stem from a lack of public awareness regarding the effects of energy efficient lighting technologies on public health, especially with regard to the minimal amount of mercury used in CFLs, or heavy metals in electronics, relative to the amount generated by the burning of fossil fuels to generate electricity used by inefficient lamps. Concerns should be addressed, and the barriers overcome, via public information campaigns, establishing limits on the amount of mercury allowed in lamps, and the creation of environmentally sound management including the collection and recycling of spent lamps.

3.7 Overview of Barriers and Possible Remedies

The success of any inefficient lighting phase-out strategy requires a preliminary analysis of the existing barriers. Table 5 presents a brief overview of the barriers described above and the potential ways to overcome each barrier[11].

Table 4: Barriers and remedies

Barrier	Definition	Examples	Possible remedies
Financial	Ratio of investment cost to value of energy savings	• Relatively higher cost of energy efficient lighting products (e.g. high initial cost, relamping and/or replacing fixtures) compared to inefficient lamps, making them unaffordable to low-income consumers and residents in rural areas • Lack of attractive and sustainable financing schemes to support the purchase and use of energy efficient lighting products • Lack of incentives to encourage local lighting manufacturers to increase their domestic sales of energy efficient lighting products	• Fiscal and economic instruments such as tax incentives, subsidies, financial assistance programmes for low-income families, regulatory instruments, information campaigns • See Section 2 and Section 3
Market	Market structures and constraints that prevent a consistent trade-off between efficient lighting technology investment and energy saving benefits	• Limited availability of low-cost, high-quality, energy-efficient lighting products • Lack of local production of affordable and high-quality energy-efficient lighting products • Lack of financial and economic conditions for developing an energy service companies • Ineffectual and inadequate promotion of energy-efficient lighting products • Potential adverse economic impact due to manufacturing conversion to efficient lighting production for market players such as manufacturers and related industries	• Fiscal instruments and incentives • Product standards • Economic instruments • Technology transfer mechanisms • See Section 2

11. UNEP, CEU. (2007). Assessment of policy instruments for reducing greenhouse gas emissions from buildings. Retrieved from: http://www.unep.org/themes/consumption/pdf/SBCI_CEU_Policy_Tool_Report.pdf

Barrier	Definition	Examples	Possible remedies
Information and awareness	Lack of information provided on energy savings potential	• Lack of lighting-related knowledge and skills among policymakers, lighting system designers, suppliers, and operators/maintainers of lighting systems in public, commercial, residential and industrial facilities • Low level of public awareness of the benefits of energy efficient lighting products	• Awareness raising campaigns • Training of professionals • See Section 6 and Section 2
Regulatory and institutional	Structural characteristics of the political and legal system that make the promotion of efficient lighting difficult	• Lack of supporting policies and practical experience to encourage the business transformation of local inefficient lamp manufacturers • Lack of comprehensive national and local policies and laws encouraging energy efficiency in lighting systems including; regulatory enforcement mechanisms and reporting and monitoring systems • Lack of specific warranties to ensure product quality • Absence of policies/regulations on energy efficient lighting product features • Absence of local institutions to sustainably promote energy efficient lighting products	• Streamline the standards process • Establish incentive policy encouraging the promotion of efficient lighting • Enhancement of international cooperation and technology transfer • Establishment of governmental policy taskforces in partnership with industry and academia on specific products issues • See Section 2
Technical	Lack of resources and infrastructure for the sustainable promotion of efficient lighting	• Lack of processing and recycling for energy-saving lamps • Poor quality of power supply that affects the performance and longevity of lamps • Lack of adequate testing facilities to support an increasing demand for energy efficient lighting products • Limited resources to monitor, verify, and enforce national compliance standards for importers and manufacturers	• Capability to control mercury or other hazardous substances during the CFL production process; and the recycling/ disposal of production waste containing hazardous substances • Collaboration with internation-ally recognized testing centres • Combining MVE practices for lighting with other similar stand-ards and labelling programmes • See Section 4 and Section 5
Environmental and health risk perception	Concerns over the mercury content of CFLs or heavy metals in electronics	• Common misperception of the amount of mercury contained in CFLs in comparison to the emissions associated with operating inefficient lamps • Lack of legislation to control the permitted levels of mercury and other heavy metals in lamps • Lack of public awareness about the steps to take in case of lamp breakage • Lack of collection and recycling programmes for the recovery and sound end-of-life treatment of all lamps • Poor public information campaigns about the effects of efficient lighting technologies on health	• Awareness-raising campaigns • Incentive policy limiting the use of mercury and other heavy metal contents in lamps • Creating recycling and disposal facilities • See Section 5 and Section 6

4. A Brief Overview of Lamps

In order to comprehend the benefits of energy efficient lighting and its impact on society and the natural environment, it is beneficial to understand the fundamentals of lighting technology and the basic differences between inefficient lamps and their energy efficient alternatives. Annex B contains more details on lamps, while Section 5 describes the life cycle and environmental, safety and health considerations for efficient lamps.

The technology focus of the Toolkit is primarily single-ended, omnidirectional lamps used for ambient illumination. It does not address directional lamps or special purpose lamps but rather focuses on three general categories of light sources (the components of lamps that emit light):

- Metal filament lamps (incandescent and tungsten halogen incandescent)
- Gas discharge (compact fluorescent)
- Solid state (light emitting diode)

Incandescent and tungsten halogen lamps produce light when electrical current passes through a metal filament that is sealed inside a glass bulb. The filament resists the current and emits heat and visible light. Compact fluorescent lamps (CFLs) produce light when electrical current arcs through mercury gas that is sealed inside a glass tube. The mercury gas emits ultraviolet radiation that excites phosphors that coat the inside of the tube. The phosphors fluoresce and emit visible light. In light emitting diode (LED) lamps, electrical current passes through semiconductor materials to generate light of specific wavelengths. The most commonly available LED lamps for consumer use contain LEDs that emit blue light to excite phosphors that in turn emit other wavelengths of light; the human visual system combines the colours, perceiving them as white light. White light is quantified in lumens (l).

Table 6. Comparison of lamps: Cost, energy, performance and production parameters

	Incandescent	Tungsten Halogen	Compact Fluorescent	Light Emitting Diode
Initial cost	Very low	Low to medium	Low to medium	High to very high
Average life	<1 000 h	<4 000 h	<20 000 h	<50 000 h
Luminous efficacy	<12 lm/W	<15 lm/W	<70 lm/W	<120 lm/W
Lifetime cost	High	High	Low	Medium to low
Technical and production Complexity	Low	Medium	High	Very high

Conclusions

Most developed and emerging countries around the world have set up energy efficient lighting programmes to address the dual issues of environmental and energy security. Case studies presented in this Toolkit offer fact-based information on best practices involving lighting technologies, policy, and consumer and environmental protection. Countries that embark on a transition can access additional resources available from the en.lighten initiative, such as the Global Efficient Lighting Partnership Programme. The en.lighten initiative recognizes that there is not a '"one size fits all' approach to promoting an effective transition to efficient lighting. The information in this Toolkit should be considered by each country and adapted as appropriate to national circumstances.

Annex A: Country Lighting Assessments

To provide countries with estimates of potential energy and financial savings, CO_2 emission reductions and other potential environmental benefits, the en.lighten initiative has prepared Country Lighting Assessments. The newest assessments estimate the savings from the transition to energy efficient lighting in the residential, commercial, industrial and outdoor sectors for all major lamp types. They present information in a way that can be easily understood and used by stakeholders who are considering or developing National Efficient Lighting Strategies.

The first page of each Country Lighting Assessment presents:

- annual cost savings for the country and payback period for investment in efficient lighting
- annual energy saving benefits, including electricity savings, the percent savings in total national electricity consumption and electricity consumption for lighting consumption. These savings are also converted into equivalent number of average annual household electricity use, the number and size of power station output equivalent, and the energy equivalent in tons of oil
- annual CO_2 emission reductions, including tonnes of CO_2 emissions avoided, and the equivalent number of mid-sized cars removed from the road that this represents
- other environmental benefits, including the mercury, sulphur dioxide and the nitrous oxide emissions that could be avoided

The following pages identify each lamp type within a given lighting sector and provide estimates for the results before and after a transition to efficient lighting. The information covered for each country includes: the number of lamps installed, total electricity consumption; and CO_2 emissions due to energy consumption. Two graphs represent the total cost for electricity, labour and lamp costs; and the amount of mercury emissions before and after a shift to efficient lighting.

The fourth page of each Country lighting Assessment provides specific information for each country such as: population data, area, gross domestic product (GDP) and the percentage of electrification. Electricity data is also provided and includes: generating capacity; total annual electricity consumption and production; GDP per unit of electricity consumption; the share of electricity consumed for lighting purposes; average electricity costs; and annual electricity production from coal-fired power plants. Additionally, CO_2 emissions data is reviewed, along with identification of air and ground pollutants. Representation of the electricity production mix and lamp wattage and rated life for each lamp type by each sector is demonstrated by way of graphs.

The final pages of each Country Lighting Assessment identify the references and data sources used to generate the assessments.

Annex B: Lamp Technology

Incandescent Lamps

The incandescent lamp is a 130-year old technology. It produces light by heating a thin metal filament to a temperature high enough to emit visible radiation. Incandescent lamps are inefficient - nearly 90 per cent of the input electrical energy converts to thermal energy and is wasted as heat. In the presence of air, the metal filament would burn out quickly therefore, it is encased in a glass bulb from which air is evacuated and replaced with an inert gas. The base of the lamp is fitted with a metallic socket (lamp cap or lamp base) that provides mechanical support for the glass bulb and electrical contact.

Incandescent lamps are produced in a broad range of sizes, light output levels, and voltage ratings. Incandescent lamps are inexpensive to manufacture and purchase, but they are expensive to operate. Compared to alternative lighting technologies such as CFLs and LEDs they are relatively short-lived and have very low luminous efficacy. For incandescent lamps, luminous efficacy depends on the supply voltage (typically 120 V or 230 V) and consumed power, for residential applications, typically between 15 W and 200 W.

Table 1: Characteristics of incandescent lamps

Initial cost (price to consumer)	Very low
Average life and lumen depreciation over lifetime	Short (<1000 h). No noticeable lumen depreciation over lifetime.
Luminous efficacy	Low (<12 lm/W)
Operating costs including replacing spent lamps	Initial cost of lamp is very low, but the operating costs are very high and lamps must be replaced frequently.
Colour temperature	Warm white (2700 K — 2800 K)
Compatibility with existing luminaires	Yes
Compatibility with dimming controls (dimmable)	Yes
Environmentally sound management	May have lead in solder. Risk of glass breaking.

Tungsten Halogen Lamps

A conventional tungsten halogen lamp is similar to an incandescent lamp as it heats a metal filament to produce light. It differs in that a tungsten halogen lamp bulb is filled with a halogen gas (typically either bromine or iodine or a mix of gases) rather than an inert gas. The halogen gas facilitates a chemical process that returns metal to the filament during lamp operation thereby, preventing its evaporation and the condensation of metal on the inside of the lamp bulb. This process allows the tungsten halogen bulb to operate at higher temperatures than a standard incandescent lamp and allows the size of the glass bulb to be significantly reduced relative to an incandescent lamp with similar light output, leading to slightly higher efficiency and a longer product life than standard incandescent lamps.

In general, the cost of a conventional tungsten halogen lamp is greater than that of its incandescent counterpart, but tungsten halogen lamps provide longer life and higher luminous efficacy than incandescent lamps. The luminous efficacy of conventional tungsten halogen lamps can be enhanced by replacing a small amount of the halogen gas with xenon gas. The addition of xenon gas produces a slightly cooler white light than that produced by a conventional tungsten halogen lamp; helps reduce deposits on the inner surface of the bulb; and increases the light output (relative to light output from a standard incandescent lamp) up to 25%. Lamps for which the enhanced halogen (xenon-added) capsule is placed in a second glass bulb and fitted with a standard lamp base thereby, allowing its use with all luminaires designed for conventional incandescent lamps.

Table 2: Characteristics of halogen lamps

Initial cost (price to consumer)	Low to medium, but higher than incandescent lamps
Average life and lumen depreciation over lifetime	Short, but longer than incandescent lamps (<4,000 h). No noticeable lumen depreciation over lifetime.
Luminous efficacy	Low (<15lm/W), but higher than incandescent lamps
Operating costs including replacing spent lamps	Initial cost of lamp is low, but the operating costs are high and lamps must be replaced frequently.
Colour temperature	Warm white (2700 K — 3000 K)
Compatibility with existing luminaires	Yes
Compatibility with dimming controls (dimmable)	Yes
Environmentally sound management	May have lead in solder. Risk of glass breaking.

Compact Fluorescent Lamps (CFLs)

In a fluorescent lamp tube, electricity excites a mercury vapour, producing short-wave ultraviolet radiation that stimulates a phosphor coating inside the tube to emit visible radiation. The electrical current in the tube must be controlled therefore, each compact fluorescent lamp requires an integrated ballast.

Compact fluorescent lamp tubes are folded or twisted to fit within the same space as an incandescent lamp. Some CFLs have bare tubes. Others are fitted with external glass or plastic bulbs that are decorative and protective. These bulbs decrease the lamp's luminous efficacy but add protection by containing mercury if a tube breaks.

CFLs have a much longer lifetime and much higher luminous efficacy than incandescent lamps. In general, a CFL uses up to 80% less power than an incandescent lamp to produce equivalent light output. CFLs are available in a range of colour temperatures that are compatible with residential applications, from warm white to cool white.

Consumers should replace incandescent lamps with CFLs of similar light output, referring to the rated lumens on the product label or package. To ensure sufficient light output over the life of the CFL, consumers should look for models with an eco-label or consumer warranty.

Table 3: Characteristics of CFLs

Initial cost (price to consumer)	Low to medium
Average life and lumen depreciation over lifetime	Long (<20,000 h). Lumen depreciation may be noticeable during lifetime.
Luminous efficacy	High (<70 lm/W). CFLs with an added plastic or glass bulb have reduced luminous efficacy.
Operating costs including replacing spent lamps	Low
Colour temperature	Models available in a wide range of colour temperatures, from very warm white (2400 K) to very cool white (6500 K)
Compatibility with existing luminaires	Most are compatible, but some CFLs may not fit in some existing luminaires. Lamp may take a short time after starting to attain full light output
Compatibility with dimming controls (dimmable)	Most CFLs are not dimmable. Lamp label or package will identify a dimmable model.
Environmentally sound management	Contain mercury. May have lead in solder. Electronic and plastic components similar to other consumer electronics. Risk of glass breaking.

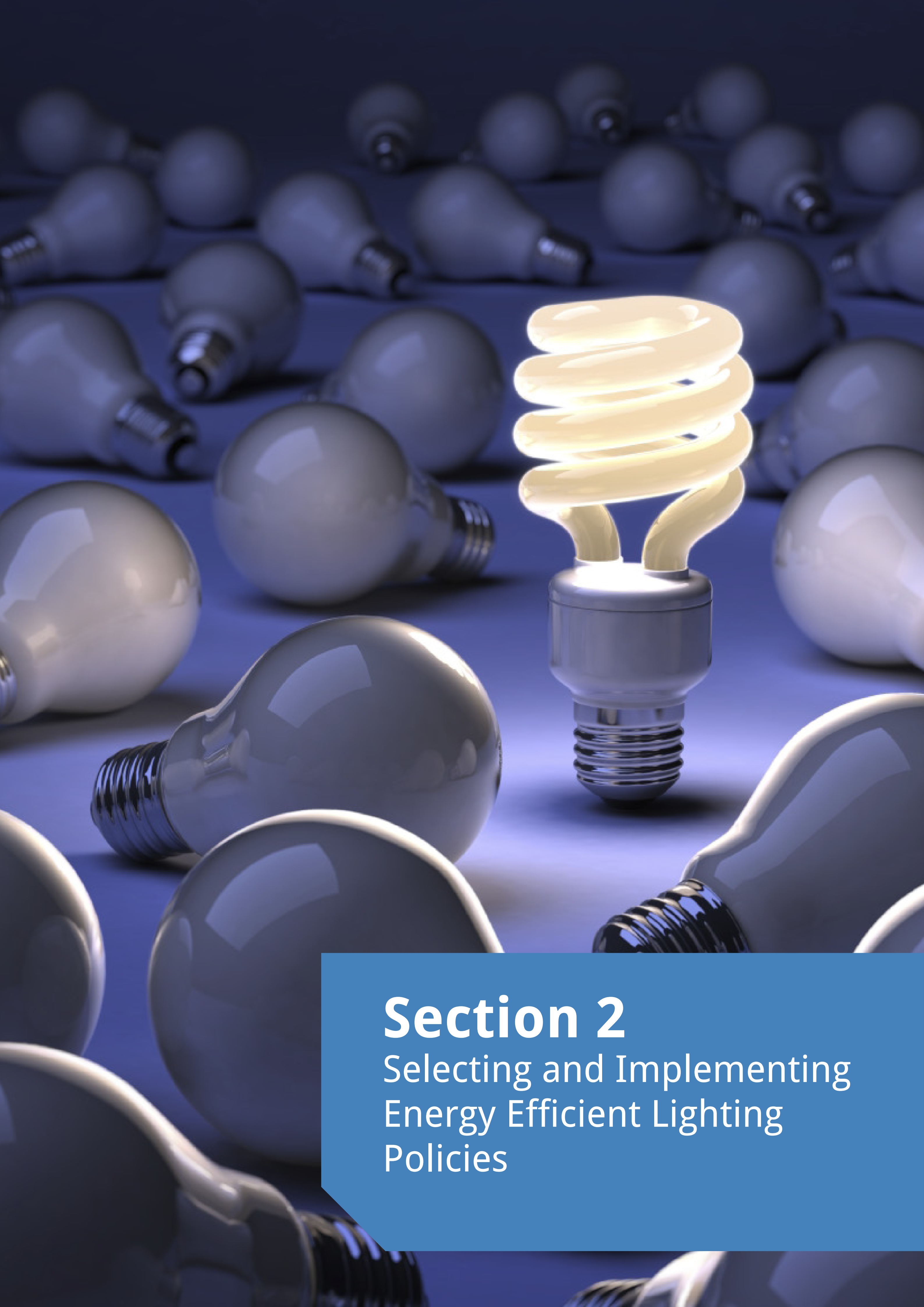
Light Emitting Diode (LED) Lamps

A diode is a solid-state electronic component that allows electrical current to flow in only one direction. A light emitting diode (LED) is a diode that produces light of a specific colour. Good quality LED lamps have a very long average life of up to 50,000 hours.

LED lamps have higher luminous efficacy than either fluorescent or incandescent lamps have. They are durable, with no metal filaments and typically without any glass bulb. Using an LED lamp to replace an incandescent lamp reduces energy consumption by up to 90 per cent. Unlike CFLs, LEDs do not contain mercury. Like other electronics and lamps the solder used in LED lamps can contain lead or other heavy metals. However, some manufacturers offer models that contain lead-free solder. At present, the initial cost of LED lamps is high compared to incandescent lamps and CFLs, but prices are expected to decline rapidly as demand for LED lamps increases.

Table 4: Characteristics of LED lamps

Initial cost (price to consumer)	Medium to very high
Average life and lumen depreciation over lifetime	Very long (<50,000 h)
Luminous efficacy	High (<120 lm/W). Lumen depreciation may be noticeable during lifetime.
Operating costs including replacing spent lamps	Low
Colour temperature	Models available in a wide range of colour temperatures, from very warm white (2400 K) to very cool white (6500 K)
Compatibility with existing luminaires	Most are compatible, but some LED lamps may be heavier due to metal heat sink. Some may not fit in all luminaires.
Compatibility with dimming controls (dimmable)	Only if specified on label or packaging.
Operating temperature (surface of lamp)	Very low. The heat sink on some LED lamps may be warm to hot.
Environmentally sound management	Contain mercury. May have lead in solder. Electronic and plastic components similar to other consumer electronics. Risk of glass breaking.



Section 2
Selecting and Implementing Energy Efficient Lighting Policies

Table of Contents

Introduction

There are a wide range of tools for designing and implementing energy efficient lighting programme available to policymakers. The tools constitute policy options, in four main categories[1]:

- Regulatory and control mechanisms - laws and implementation regulations that require certain devices, practices or system designs to improve energy efficiency.[2]
- Economic and market - based instruments - market mechanisms initiated and promoted by regulatory incentives but which may contain elements of voluntary action or participation
- Fiscal instruments and incentives - mechanisms that impact prices, such as taxes aimed at reducing energy consumption or financial incentives to overcome upfront costs
- Support, information and voluntary actions - initiatives that aim to persuade consumers to change their behaviours by providing information and examples of successful implementation.[3]

Each category includes a specific set of policy options and applicable market sectors (see Table 1 below). The main focus of this Section is on policies that accelerate the phase-out of inefficient incandescent lamps.

Table 1: Policy options

Sector	Regulatory and control mechanisms	Economic and market-based instruments	Fiscal instruments and incentives	Support, information and voluntary actions
Consumer, residential and small business	Minimum energy performance standards (MEPS)	Cooperative (bulk) procurement	Subsidies, rebates and giveaways	Awareness raising, promotion and education
	Technology prohibition		Taxation (increase or exemptions)	Detailed biling and disclosure
	Mandatory labelling and certification	Instalment payments (on-bill financing)		Voluntary certification and labelling (VCL)
	Energy efficiency obligations and quotas	Bank loans		Public leadership and demonstration
Commercial	Energy codes for buildings	Energy service performance contracting		Voluntary and negotiated agreements

Of all the policy options listed above, the use of minimum energy performance standards (MEPS) constitutes the best and most sustainable option for achieving high levels of energy efficiency, specifically for lighting products in the consumer sector.[4] The various policy options identified generally support MEPS, either by restricting the supply of inefficient lighting products, or by promoting the demand for MEPS-compliant products. Fiscal instruments, such as the elimination or reduction of value added tax (VAT) or import duties, support MEPS implementation. Although a MEPS policy is the best tool for an energy efficient lighting programme, the success depends on selecting and implementing other policies to meet the specific needs of a country and the particular objectives of a phase-out strategy.

1. To maintain consistency and build upon previous UNEP experience in the energy efficiency policy arena, the en.lighten toolkit utilises a set of definitions and a classification system that is adapted from its 2007 report, Assessment of Policy Instruments for Reducing GHG Emissions from Buildings. Koeppel S. & Urge-Vorsatz D. (2007). Assessment of policy instruments for reduction for reducing greenhouse gas emissions from buildings. Paris, France: UNEP
2. Koeppel S. & Urge-Vorsatz D. (2007). Assessment of policy instruments for reduction for reducing greenhouse gas emissions from buildings. Paris, France: UNEP
3. Ibid
4. Harrington, L. Energy Efficiency Strategies, Australia, and Holt, S. Australian Greenhouse Office. (2002). Matching World's Best Regulated Efficiency Standards. Retrieved March 8, 2012, from: http://www.energyrating.gov.au/wp-content/uploads/2011/02/aceee-2002a.pdf

1. Regulatory and Control Mechanisms

1.1 Minimum Energy Performance Standards (MEPS)

MEPS are regulatory tools that increase the average energy efficiency of individual product classes. They contribute to the phasing out of the least efficient products in a market by setting the minimum levels of energy efficiency that a product in a given class must meet before it can be sold. MEPS provide the most cost-effective policy option for phasing out inefficient lighting products and replacing them with more energy efficient options. When effectively applied, MEPS, in conjunction with supporting policies, encourage manufacturers to improve the efficiency of their products or to introduce more efficient replacements. Before MEPS are adopted, cost/benefit analyses must be performed to ensure that the associated rules and regulations provide a positive economic benefit to the nation or market that implements them. MEPS should be developed in consultation with all of the stakeholders involved in the manufacture and sale of the products to which they apply.

Energy parameters for MEPS can be designed according to one of two approaches: technology-specific or technology-neutral. In both cases, MEPS should be carefully defined to avoid unintended outcomes, such as exempting or disadvantaging specific applications.

- Technology-specific approaches set MEPS for individual technologies or product categories, for example, for CFLs
- Technology-neutral approaches set MEPS for lamps without respect to the technology involved. For example, the European Union phase-out strategy allows any lamp technology to be sold if it meets the specified energy performance and other legal standards.[5]

Advantages

MEPS offer many advantages for energy efficient lighting programmes, as they:

- Focus on technically achievable energy efficiency levels that can be delivered with an attractive benefit-to-cost ratio
- Provide a high degree of certainty for delivering energy savings, due to their mandatory approach
- Minimize governmental fiscal and political impact compared to legislative actions, such as subsidies and levies
- Are relatively easy to adjust periodically (as products improve or new products become available)
- Can be designed to maximize consumer benefits with very low per unit transaction costs

MEPS create a stimulus for manufacturers to invest in research and development. MEPS effectively create a baseline for energy efficient lamps from which more stringent levels can be set as the market matures and new, more efficient technologies are introduced by manufacturers.

Constraints

Constraints in establishing lighting MEPS include:

- Energy efficient products may not be widely available
- Products may not meet desirable performance or quality levels equivalent to the less efficient products they must replace
- The initial cost of energy efficient options may be greater than less efficient options
- Stringent energy efficiency standards may affect local industry therefore, preparation time must be built into phase-out schedules
- MEPS programmes need to be supported with other policy options and comprehensive measures such as testing, monitoring, verification and enforcement

These constraints may be magnified in some developing markets. Although desirable, it may not be immediately practical to establish MEPS that are as stringent as standards of developed nations. Nonetheless, incandescent lamps are a commonly traded commodity and so it may be possible to align MEPS with trading partners or within geographic regions.

Key Factors for Success

To be effective, MEPS must be carefully applied. Performance levels and other requirements must be determined by technological developments and market trends for lighting products (for example, CFL manufacturing trends or developments in LED performance, including pricing and testing methodologies). The levels should also take into account international standards and regional conditions, where feasible.

Performance levels and programme requirements need stakeholders' input to gain their support and participation. Programmes should involve stakeholders that represent the government, public, and private sectors. This includes: government standards and test agencies, customs, standardization institutes, certification and accreditation bodies, test laboratories, manufacturers, suppliers and distributors of lamps, consumer organizations and technology research institutes.

Once established, MEPS programmes need to be monitored, evaluated, updated, and revised regularly. The most important factor for programme success is a functioning system of monitoring, control, and testing facilities capable of ensuring product compliance (see Section 4). Programmes should be monitored to ensure that their implementation does not result in an overall increase rather than

5. European Commission (2011). Energy Efficiency, Eco-Design Legislation. Retrieved October 10 2011, from: http://ec.europa.eu/energy/efficiency/ecodesign/eco_design_en.htm

decrease in energy consumption, due to increased consumer purchases of energy-consuming products. Other policies that inform and educate the public, as well as financial measures to help address the initial cost of more efficient lamps can help establish the initial implementation of a MEPS programme.

Case Study: India - MEPS

Before 2007, India imported about one-third of its CFLs to satisfy local demand, with the balance being supplied by Indian manufacturers. An estimated 30% of the products operated less than 3000 hours before failure. In 2008, the Bureau of Indian Standards (BIS) issued a two-part CFL standard: IS 15111 Part 1, and IS 15111 Part 2. These addressed safety (Part 1) and lighting quality/performance (Part 2) to ensure that CFLs carrying the BIS mark were both safe and efficient to use. BIS also required a minimum average life of 6000 hours.

Table 2: Indian Standard IS 15111 Part 2

Lamp wattage (W)	Luminous efficacy (lm/W)		
	For 2700K	For 4000K	For 6500K
<=7	45	44	42
8 to 10	50	49	47
11 to 15	55	54	51
16 to 23	60	59	56
24 to 26	60	59	56

Since 2008, CFLs in the Indian market have been required to carry the BIS mark, indicating that they have been tested to conform to BIS requirements. In 2009, independent testing of products in the market found that most Indian made products were able to meet BIS requirements. Due to this high rate of participation by domestic manufacturers, BIS is considering amending the CFL standards to require a decrease in mercury content from 5 mg to 3 mg by December 2013.

Table 3: Countries with MEPS for CFLs

Country	Title of Standard
Australia	AS/NZS 4847.2-2010: Self-ballasted lamps for general lighting services - MEPS requirements (07-04-2008)
Brazil	Portaria Inmetro 289/2006 - CFLs (2006)
Chile	MEPS for Residential Lighting (CFLs)
Chinese Taipei	CFL Standard
Colombia	Programme for the Rational and Efficient Use of Energy and Other Non-Conventional Energy Forms(1988)
Ecuador	Draft Technical Regulation RTE INEN 036: Energy Efficiency, Compact Fluorescent Lamps, Energy Performance Ranges and Labelling
EU Member Countries	Draft Commission Regulation implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to Ecodesign requirements for non-directional household lamps - CFLs (2009)
Ghana	Ghana Electrical Appliance Labelling and Standards Programme (GEALSP) - Standard for CFLs (30-06-2005)
India	MEPS for CFLs
Mexico	NOM-017-ENER/SCFI-2008: Energy efficiency of compact fluorescent lamps. Limits and test methods (2008)
New Zealand	MEPS for compact fluorescent lamps
Nicaragua	Nicaraguan Mandatory Technical Standard (NTON) No. 10 008-08: Energy Efficiency, Self-Ballasted Compact Fluorescent Lamps, Energy Efficiency Requirements (2008)
Pakistan	Compact Fluorescent Lamps - Pakistan
People's Republic of China	GB 19044-2003:Limited values of energy efficiency and rating criteria of self-ballasted fluorescent lamps for general lighting service (01-09-2003)
Philippines	PNS IEC 969:2006 - Self Ballasted Lamps for General Lighting Service - Performance Requirements (2002)
Republic of Korea	MEPS for Compact Fluorescent Lamps - Korea (01-07-1999)

Country	Title of Standard
Thailand	TIS 2310-2549 (2006): Self-Ballasted Lamps for General Lighting Services: Energy Efficiency Requirements (2006)
United States	MEPS for Medium Base Compact Fluorescent Lamps (CFLs) (2006)
Vietnam	MEPS for Compact Fluorescent Lamps - Vietnam

Note: The year in parentheses after each programme name is its effective date. Source: UNEP/CLASP (2011), Assessment of Opportunities for Global Harmonization of Minimum Energy Performance Standards and Test Standards for Lighting Products.

Table 4: LED related standards, voluntary labelling programmes and international standards

China GB/T	GB/T 24908-2010: performance requirements for self-ballasted LED lamps for general lighting GB/T 24823-2009: performance requirements for LED modules for general lighting	GB/T 24908-2010: performance requirements for self-ballasted LED lamps for general lighting GB/T 24824-2009: measurement methods of LED modules for general lighting
ELI	ELI Voluntary Technical Specification for Self-Ballasted LED Lamps for General Lighting Services	ELI Voluntary Technical Specification for Self-Ballasted LED Lamps for General Lighting Services
EU	EU 244/2009 EC JRC LED Quality Charter	EU 98/11/EC EU 244/2009
IEC	IEC/PAS 62612: Performance requirements for self-ballasted LED lamps for general lighting	IEC/PAS 62612: Performance requirements for self-ballasted LED lamps for general lighting
UK Energy Savings Trust	EST LED Lamps and Modules V2.0	
US ENERGY STAR	Programme Requirements for Integral LED Lamps V1.3	LM 79-08: electrical and photometric measurement of solid-state lighting products LM 80-08: measurement of lumen maintenance of LED light sources

Source: UNEP/CLASP (2011), Assessment of Opportunities for Global Harmonization of Minimum Energy Performance Standards and Test Standards for Lighting Products.

Case Study: European Union - MEPS

The basis for regulation of lamps in the European Union is a 2005 Directive issue by the European Parliament, commonly referred to as the Ecodesign Directive.[6] More detailed requirements for lamps for domestic use are included in: "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." Requirements take effect in six stages, from 2009 through 2016. Luminous efficacy requirements for lamps are described by functional curves specifying maximum rated power for a given rated luminous flux. Some exceptions and correction factors are included. Functional requirements for specific technologies address lamp performance and quality parameters for various types of lamps. The regulation also includes product information requirements.

Additional Resources

- en.lighten initiative Efficient Lighting Policy Status map
- Super-efficient Equipment and Appliance Deployment (SEAD) Initiative.
- Harrington, L. Energy Efficiency Strategies, Australia, and Holt, S. Australian Greenhouse Office. (2002). Matching World's Best Regulated Efficiency Standards – Australia's success in adopting new refrigerator MEPS.
- Energy Efficiency Policies for Appliances, IEA Energy Training and Capacity Building Week, Paris, 4-7 April, 2011.
- Hernandez N. C. Bureau of Product Standards, Department of Trade and Industry, Republic of the Philippines. Prospects of Minimum Energy Efficiency Standard (MEPS) in the Philippines.
- The exchange of knowledge and discussions on Minimum Energy Performance Requirements in the European Member States.
- E3 Equipment Energy Efficiency (2012), Minimum Energy Performance Standards (MEPS) programmes in Australia and New Zealand.
- World Energy Council (2012). Energy Efficiency Policies around the World: Review and Evaluation.

6. ECEEE (2012). Domestic lighting; incandescent, halogen, and compact fluorescent lamps. Retrieved on February 1, 2012, from: http://www.eceee.org/Eco_design/products/domestic_lighting/. For more technical details about the EU MEPS please refer to http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:076:0003:0016:EN:pdf

1.2 Technology Prohibition

A technology prohibition policy bans a specific technology, such as incandescent lamps, from a market.[7] This can be achieved in a variety of ways, for example, by banning the sale of the product or by imposing an import ban in countries that do not have domestic manufacturing capacity.

Advantages

Prohibiting a technology is a simple policy to communicate and understand. It forces the adoption of replacement technologies and can encourage the rapid development of new alternatives. It offers a clear signal to suppliers and customers regarding efficiency levels for new products. It can help maintain and expand retail channels for efficient lamps.

Constraints

In practice, it is very difficult to define a technology to ban because there may be aspects of the technology or its particular applications that are still desirable. For example, banning all incandescent lamps could also remove lamps required for special applications, such as lamps for medical devices. Creating exemptions, however, can also create unexpected loopholes that may be exploited for more general applications. For example, a manufacturer might argue that although a lamp was designed for medical use, it appeared later in the general consumer market.

Banning a particular technology also removes opportunities for innovation within that and therefore, could narrow the range of products available in the future. A technology ban may require high up-front costs for replacement products. It may also create challenges for collection and environmentally sustainable treatment of the banned lamps.

Key Factors for Success

It is very important to establish MVE systems to ensure good quality of anew lighting technology. Developing measures such as strict enforcement penalties, custom control penalties or immediate destruction and disposal of the banned lamps are necessary in order to prevent dissatisfaction or a return to the banned lamps. Market surveillance tracks how the programme develops and can alert regulators if adjustments are necessary to the policy. Collection of banned lamps and the establishment of collection and recycling systems for new alternatives support the technology ban in a sustainable manner.

Case Study: Cuba - Technology Prohibition[8]

During 2006 and 2007, Cuba implemented a massive market transformation scheme to replace every incandescent lamp in the country with a CFL. Cuba banned incandescent lamps from sale and production. This approach was only possible because the previously installed products were primarily incandescent lamps, and dimming controls were not commonly installed. Thus, CFL dimming compatibility was not needed. The scheme was completed in 2007 making Cuba the first country in the world to have phased out incandescent lighting. About 9 million incandescent lamps were replaced by CFLs, resulting in peak demand savings of about 440 MW and annual emission savings of more than 260 000 tons of CO_2 equivalent.

1.3 Mandatory Product Labelling and Certification

Mandatory labelling and certification programmes require that labels on electrical products, such as consumer appliances and lamps, provide end users with information about the product's energy performance. These labels inform and empower end users to make educated choices and motivate suppliers to deliver products that meet the prescribed levels of efficiency and quality. Products must be evaluated for performance and certified to meet programme requirements.

Labelling and certification programmes are widely considered to be among the most cost-effective policy tools to achieve the market transformation necessary to phase-out inefficient lighting. They can be combined with other policy instruments, such as MEPS, financial incentives or voluntary agreements, to enhance their effectiveness. Successful programmes employ any combination of legal, financial, and social considerations, depending on the structure, economics, and culture of the society to which they apply. A labelling scheme alone cannot phase-out inefficient incandescent lamps, because the initial price difference between the older, inefficient products and their newer, more efficient alternatives may be a purchasing barrier.

Many developed and developing countries have appliance product labelling and certification programmes, but no single programme meets the needs of every country. To develop and employ a labelling and certification programme to its fullest potential, government officials and stakeholders must combine various features from prospective designs to develop a programme that is most suitable to their country's specific needs.[9]

Direct legislative support or some form of legally mandated authority for the implementing agency greatly improves the likelihood that a labelling and certification programme will be adopted. The stronger the claim to legal jurisdiction by the implementing agency, the more likely the programme will succeed and survive adversarial challenges.[10] The successful implementation of a mandatory labelling and certification programme requires changing or introducing (and enforcing) laws that require manufacturers to provide specific information to end users. When designed and implemented well, mandatory requirements are very effective.

7. Australia Department of Climate Change and Energy Efficiency (2009). An Introduction to Phase-out Schemes for Inefficient Lighting (Draft).
8. Personal communication with Roberto Gonzalez, Vale, July 30 2012.
9. Paton, R.B. (2004). Two Pathways to Energy Efficiency: An Energy Star Case Study. Human Ecology Review. 11(3), 247-259.
10. Mandatory labels can have an inherently adversarial aspect; however, as they force manufacturers to take actions that they might not otherwise take.

It is important to consider that end users will recognize the benefits of energy labels when they are used with a wide variety of appliances and not just with lighting products. Additionally, coordination of labelling requirements among neighbouring countries or within a given region encourages many manufacturers and distributors to use the label and therefore, increase its recognition and chances of success.

Advantages

Labelling and certification programmes are a cost-effective component of any comprehensive strategy to phase-out inefficient incandescent lamp. They can significantly impact the lighting market because mandatory programmes can affect all of the stakeholders in the supply chain. They allow suppliers to control their entry into the market when they are ready to introduce products that meet programme requirements. They also assist managers of procurement programmes to select products for bulk purchase or for incentives.

Advantages specific to comparative labelling include:

- Manufacturers can offer a wide range of products with various features in addition to high efficiency
- Widespread recognition of a programme provides a strong market incentive for energy efficiency
- Programmes accelerate the pace of market evolution and adoption of new technologies

Constraints

Mandatory programmes are more rigid than voluntary programmes and if they are poorly designed, they can create additional market barriers. Both mandatory and voluntary labelling requires transparent market monitoring protocols to ensure fair participation and effective enforcement mechanisms must be created or already be in place to ensure the success of such programmes. The overall success of a programme may be difficult to predict since the impact of a programme depends on varying rates of consumer awareness and market adoption. Another limiting factor is that once a labelling system is implemented, it may be difficult to change.

Key Factors for Success

Programme design should include strong stakeholder engagement, lighting industry collaboration, and incentives for industries to promote better products. The programme outline should also take into account the design of similar programmes around the world, and involve the establishment of MVE regimes to reduce the risk of non-compliance.

From the outset, governments must examine the existing regulatory framework to determine the extent of authority available to establish a certification and labelling programme. A mandatory labelling and certification programme for lighting products must be defined by legislation. The legislation must reflect strong, clear political backing for the standards which should be articulated to the public as early as possible to avoid potential conflict in the marketplace. The political authority for mandatory standards and labels should be built on a firm but flexible foundation to create a strong consensus.[11]

Comprehensive market surveillance can detect instances in which labels are not displayed on products, or where they are misused. Transparent procedures should be put in place to handle non-compliance. For comparative labelling programmes, which are often mandatory, a violation of the labelling requirements must be penalized by means of legal sanction to discourage non-compliance. For voluntary programmes, instances of incorrect labels or misuse can affect programme credibility if not addressed early and consistently.

In some instances, the agency assigned to address compliance issues is the same agency that initiates the labelling and certification programme. In other cases, the agency responsible for compliance issues is separate from the standards-implementing agency. Governments must identify or designate an agency responsible for coordinating compliance issues. A transparent process for handling cases of non-compliance is needed in order to provide manufacturers with a 'level playing field' and to ensure consumer confidence.

Opportunities for harmonisation and regional cooperation can greatly aid in the success of any labelling and certification programme. Lighting products are commodities that cross national and regional borders, so monitoring and verification resources in cooperating regions could be shared. Such harmonization and cooperation helps to prevent the multiplication of standards and labels both for consumers and industries, reduce costs of implementing labelling programme for producers and importers and to reduce non-tariff trade barriers[12]. However, the harmonization of mandatory rules limiting the sale of inefficient products may require significant diplomacy, both within the country that is implementing the programmes and among its cooperating partners. This is especially relevant for small countries for which implementing a national labelling programme may not be cost-effective because of the small size of the market.

11. In addition, the effectiveness of such programs can be enhanced by combining them with other policy instruments, such as fiscal incentives or voluntary agreements.
12. Thigpen, S., Fanara, A., ten Cate, A., Bertoldi, P. and Takigawa, T. (1998). Market Transformation Through International Cooperation: The Energy Star Office Equipment Example. ACEEE Summer Study on Energy Efficiency in Buildings (5.315-5.326), Retrieved from: http://eec.ucdavis.edu/ACEEE/1998/pdffiles/papers/0526.pdf.

Table 5: Sample mandatory label standards for CFLs

Country	Title
Argentina	Programmea de Calidad de Artefactos Electricos para el Hogar (PROCAEH) - CFLs
Brazil	Stamp Procel de Economia de Energia (Energy Efficiency Stamp) - Compact Fluorescent Lamps (1993)
Brazil	INMETRO Brazilian Labelling Programme for Compact Fluorescent Lamps
Canada	Lamp Package Labelling - CFLs (01-06-2009)
Chile	Mandatory Label for Compact Fluorescent Lamps (Chile) (30-06-2007)
Ecuador	Labelling Programme for Compact Fluorescent Lamps
EU Member Countries	Commission Directive 98/11/EC - CFLs (2000)
Ghana	Ghana Electrical Appliance Labelling and Standards Programme (GEALSP) - Label for CFLs (30-06-2005)
Hong Kong, China	The Hong Kong Mandatory Energy Efficiency Labelling Scheme (MEELS) for CFLs (09-11-2009)
Nicaragua	Nicaraguan Mandatory Technical Standard (NTON) No. 10 009-08: Energy Efficiency, Self-ballasted Compact Fluorescent Lamps, Rating and Labelling
People's Republic of China	China Energy Label - Self-ballasted Fluorescent Lamps (01-06-2008)
Philippines	PNS 2050-2: 2006 - Lamps and related equipment - Energy Efficiency and Labelling requirements - Part 2: Self ballasted lamps for general lighting services (01-09-2003)
Republic of Korea	Energy Efficiency Rating Labelling Programme for Compact Fluorescent Lamps (01-07-1999)
Thailand	The Energy Efficiency No.5 label - CFLs (08-1994)
United States	EnergyGuide - Medium Base Compact Fluorescent Lamps (CFLs) (2007)

Note: The year in parentheses after each programme name is its effective date. Source: UNEP/CLASP (2011), Assessment of Opportunities for Global Harmonization of Minimum Energy Performance Standards and Test Standards for Lighting Products.

Case Study: Korea - Energy Efficiency Rating Labelling Programme for CFLs [13]

Since 1974, the Republic of Korea has implemented laws and regulations that mandate labelling for various energy-consuming products. The labelling programmes have resulted in active competition between manufacturers to produce and sell energy saving appliances, and consumers have been encouraged to choose such appliances. However, despite the labelling mandates, consumers who lacked detailed knowledge of energy efficiency issues had to conduct their own research when making purchasing decisions. In 1992, the Korea Energy Management Corporation addressed the issue by implementing the Efficiency Standard and Labelling Program, which introduced a mandatory labelling programme for items including household appliances, lighting equipment and motor vehicles.
The programme requires a label with a simple energy efficiency grade from a scale of 1 to 5. Generally, Grade 1 products save up to 30% to 40% energy compared to Grade 5 products. The current labelling programme is based on an efficiency test by authorised institutes including the Korean Agency for Technology and Standards and the Korea Testing Laboratory.

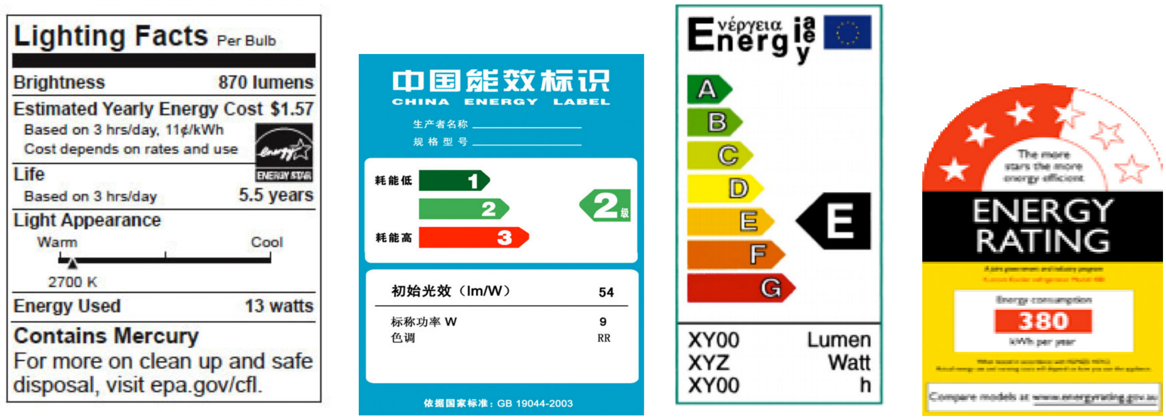
13. Korea Energy Management Corporation. (2007). Efficient Lighting Initiative (2007). Korea's Energy Efficiency Programs: Regional quality assurance program for CFLs. Retrieved from: http://www.efficientlighting.net/doc/20071114(17).pdf

Two types of labels are commonly used in countries around the world:

Comparative Label - a comparative label informs consumers about product features for comparison purposes
Endorsement Label - a endorsement label[14] presents a set level of performance information and distinguishes those products that meet the performance criteria from those that do not

With comparative labels, energy use is indicated across a performance category or on a continuous scale between market extremes. It provides end users with relative performance information within the same product group or category, for example, all lamps for residential use. A comparative label works well if it is simple and compares only a few common characteristics such as light output (lumens) and power demand (watts). However, it can communicate other product information, such as average life (hours) and colour temperature.

Figure 1: Example of energy efficiency comparative labels



An endorsement label is typically used for the same product group and is intended to inform the end user of approved quality products. It is often used by third parties and can be based on independent testing. The endorsement label requires that products meet a set of criteria and performance levels. It enables consumers to compare endorsed to unendorsed products.

Figure 2: Example of energy efficiency endorsement labels

Additional Resources

- Wiel S. & McMahon J. E. (2005). A Standards & Labelling Guidebook for Appliances, Equipment, and Lighting (2nd Edition) - English Version, US: Collaborative Labelling and Appliance Standards Programme (CLASP)
- McNeil M. A. & Letschert V. E. (2008). Global Potential of Energy Efficiency Standards and Labelling Programmes. LBNL-760E
- United Nations Technical Cooperation (2012), Energy efficiency Standard and Labelling Programme
- GTZ (2012), Introduction of Bureau of Energy Efficiency (BEE) Standards and Labelling Program (PPP)
- CLASP (2011) List of mandatory labelling programmes for CFLs

1.4 Energy Efficiency Obligations

Energy efficiency obligations can be defined as a legal obligation for electricity suppliers to save energy at their customers' premises. The targets do not usually prescribe how suppliers should attain the improvements hence, they can fulfil their obligations by carrying out any combination of approved measures for example, by promoting energy efficient lamps.[15]

14. Ton, My. (2009). Product and Packaging Marking; Comparative and Endorsement Labelling: What do the Consumer and the Regulator Need? Retrieved on March 8, 2012, from: http://cleanenergy.server313.com/upload/resources/file/file_471.pdf
15. Lees, E. (2007). European Experience of White Certificates. France: ADEME/WEC.

Advantages

Energy efficiency obligations are usually cost-effective. They are relatively inexpensive to administer and they are not considered government expenses. If a government decides on the target and the discount rate, the effectiveness of energy efficiency obligations can be maximized because of the social and environmental implications of these decisions. For example, by allocating part of the energy saving target to low income consumers, fuel poverty can be reduced.[16]

Constraints

Energy efficiency obligations can increase energy prices by 1 to 2 percent on customers' bills. Energy efficiency obligations are most common in developing countries but the possibility of linking them to carbon development mechanisms or carbon offsetting could be explored.[17]

Key Factors for Success

"Free riders" - those who would have introduced energy efficiency retrofits without the influence of a programme or incentive – are addressed by increasing the ambition level of the target. Administration, monitoring and verification of the energy companies must be ensured and adapted to the local circumstances. Government should clearly define the part of the energy supply and distribution chain upon whom the obligation to save energy is placed.[18]

Case Study: United Kingdom - Energy Efficiency Commitment[19]

Energy efficiency obligations have been in place in the UK since 1994. Along with building regulations, they form the main energy policy for tackling residential CO2 emissions. From 2002 to 2005, a goal of 62TWh of energy savings was projected at a proposed annual cost of £3.60 per customer. It allowed electricity suppliers to place surcharges on domestic energy bills. The monies collected were used to fund energy efficiency measures. Simultaneously, the companies were obliged to achieve a set energy efficiency targets. Fifty percent of their energy savings had to be derived from Priority Group households (those receiving certain income-related benefits and tax credits). This practice helped to equitably distribute benefits. According to DEFRA, between 2002 and 2004, the overall cost-effectiveness of the programme was a saving of £150/tC. The total investment was estimated at £276m, of which £154m was funded through the programme by increases in consumers' electricity bills. Significantly, 24% of energy efficiency savings came from CFL installations.

Additional Resources

- Lees, E. (2007) European Experience of White Certificates. France: ADEME/WEC.
- Raponline. (2012). The Regulatory Assistance Project Presentation on Energy Efficiency Obligations (EEOs).
- Boot, P.A. (September 2009). Energy efficiency obligations in the Netherlands. Netherlands: Energy research Centre of the Netherlands.

1.5 Energy Codes for Buildings

Energy codes for buildings set efficiency standards to improve overall building energy performance. They require robust code development, implementation and enforcement mechanisms. Building energy codes cannot be used as the primary method for phasing out inefficient incandescent lamps. Building codes can however, support a country's phase out policy by increasing demand for efficient lighting products. Care should be taken when building codes are written or revised to avoid exemptions that could become loopholes for avoiding inefficient lamp phase out policies. Likewise, when codes are revised, lamp phase out policies should be considered so that the code anticipates the availability of highly efficient lamps.

2. Economic and Market-Based Instruments

Economic and market-based policies for energy efficient lighting programmes are usually voluntary and often initiated and promoted by regulatory incentives. They include:

- **Cooperative procurement (bulk purchasing)** - takes advantage of economies of scale that can be obtained when purchasing large quantities of products to reduce the purchase price of energy saving lamps for end users
- **Instalment payments (on-bill financing)** - helps end users fund investments in energy efficiency improvements with low - or no-interest financing repaid through monthly instalment charges added to the their energy bills
- **Private sector loans** - secures financing for energy efficiency programmes without using public sector funds
- **Energy service performance contracting** - uses the monetary savings from energy efficiency programmes that have been successfully implemented to cover part or all of the investment costs

16. Koeppel S. (2007). Assessment of Policy Instruments for Reducing GREENHOUSE GAS Emissions From Buildings. Paris: United Nations Environment Programme.
17. Lees, E. (2007). European Experience of White Certificates. France: ADEME/WEC.
18. Ibid.
19. Oxera/Defra. (2006). Policies for energy efficiency in the household sector. UK: Oxera.

2.1 Cooperative Procurement (Bulk Purchasing)

Cooperative procurement consists of the bulk purchase of energy efficient lighting by government agencies, utilities, or cooperatives.[20] By pooling the collective buying power of these entities, it is possible to achieve economies of scale for energy efficient lighting products and to pass on the savings to the end users who are purchasing or receiving the products.

Cooperative procurements are typically coordinated by a designated government agency or by utility companies with the capacity and expertise to convene interested stakeholders and manage the design, implementation, and even evaluation of such programmes. If procurement is linked to other measures - such as MEPS, labelling programmes, information programmes, and energy service obligations - they can stimulate market change.[21]

Advantages

Cooperative procurement can:

- Lead to wide distribution and market adoption of energy efficient lamps
- Reach members of society who otherwise would not be able to purchase efficient lamps or reduce their energy consumption
- Result in lower costs and increased market availability for efficient technology
- Lower the risk associated with developing technologically advanced products from the manufacturers' standpoint because they essentially guarantee a market and can deliver pre-negotiated price points
- Benefit end users, as long as it involves the purchase and distribution of high quality, energy efficient light sources. If not, lesser quality products cause dissatisfaction that may lead to a public backlash

Finally, cooperative procurement can be used to support complementary policies, such as MEPS, public leadership and demonstration and energy service obligations for energy companies.

Constraints

Although cooperative procurement significantly lowers the costs of individual products, it has a number of constraints:

- Requires significant upfront investment (funding, time, effort and other resources), which must be addressed in the programme design
- Can significantly impact the retail sector, which may not benefit in the short-term from the sales that it would normally enjoy
- Assessing energy saving impacts quantitatively can be a challenge if lamps distributed by the programme are not immediately utilized by end users
- End users might opt to use more lamps than they would otherwise, due to the lower cost per unit. Thus, net energy consumption could increase if utility rates or other factors remain constant.

Key Factors for Success

Cooperative or bulk procurement programmes can disrupt the lighting market – which can be both an advantage and a liability. These programmes can circumvent the traditional distribution and retail lighting channels to increase awareness of availability of energy efficient lamps directly, reducing the normal market introduction time. However, these programmes are not sustainable and need to incorporate exit or transition strategies to ensure that the local lighting market remains transformed and does not revert back to supplying inefficient lamps when programmes end. Retailers bypassing these programmes may continue to stock less efficient products unless they have an incentive to change. Similarly, end users receiving products directly from agencies or utilities instead of through their normal retail channels will not know where to obtain additional or replacement efficient lighting products.

Cooperative or bulk procurement programmes should only be considered as a way to stimulate the market and increase end user awareness of energy efficient lamps. They are not a substitute for establishing MEPS. The design of procurement programmes must consider the impact to retailers, address the issues of fair competition and ensure product quality. If possible, they should avoid sole-source approaches to avoid disadvantaging some manufacturers or generating unanticipated consequences in the marketplace.

The success of bulk procurement should be combined with complementary measures such as MEPS and lamp labelling. Organizers should consult with users, manufacturers, distributors, retailers and other stakeholders to define the technical specifications for the procurement of energy efficient lamps. Finally, plans need to be prepared that can pave the way for a long-term, self-sustaining energy efficient lighting market.

Case study: Vietnam - Bulk Procurement

In August 2004, Electricity of Vietnam (EVN) implemented a competitive tendering process using the World Bank International Competitive Bidding (ICB) approach.[22] EVN issued a request for bids to select one supplier for 300,000 CFLs. To ensure that only high quality lamps were obtained, the request-for-bid document included technical specifications that were based on the International Finance Corporation/Global Environment Facility (IFC/GEF) Efficient Lighting Initiative (ELI) Voluntary Technical Specifications for CFLs. The winning bidder offered a lamp unit price of 1.07 USD, which compared favourably with the market price of CFLs at that time, which ranged from 2.50 USD to 3.00 USD.[23]

In view of the low price per unit, EVN opted to not offer any subsidy to its customers. While EVN wanted to give customers the benefit

20. Energy Sector Management Assistance Program. (2012). Large-Scale Residential Energy Efficiency Programs Based on Compact Fluorescent Lamps (CFLs) Approaches, Design Issues, and Lessons Learned. Retrieved on March 18, 2012, from: http://www.esmap.org/esmap/sites/esmap.org/files/2162010114742_CFL_Toolkit_Report_Rev_Feb_15_2010_Final_PRINT_VERSION.pdf.
21. United States Energy Association. (2012). Financing Energy Efficiency in Developing Countries – Lessons Learned and Remaining Challenges. Retrieved March 18, 2012, from: http://www.usea.org/ Programs/EUPP/gee/presentations/Wednesday/Singh_Notes_ESMAP_EE_Financing_Scale_Up_Energy_Policy_draft.pdf.
22. EVN is a state-owned enterprise which operates in power generation, transmission, distribution and other activities.
23. While the main contributing factor for the lower unit price was the volume purchase, it should be noted that under the World Bank procurement regulations, the Bank does not allow for payment of any import duties or taxes; therefore, the government waived such import tariffs.

of the lower cost of the bulk procurement, it did not want to distort the market for existing suppliers and retailers by offering CFLs at a very low price. EVN therefore, established a market price of VND 25,000 (about 1.56 USD) per lamp. The difference between the sales price and bulk purchase price was used to cover the distribution and sales expenses.

A second bulk procurement of 700,000 CFLs was conducted in September 2005 using a similar request for bids. The result of this competitive procurement was the selection of the same supplier at a unit price of 0.98 USD. The programme has saved roughly 46 GWh per year, experienced a lamp failure rate of less than 5% (replacements were provided by EVN when a lamp failed), and received a customer satisfaction rating of 92% based on a post-implementation survey.[24]

Additional Resources

- Borg N. & Englerdyd A. (1998). Cooperative Procurement of Lighting Systems. ACEEE Summer Study on Energy Efficiency in Buildings (4.13-4.28).
- ESMAP (2012). Uganda Compact Fluorescent Programme.
- Birner S. & Martinot E. Eric Martinot (September 2011). Market transformation for energy efficient products: lessons from programmes in developing countries.
- Feist J. W., Farhang R., Erickson J., Stergakos E., Brodie P. & Liepe P. Super Efficient Refrigerators: The Golden Carrot from Concept to Reality. ACEEE Summer Study on Energy Efficiency in Buildings, (3.67-3.75).

2.2 Installment Payments (On-Bill Financing)

The use of instalment payments (on-bill financing) is a financing approach through which utilities can help their customers fund investments in energy efficiency improvements. Energy customers are provided with low- or no-interest financing for the purchase and installation of energy efficient lighting. The utility purchases efficient lamps in bulk, and provides them to its customers at cost or cost plus interest charges. For commercial customers, the utility finances the project's upfront capital costs, and the loan is then repaid through monthly instalment charges added to the customer's bill. If lighting is used for the same amount of time before and after the efficiency upgrade, end users should see no increase, or, a decrease, in their utility bill because the reduced energy consumption will offset the capital cost of the upgrade.

Loan terms can be short-term (1-4 years), medium-term (5-10 years or longer), or long-term (as long as 30 years). Short-term loans are used for household and small-business on-bill loan programmes. For energy efficient lamps, terms can be as short as one year. Medium-term loans can be used, when loan terms are designed around the life of the efficiency measures. Long-term loans can be tied to a property tax or a mortgage.

On-bill utility loans can be grouped into two general types:

- A loan that a utility makes directly to a business, government, institution or homeowner
- An energy service charge on an end user's bill that stays with the property in the event the homeowner or business moves to another location.

The on-bill mechanism works well for small businesses that need simple, turnkey approaches to improve energy efficiency and for homeowners seeking financing for more modest energy efficiency measures.

Advantages

On-bill financing programmes encourage private investments in energy efficiency improvements through the provision of low-cost or zero-interest short-term loans. They provide a convenient method for homeowners or individual customers to purchase and pay for energy efficient lighting directly without having to provide the full upfront costs. All new lamps can be installed at the same time, reducing labour costs for relamping. They also allow small business and government customers to repay loans for energy efficiency from their regular operating budgets, and they reduce private sector energy costs, improving local business profitability. They reduce energy intensity of the economy and provide a new service with both public and private benefits.[25]

Constraints

Although on-bill financing is simple for utility customers, it complicates billing for the utility, which must modify its systems to accommodate the loan accounting. It can also involve increased staffing and administrative costs, because the programme administrator must devote staff to running credit checks, approving loan agreements, carrying out and assessing engineering audits, accounting activities, and handling customer service issues.

An on-bill financing programme also requires an initial pool of funds to supply project loans, or to purchase energy efficient lamps for resale to customers. These funds can be collected either from normal energy utility operating revenues, as part of a utility capital expenditure budget, or from a separate surcharge on all customers' bills. Both of these methods involve costs to either the utility (the opportunity cost of diverting funds to this purpose) or its customers (increased rates due to the small surcharges on monthly bills). Due to these constraints, some utilities may hesitate to take part in such programmes until they are tested widely and demonstrate success.[26]

24. Energy Sector Management Assistance Program. (2012). Case study Vietnam Compact Fluorescent Lamp Program. Retrieved on March 8, 2012, from: http://www.esmap.org/esmap/sites/esmap.org/files/18.%20Vietnam_CFL_Case_Study.pdf
25. O'Connor, D. Joint US-China Collaboration on Clean Energy (JUCCCE). United Illuminating. On-Bill Financing for Energy Efficiency - Mayor's Training Program Case Study. Retrieved March 8, 2012, from: http://energy.sipa.columbia.edu/researchprograms/urbanenergy/documents/On%20bill%20Financing%20FINAL.pdf.
26. Ibid

Key Factors for Success

To ensure the success of an on-bill financing programme, the programme must not involve a customer down payment, and, the cost of applying energy efficiency measures must be lower than the market rates. Additionally, the rates and amounts paid by the customer should be constant for the term of the loan. For implementation, where the utility may become the retailer, or need to work with retailers to facilitate the sale of lamps to customers, it is essential that high quality lamps are selected and sufficient numbers of lamps are available to meet initial customer demand. Should the utility choose to sell lamps directly, it is important that they have a transition plan and clear communication with retailers to avoid the appearance of direct competition with the retail sector. The utility should develop a system to avoid unpaid loans if customers decide to change utility suppliers.

If the programme is designed properly, customers should not see their bills increase, because the monthly loan payments are usually equal to or less than the cost savings delivered by the efficient lamps. Moreover, the payback period for the project should match the loan period, which means that as soon as the loan is repaid, the customer's energy bill should decrease, with all savings thereafter going directly to the customer.

Case Study: U.S.A. - Portland, Oregon Clean Energy Works Portland Program[27]

In June 2009, the U.S. city of Portland, Oregon, in collaboration with Energy Trust Oregon, launched the Clean Energy Works Portland pilot program. The program was designed to retrofit 500 local homes. A revolving loan fund was capitalized with federal American Recovery and Reinvestment Act funds (2.5 million USD), Enterprise Cascadia resources (2 million USD), and a grant from the Portland Development Commission (3.5 million USD).

The pilot phase was followed by the formation of a new non-profit organisation: Clean Energy Works Oregon, Inc. The City of Portland helped to create this organization and subcontracted 18 million USD of a 20 million USD Better Buildings (American Recovery and Reinvestment Act) grant to implement the program. The mandate of the organisation was to retrofit 6,000 homes and small businesses throughout Portland. The loan programme had on-bill repayment whereby participants receives low-interest loans through a revolving loan fund administered by a local bank and paid back the loans through their utility bills, which showed the payments as separate line items.

More than 30 organizations were involved in the development of the program and in various aspects of its implementation, including: Energy Trust Oregon, a public purpose agency that is responsible for enrolling and serving participants in the program; ShoreBank Enterprise Cascadia, a community development financial institution that provides the loans to participants; local utilities that are collecting the payments as part of the utility bills they issue; and Green For All, a national organization concerned with finding ways to support a green economy and which helped the city develop its Community Workforce Agreement.

Additional Resources

- O'Connor, D. Joint US-China Collaboration on Clean Energy (JUCCCE). United Illuminating. On-Bill Financing for Energy Efficiency - Mayor's Training Programme Case Study.
- Le Uyen. (2010) On-Bill Repayment: Understanding and Advocating for an On-Bill Repayment System.
- Rezessy S. & Bertoldi P. (2010) Financing Energy Efficiency: Forging the Link between Financing and Project Implementation.
- Gandhi N., O'Connor D., Gray P., Vagnini R., Kiernan K. & Baggett S. On-Bill Financing of Small Business Energy efficiency: An Evolving Success Story. 2008 ACEEE Summer Study on Energy Efficiency in Buildings (5.106-5.115).

2.3 Private-Sector Loans

In an effort to reduce public debt, some governments have chosen to involve commercial banks and private capital in energy efficiency investments, rather than use public sector funds. By involving the private sector, which seeks profit from its loans, it is possible to develop a self-sustaining, long-term market while obtaining a good return on investment in the short term.[28]

The main goal of the bank-loan funding method is to get banks involved in energy efficiency programmes and introduce them to the idea of profiting by financing energy efficiency efforts. However, the higher risk market environments in developing countries and emerging economies can often make it difficult to raise financing from banks. Banks tend to be conservative in their investments and are not accustomed to the concept that energy efficiency projects can generate returns. Consequently, a substantial effort is required to establish an appropriate institutional framework and enable the financial environment to back investments in energy efficiency projects.

Micro-finance schemes or efficiency loans for multi-family housing have proven successful in areas not served by traditional banking institutions. However, the magnitude of programmes to phase-out inefficient lamps may attract banks. Some lamp suppliers serve as lender, receiving payment for the sale of their products over time with interest, instead of one upfront payment.

Advantages

The involvement of commercial banks or other private sector lenders can guarantee financial support with advantageous financial conditions and provide tailored packages in countries that lack financial capacity and/or experience. Experts from commercial banks offer professional skills and services that may not be available in the public sector. Additionally, bank loans can often produce funds

27. Duffy, R. and Fussell, H. (2011). Building Fast Action for Climate Change and Green Jobs. Canada: Center for Civic Governance.
28. World Energy Council. (2004). Energy Efficiency: A Worldwide Review – Indicators, Policies, Evaluation. - A Report of the World Energy Council in Collaboration with ADEME. UK: World Energy Council.

more quickly than financing that is tied to government or donor programmes. The involvement by banks or private financial institutions also assures other programme participants, such as suppliers and distributors, of the validity of and funding availability for, the programme.

Constraints

Some banks may lack understanding of the value of energy efficiency projects. Many bankers do not have the technical knowledge necessary to adequately assess and evaluate the contribution that an efficient lighting project can make to the profitability of a loan applicant. Consequently, loan applications for commercial energy efficiency projects may be unfavourably viewed by bank officers. Banks must understand the nature of the energy efficiency businesses, including the opportunities and the risks, in order to develop suitable financing, marketing strategies and appraisal methods, and to determine reasonable default projections, and eventually to develop bankable projects.[29]

In addition, energy efficiency projects may be considered to be high-risk investments because they involve the use of innovative technology. Bankers are often reluctant to make loans to advance technologies that they consider untested or less likely to produce predicted cost savings and associated productivity gains. Energy efficiency projects can also have long payback periods, and banks are often uneasy about lending money for these projects due to the increased risk of default.

Finally, many energy efficiency projects are simply too small to attract attention from banks, which prefer making larger loans. Transactions costs represent a much larger proportion of a small loan than they do of a larger loan. In many situations, the small scale of an energy efficiency project investment makes the transaction cost highly prohibitive.

Key Factors for Success

The primary factor in the success of bank-loan financing is the interest rate. The lower the interest rate, the more attractive the loan is to potential applicants. Another important aspect is the structure of such loans. A number of energy efficient lighting project loans have been structured in such a way that the financial risks are shared among the lending institutions, product suppliers, and implementing agencies.

Lack of knowledge or awareness is also a significant barrier affecting this form of funding. Financial institutions should be provided with more information on the benefits of an energy efficiency programme. Governments and other institutions should consider ways to further provide important information and justification tailored to specific national or regional needs. In the case of micro-financing, where the interest rates can be significantly higher than commercial lending rates, governments or implementing agencies may be able to leverage their relationship with the lenders to lower the interest rate for energy efficient lamps to make them more affordable to end users. Agencies also have the option of using their funding to buy down the interest rate as a way of increasing the availability and affordability of energy efficient lamps for rural end users.

Case Study: Mexico – Fideicomiso para el Ahorro de Energía Electrica (FIDE)[30]

In 1990, the Mexican government launched Fideicomiso para el Ahorro de Energía Electrica (FIDE), a national trust to promote sensible electric energy use. FIDE's many activities include providing no- and low-interest loans for domestic, commercial, industrial, and municipal energy efficiency projects. The programme was established in cooperation with its commercial banking partner, BANORTE.

One of the main objectives of FIDE's energy efficiency financing programmes was to increase the participation of the commercial banking sector in providing debt and other financing to energy efficiency projects and ventures. To achieve this, a guarantee fund was launched, which was financed by FIDE (MXN 5 million, approximately 440,000 USD) and NAFIN, a Mexican development bank (MXN 50 million, approximately 4.4 million USD). The FIDE/NAFIN guarantee covered 75% of the loan, limited only by the financial cap of the fund itself (approximately 5 million USD). The partner bank assumed the financing of the loan and the remaining risk of 25% of the total debt granted.

The FIDE debt financing mechanisms demonstrate significant results with respect to loan servicing and leveraging further financing and energy savings. FIDE even covered the technical due diligence and related transaction costs. Despite the successful FIDE loan track record to date, no commercial loans have been granted under the private bank loan and FIDE/NAFIN guarantee programme.
This demonstrates the ongoing challenges of convincing the commercial and local banks that energy efficiency ventures and projects are profitable and that servicing debts through energy savings is a reliable model.

The FIDE example also shows that guarantee funds cannot be used as a stand-alone solution. In Mexico, strategies and efforts such as banker awareness and training are presently under consideration to make the commercial finance sector more aware of the opportunities associated with financing energy efficiency.

Additional Resources

- United Nations Environment Programme Division of Technology, Industry, and Economics - Energy Branch.
- Hamilton K. (2009). Energy efficiency and the finance sector – a survey on lending activities and policy issues. UNEP Finance Initiative
- Rezessy S. & Bertoldi P. Joint Research Centre of the European Commission. Financing Energy Efficiency: Forging the Link between Financing and Project Implementation.
- European Fund for Southeast Europe. (2012). Introducing Energy Efficiency Lending –What to consider?

29. Makinson, S., (2006). Public Finance Mechanisms to Increase Investment in Energy Efficiency - A report for policymakers and public finance agencies. Basel: BASE.
30. United States Energy Association. (2012). Financing Energy Efficiency in Developing Countries – Lessons Learned and Remaining Challenges. Retrieved March 18, 2012, from: http://www.usea.org/Programs/EUPP/gee/presentations/Wednesday/Singh_Notes_ESMAP_EE_Financing_Scale_Up_Energy_Policy_draft.pdf.

2.4 Energy Service Performance Contracting

Energy service performance contracting is a form of purchasing in which monetary savings from successfully implemented energy efficiency measures are used to cover part or all of the investment costs. This policy approach primarily targets commercial buildings and can achieve significant results in the commercial sector, including energy efficient lighting. However, this is not a primary tool to facilitate the phasing out of inefficient lamps since the administrative costs of conducting an audit, arranging financing and implementing energy efficiency measures is cost prohibitive unless the projects are of a significant scale that far exceeds that of single and multi-family homes.

3. Fiscal Instruments and Incentives

Fiscal instruments and incentives are policy instruments that influence energy prices or energy efficient products with the objective of reducing energy consumption. They include:

- **Tax incentives:** policies used to reward the manufacture and purchase of energy efficient lighting and/or penalize the purchase of inefficient lamps
- **Subsidies, rebates, and giveaways:** help to overcome the financial barriers that many end users face with respect to investing in energy efficient lighting products

3.1 Taxation Incentives

Tax incentives play an important role in making end users more open to acquiring efficient lighting products. Reduced taxes encourage desired behaviour and/or penalize the purchase of inefficient lamps.[31] Other mechanisms such as accelerated depreciation, tax deduction or tax credits that are only aimed at businesses and are not applicable for the promotion of efficient lamps in the residential sector.

3.1.1 Tax Reductions

Under a tax reduction incentive, taxes paid on the purchase of energy efficiency equipment, such as consumption or value added tax (VAT) or import duties, are reduced or eliminated. In developing countries, reduction of import duties can be significant, as domestic sources of energy efficiency technology may be limited, and standard duties on imported equipment may be a substantial barrier to their use.

VAT reductions for efficient equipment - in particular, for CFLs - constitute the most common application for a tax reduction strategy outside developed countries. VAT concessions also exist for labour rates to reduce the investment cost in renovating buildings. These concessions are becoming more common for companies that commit to energy efficiency gains and CO_2 reduction targets. Reducing VAT rates for energy efficient products serves to decrease their prices relative to inefficient products thus, influencing end users to naturally shift the market in favour of the energy efficient product.[32]

3.1.2 Tax Increase on Inefficient Technologies

Energy efficient lamps are usually more expensive than the inefficient incandescent lamps they replace. End users are sensitive to the initial costs of products they need to purchase, so imposing a significant tax on inefficient incandescent lamps helps to make the more efficient lamps more competitive from a end user's perspective.

Advantages

Tax incentive policies are ideal for encouraging end users to utilize energy efficient products. Such incentives can increase and encourage the adoption of CFLs or LED lamps, or discourage the use of inefficient lamps. Compared with other types of subsidies, tax incentives may also be preferable because they are typically easier to implement. They are also highly flexible, can be adjusted to the needs of the customer, and can be associated directly with targeted products, such as energy efficient lamps. A tax increase on inefficient incandescent lamps could have a positive impact on the fiscal system of a country.

Constraints

Although many countries use tax policies to promote energy efficiency, it is often difficult to determine how effective those policies are at changing behaviour. Some countries do not collect data on the adoption rates for tax incentives. Energy efficiency tax policies are also subject to free ridership.

It is difficult to separate the impact of a tax incentive itself from the impact of other, simultaneous policies and programmes, or market changes, such as increasing or decreasing energy prices. In addition, removal of tax burdens might not be sufficient to overcome the initial costs of efficient lamps. A tax increase on inefficient incandescent lamps might become ineffective if factors other than retail price of the lamp determine customers' choices. By reducing the amount of tax income for the region affected by the taxation policy, tax reductions can have negative impacts on the fiscal system, which may be difficult to overcome.

31. UNEP. (2006). Improving energy efficiency in industry in Asia - review of financial mechanisms as part of the Energy Efficiency Guide for Industry in Asia. United Nations Environment Programme.
32. Næss-Schmidt S., Jespersen S. T., Termansen L. B., Winiarczyk M. & Tops J. (2008). Reduced VAT for environmentally friendly products. DG TAXUD.

Key Factors for Success

For promoting investments in energy efficient lighting, tax incentives are usually more effective than taxes on fuel or power use, because the benefits are directly linked to the investment. Tax incentive programmes can be combined with other instruments and policies and should be designed with flexibility as to the credit recipient. However, compared to other policies to phase-out inefficient lighting, the cost per unit for administration can be high.

To ensure success, the incentives should be tied directly to products or results that meet performance criteria. In the case of incentives aimed at benefiting end users, it is essential that the guidelines for qualification are as simple as possible and clearly communicated. In addition, qualifying products need to be identified at the point of purchase. Finally, programme criteria should support MEPS and focus only on high-quality products.

Case study: Ghana - Tax Elimination for CFLs

The government of Ghana conducted a large energy efficiency programme to address the country's electricity grid supply and demand imbalance. CFLs were seen as a significant means for reducing electricity consumption. To promote the widespread use of the lamps and to make their prices affordable, Ghana eliminated tariffs and VAT on CFLs. The foregone tax revenues were approximately $2 million net present value (20% import duty and 12.5% VAT on CFL).[33] The current market price of an unbranded but labelled 11W CFL is about 1.5 cedis (1USD).[34]

Case study: Tunisia - Tax Increase on Inefficient Incandescent Lamps

Tunisia plans to phase out inefficient incandescent lamps by 2014. For four years starting in 2008, Tunisia aimed to market eight million CFLs to achieve a market penetration of 90%. To increase the initial cost of inefficient incandescent lamps and to make CFLs cost competitive, the government introduced a progressive consumption tax (from 10% in 2007 to 50% in 2011) on the sale of incandescent lamps. Revenues from this tax will subsidize the cost of the CFLs.

Additional Resources

- McKane A., & Price L. (2008). Policies for promoting industrial energy efficiency in developing countries and transition economies. United Nations Industrial Development Organization.
- Brown M. Harcourt Brown & Carey. (2012). State Energy Efficiency Policies Options and Lessons Learned - State Tax Policies to Encourage Energy Efficiency.
- Arvanitakis D. Agencia Para Energia. (2012). Financial Incentives for the Adoption of Residential Energy Efficient Products: An Analysis of European Programmes and Best Practices.
- GreenFacts. (2012) Table SPM-7 Selected sectoral policies, measures and instruments.

3.2 Subsidies, Rebates and Giveaways

Subsidies, rebates, and giveaways are policy measures that address the initial cost of efficient lamps. This approach utilizes existing market channels to distribute or sell increased quantities of high quality energy saving lamps that meet specified technical criteria (some giveaway programmes however, do not use existing market channels). These strategies are commonly used in the residential sector to achieve simple and immediate price reductions which promotes more rapid adoption. Incentives for manufacturers or suppliers can encourage them to supply more efficient products, with the assumption that most of the incentive will be reflected in a lower price. Vendor incentives can help increase product availability and, by increasing sales volume, reduce prices in the long term.

The stakeholders who are most likely to be affected by these kinds of programmes are end users, vendors, installers and manufacturers. The costs related to the implementation of such programmes can be borne by three major stakeholders:

- Utility companies - when there is the prospect of revenue generation as a result of actions to reduce peak demand, eliminate power theft, or increase revenue from additional services or electricity sold
- Third party investments by manufacturers or service providers - where there is the prospect of increased revenue from expanded sales of products or services
- Government and/or international organisations - when social or environmental benefits are identified and considered achievable

3.2.1 Subsidies

Subsidies can be used as temporary measures to mobilize end users, to prepare the market for new regulations, or to promote energy efficient lighting technologies by creating a larger market than would otherwise exist[35]. The ultimate objectives of such programmes are to: use available funds to reduce perceived risks for market players; decrease the initial cost of energy efficient lighting products; capture the attention of otherwise disinterested or uninformed end users; and, temporarily reduce prices until market trends force these prices downward and create a sustainable market transformation.[36]

33. Agyemang-Bonsu, W. K.Resource Service. (2007). Multilateral Technology Transfer Process -Ghana's Experience and Lessons Learned. Retrieved March 8, 2012, from: http://www.resourcesaver.com/file/toolmanager/0105UF1335.pdf.
34. Based on personal communication with ECOWAS
35. Vreuls, H. (2007). Evaluating energy efficiency policy measures & DSM programs. The Netherlands: SenterNovem.
36. Gibbs, M. and Townsend, J. (2000). The Role of Rebates in Market Transformation: Friend or Foe. IACEEE 2000 Summer Study on Energy Efficiency in Buildings (6.121-6.132). Retrieved from: http://www.eceee.org/conference_proceedings/ACEEE_buildings/2000/Panel_6/p6_11/paper.

Case Study: Egypt - CFL Subsidy Project

The UNDP/GEF Project “Improving the energy efficiency of lighting and other building appliances” will run from 2010 to 2015.[37] The objective is to accelerate market transformation in the residential sector by providing high quality CFLs at subsidized prices. The project involves the Ministry of Electricity and Energy (MoEE) which has allocated 18 million Egyptian pounds to support the sale of three to four million additional lamps. The subsidy will be as much as 50% of the regular retail price of the lamps.

The specific target group will be those low-income families that are not able or willing to invest in CFLs due to their still relatively high costs, when compared to the income level of the families and their current electricity tariffs. The number of customers in this group is 5 million, which represents over 23% of all residential customers in the country. The resulting savings have been targeted at 0.67 TWh of cumulative electricity demand with the avoidance 0.37 Mt of CO_2 emissions.

3.2.2 Rebates

Lighting rebate programmes encourage consumers to buy efficient lamps that have higher initial costs than inefficient lamps. Rebates are a market transformation financial incentive tool, particularly useful when a new type of lighting technology is introduced to a market. Energy efficiency advocacy organizations and governments have studied and evaluated the benefits of rebates, documenting best practices. Both the American and the European Councils for an Energy Efficient Economy offer archives of conference proceedings and reports that summarize best practices for rebate programmes.[38] Typically, these programmes are implemented by utility companies or energy service companies.

Electric utilities often have the strongest technical ability and implementation capacity. In smaller countries with limited technical expertise and institutional capacity, utility administration of a rebate programme may be the only viable option for implementing and financing energy efficient lighting programmes.[39] Customers may purchase the qualified lamps at a number of facilities, including retail outlets or locations where the customer usually pays the electricity bill.

Rebates programmes for lamps should be tailored to a specific audience. The form of the rebate influences the audience response. Often pilot studies are conducted with segmented customer groups to determine what form of rebate will have the greatest impact. Rebates forms include:

- Mail-in rebates that entitle the buyer of an efficient lamp to receive a check or discount for a future purchase in return for mailing in a coupon, receipt, and barcode for the purchase
- Instant, point-of-purchase rebates that are redeemed in the retail store
- Door-to-door schemes in which local salespeople sell their goods and end users receive their rebates when paying their electricity bill
- Mid-stream rebates whereby the electric utility or funding agency offers a rebate directly to the manufacturer, distributor or retailer rather than to the end user. This leads to a lower retail price for the product and less administrative effort and cost for the program manager

Rebate programmes include awareness raising activities and informational campaigns to educate retailers and end users about the benefits of the efficient lighting.[40] Most rebates are set at levels that address very local markets, typically no larger than a province or state, and commonly within a single electric utility territory. The rebate for each type of lamp featured in an incentive programme should be set at a level that will offset the difference in cost between the efficient and the inefficient products.

Mid-term and post-programme evaluations are essential for tracking and measuring the success of programmes, and for making mid-term adjustments to reflect market trends. Rebate programmes should regularly track market prices so that rebate levels can be adjusted as the price of new technologies declines over time.For example, rebate amounts can be adjusted as the market price shifts, or rebates can be discontinued if market prices decrease to the point where efficient lamps are approximately the same price as inefficient types.

3.2.3 Giveaways

Giveaway programmes promote the rapid installation of efficient lamps by distributing them free of charge to residential and small business customers. Such programmes can be implemented through:

- Targeted giveaway programmes that seek to reach a specific group of residents, often by leveraging an existing event or gathering place. These may include targeted locales for example, at community fairs, where the focus may be on rural communities.
- Door-to-door giveaway programmes that aim to deliver a high volume of CFL or LED lamps to a targeted group of residents (usually with low income) who are located in close geographic proximity

These measures work well with other demand-side management strategies, such as bulk procurement.

37. UNDP Project Document (2011). Retrieved July 9, 2012. Retrieved from: http://www.undp.org.eg/Portals/0/Project%20Docs/Env_Pro%20Doc_Energy%20Efficiency.pdf
38. American Council for an Energy Efficient Economy: www.aceee.org. European Council for an Energy Efficient Economy: www.eceee.org.
39. United States Energy Association. (2012). Financing Energy Efficiency in Developing Countries – Lessons Learned and Remaining Challenges. Retrieved March 18, 2012, from: http://www.usea.org/Programs/EUPP/gee/presentations/Wednesday/Singh_Notes_ESMAP_EE_Financing_Scale_Up_Energy_Policy_draft.pdf
40. Consortium for Energy Efficiency. (2006). Residential Lighting Programs National Summary. Retrieved on March 8, 2012, from: http://www.cee1.org/resid/rs-lt/06rs-lt-progsum.pdf.

Case Study: South Africa - CFL Sustainability Programme

The South African utility, Eskom's, national efficient lighting programme, Compact Fluorescent Lamps (CFL) Clean Development Mechanism (CDM) Project, has distributed more than 30 million CFLs free of charge to South Africa since 2007 through a combination of door-to-door, gate-to-gate, and exchange points. According to estimates, every one million CFLs distributed will lead to an reduction of electricity consumption by up to 60 GWh/year. With most of the residential electricity coming from coal-fired power plants, it has been determined that this project has saved more than seven million tons of CO_2 emissions and saved participating residential customers millions of South African Rand. Additionally, more than 30,000 temporary jobs were created as a result of the project.

To help sustain these savings, Eskon will continue to distribute CFLs throughout the country under the CFL Sustainability Programme[41] which is expected to distribute 20 to 40 million CFLs between 2011 and 2013. Carbon credits will be generated as an integral component of the project to cover the costs associated with the purchase of lamps, distribution, disposal, and communication, as well as monitoring and verification procedures.

Advantages

In many cases, initial cost is a major barrier to purchasing energy efficient lighting products. Subsidy, rebate, and giveaway programmes help end users obtain lamps by reducing these initial costs.[42] These programmes can also reduce the amount of time and effort end users need to research their purchases, because products are already identified. They can also decrease the risk to manufacturers and retailers because the subsidy scheme generates interest and additional sales and reduces the retailers' risk in stocking and displaying efficient lamps.

These types of programmes may fit well with carbon financing programmes (see Section 3), because measuring the programme impact in terms of energy savings is relatively easy. The mechanism by which the programme operates is quite simple and the programme beneficiaries are easily identifiable. Such programmes also reduce the perception of performance risk, because the end user assumes that an inferior product would not be subsidised.

Subsidy, rebate and giveaway programmes are also a valuable tool for situations where peak load must be reduced rapidly during electrical generation shortages, where electrical supply cannot meet demand. For example, following earthquake and tsunami damage in 2011, Japan faced rolling power outages and a summertime peak load crisis. To decrease electrical demand, LED lamps were widely offered by retailers at discount prices, accompanied by government and utility information campaigns that urged end users and small business to do their part to reduce electrical demand. Within a few months, unit sales of LED lamps exceeded sales of metal filament (incandescent) lamps for the first time.[43]

In conclusion, such programmes can be highly cost-effective for large government campaigns when supported by retailers, manufacturers and utilities. As they are voluntary programmes, they tend to build end user awareness of new, energy efficient technologies without the backlash that can sometimes accompany mandated programmes. They also provide synergy with labelling programmes when they introduce and promote labelled products. Finally, such programmes can enhance market demand thereby, lowering per unit costs.

Constraints

Subsidy, rebate, and giveaway programmes may not be sustainable in cases where energy efficient lamps are not readily available and a protocol to qualify such products has yet to be implemented. They also possess the high potential for free riders and may have a rebound effect - the increased usage of the new lighting products with resulting lower energy savings than expected. They can also negatively affect the retail and distribution channels if they are not involved during the programme design process.[44]

Administrative costs for such programmes can be high (per unit), especially when the actual number of subsidized energy saving lamps is much lower than expected. It may also be difficult to adequately publicize the existence of the incentives to the end users affected by the programmes. Subsidizing appliances with an already high penetration rate could also prove to be expensive and provide limited impact and have relatively high costs on a per unit basis. With rebates, the participation rate can vary depending on the manner in which end users can claim their rebate. In developed countries, the percentage of rebate coupons redeemed may be less than one percent in many cases. It can also be difficult to determine who should bear the cost burden of processing the rebates, whether it should be a retailer, the utility or government agency.

Key Factors for Success

To succeed, subsidy, rebate, and giveaway programmes must combine the economic incentives intrinsic to the programmes with other policy measures. They must also include the involvement of stakeholders, such as with voluntary agreements and promotional campaigns to be carried out by the retailers. It is also necessary to encourage and reward producers of lamps that exceed the minimum energy performance levels by a specified amount. To achieve lasting impact, these programmes require a complete transition strategy to transform the market to efficient lighting for the long term, rather than just create a momentary increase in acceptance.

The way in which the end user obtains the economic incentive associated offered by the programme should be simple and user-friendly, with minimal bureaucracy and potential delays. Direct subsidies or other point-of-sale incentives are more effective than mail-in rebates. They also have a lower per unit administrative cost. The incentive should guide the purchase of high efficiency and good

41. The Eskom National Efficient Lighting Programme: Compact Fluorescent Lamps (CFL) Clean Development Mechanism (CDM) Project (2011). Retrieved on July 9 2012 at: http://www.eskom.co.za/content/The%20Eskom%20National%20Efficient%20Lighting%20Programme%20Compact%20Fluorescent%20Lamps%20Clean%20Development%20Mechanism%20Project.pdf
42. Energy Charter Secretariat (ECS). (2002). Fiscal policies for improving energy efficiency. Taxation, grants and subsidies. Brussels: ECS.
43. Kurihara, Takeshi. (2011). Power-saving public turns to LED. Daily Yomiuri Online/The Daily Yomiuri. Retrieved on 6 May 2012 at: http://www.yomiuri.co.jp/dy/business/T110605002562.htm.
44. Vreuls, H. (2007). Evaluating energy efficiency policy measures & DSM programs. The Netherlands: SenterNovem.

quality lamps to increase end user confidence in such products. When evaluating these incentives, planners should consider that each situation is different. Subsidy programmes should include both energy saving lighting market share objectives and national energy saving goals.
Developing an adequate quantitative baseline is the first step in measuring the success of a programme. For example, this could take the form of market share information, for example, which may need to be purchased from market research companies or specifically generated for the programme. Without a baseline, the expected outcome and impact for subsidies and grants can be overestimated.

Some giveaway programmes target select groups, so the mechanisms for informing these groups should be designed, as much as possible, to prohibit free ridership or insufficient use of the lamps that are distributed or bought.[45]

Programme designers may want to conduct surveys to assess end user attitudes and behaviour with regard to new energy efficient lamps. They also should determine the preferred incentive delivery mechanisms. The capacity of the rebate process should be evaluated to determine whether or not participating retailers can track sales and provide point of sale rebates. Ideally, efficient lamps should be distributed through locally accepted distribution channels to increase acceptance for both the products and programme by stakeholders. For programmes that promote the one-time or limited-time distribution of large lamp volumes in exchange for customers' inefficient incandescent lamps (for CDM credit, for example), planners should set up environmentally sound management methods for handling, storage, and disposal or eventual recycling of the collected lamps (see Section 5).

When the programme is operating, sales should be tracked to provide data to measure programme savings. Analyses should include: the number of subsidized lamps; the percentage of eligible facilities that participated in the programme; the number of subsidized agencies; and the ratio of investment-related costs to the actual subsidy. Finally, the focus and availability of subsidies should have a time limit to facilitate the market introduction of new technologies, or be limited to the target groups in greatest need of the technology.[46]

Additional Resources

- Gillingham K., Newell R. G. & Palmer K. (April 2009). Energy efficiency: economics and policy US: resources for the future
- Evan Mills. (2012). Lighting markets and energy efficiency publications.
- Sarkar. A. & Singh J. (October 2009) Financing Energy Efficiency in Developing Countries – Lessons Learned and Remaining Challenges.

4. Support, Information, and Voluntary Action Policies

Support, information, and voluntary action policies help create an integrated policy approach for the transition to efficient lighting. These policies include the following elements:

- **Awareness raising, promotion, and education** — to mobilize public support and change societal and cultural attitudes and behaviours regarding energy efficient lighting (see Section 6)
- **Detailed billing and disclosure** - provides detailed information on energy consumption so that end users can learn about and track the benefits of using efficient products
- **Voluntary certification and labelling** - encourages manufacturers to voluntarily inform end users about the energy efficiency of their products
- **Public leadership and demonstration** - by reducing energy use in government buildings, applied energy efficiency principles are demonstrated to the general public

Detailed billing and disclosure policies, as well as voluntary and negotiated agreements are generally not used as stand-alone initiatives or in combination with other policies to phase-out incandescent and inefficient lamps.

4.1 Awareness Raising, Promotion and Education

Public information campaigns designed by government agencies or utilities aim to educate and mobilize the public, influencing social or individual behaviours, attitudes, values, and knowledge. The purpose of an energy efficiency public information campaign is to raise awareness among end users, promote energy efficient lighting policies, and educate the general public.

Informed end users will seek out and participate in energy efficient energy efficient lighting programmes. Accurate information helps end users understand the long-term impact that using efficient lamps will have on their energy bills. For example, although CFLs are relatively affordable, they remain more expensive than incandescent lamps; surveys indicate that the initial price difference is the main barrier to their purchase. End users that understand and can calculate the payback period and the overall potential cost savings of CFL use are more willing to invest for longer-term savings benefits.

Various marketing strategies help end users and small businesses understand energy consumption issues and identify savings opportunities[47]. Activities that educate and inform target groups include launching communication campaigns that offer online tools and information, and, encouraging key players in the lighting supply chain to develop targeted communications for point-of-sale use. Information programmes increase the effectiveness and the long-term impact of other policy instruments (see Section 6).

45. Friedmann, R. & De Martino Jannuzzi, G. (1999). Evaluating Mexican and Brazilian Residential Compact Fluorescent Lamp Programs: Progress and Unresolved Issues. Faculdade de Engenharia Mecanica Retrieved from: http://www.fem.unicamp.br/~jannuzzi/documents/evaluat-mx-br.pdf.
46. Uyterlinde, M. and Jeeninga, H. (1999). Evaluation of energy efficiency policy instruments in households in five European countries. ECEEE 1999 summary Study Panel 1, 20. Retrieved from: http://www.eceee.org/conference_proceedings/eceee/1999/Panel_1/p1_20/paper.
47. Egan, C., Abelson, J. (2005). Designing and Implementing Marketing and Communications Campaigns for Labelling and Standards Setting Programs. In Energy Efficiency Labels and Standards: A Guidebook for Appliances, Equipment and Lighting (2nd edition). US: CLASP

4.2 Detailed Billing and Disclosure

Detailed billing and disclosure programmes display detailed information about energy consumption on the user's bill or directly on the appliance or an attached meter.[48] They make end users aware of how much energy they are using for different purposes, so that they can change their day-to-day behaviour and select products that will help them reduce consumption and costs. They target end user behaviour rather than specific technologies. Billing, metering and disclosure programmes enable end users to save up to 10 % in energy consumption[49] and they are usually cost-effective to administer.[50] Their effectiveness depends, in part, on the programme feedback type—specifically, whether it is direct or indirect.[51]

- **Direct feedback** provides information from the meter or an associated display monitor. High-demand energy users may respond to direct feedback more than low-demand users and their savings from behavioural changes range from 5% to15%. Feedback at the electricity meter is relatively expensive and complicated to supply therefore, it is preferable to display energy usage on or near the appliances themselves
- **Indirect feedback** is processed before reaching the energy user, normally via billing. This is more suitable than direct feedback for demonstrating effects on consumption due to major changes, such as replacing inefficient lamps and installing new switching circuits for lighting in a social housing complex, allowing residents to use lighting only when they need it. Savings for such feed-back and control can be as much as 10%

Advantages

Detailed billing and disclosure programmes can generate consistent, sustainable energy savings by helping end users and users to identify and adopt energy efficient habits. They can also assist utilities to strengthen the relationship they have with their customers by providing useful, value added services. Improvements in behaviour deliver no-cost energy savings that exceed the potential for technology-based solutions, as end users may opt to turn-off lights or utilize day lighting to a greater extent once they understand the costs of consumption.

Constraints

Due to the technology required to create and maintain consistent energy-use feedback for the end user, detailed billing and disclosure programmes can be expensive to implement, and their rates of return are uncertain. Additionally, they must be carefully designed to provide useful and accurate feedback for customers. There is also the potential for end users to use less energy without transitioning to more efficient technologies, as this is the simplest and lowest cost method to manage their electricity use. However, billing and disclosure programmes alone will not drive end users to adopt efficient lighting.

Key Factors for Success

Detailed billing and disclosure programmes should be evaluated regularly and must be combined with other mechanisms where feedback is provided for the energy-saving incentives. Consumers appreciate being able to compare their energy usage against other, similar households and some will be motivated by peer interactions to reduce their consumption. This policy strategy requires significant infrastructure development before it can be successfully implemented. Requirements include: individual metering systems; regular billing and payment collection cycles; and, communication channels between utilities and their customers.

Case Study: U.S.A. - PPL Electric Utilities, Pennsylvania, Ohio

PPL Electric Utilities offered an online energy analysis tool for its customers, starting in 2007. PPL's objective was to determine if there was an impact on energy usage by enabling its customers to regularly monitor their own energy consumption and to manage their energy use with this detailed knowledge. The utility also provided energy saving information, such as efficient CFL options. PPL commissioned a pre- and post-billing analysis in 2008 and 2009, which was completed in July 2010. PPL found that about 10% of its customers regularly monitored their energy use, achieving average annual savings of 3.0% to 4.3%.[52]

Additional Resources

- Dunsky, P., Lindberg J., Piyale-Sheard, E. & Faesy, R. (November 2009) Valuing Building Energy Efficiency through Disclosure and Upgrade Policies.
- Andrews J. (March 1, 2010) Mandatory Building Energy Efficiency Disclosure: Bill released and fine print revealed.
- Anderson W. & White V. (August 2009). Exploring end user preferences for home energy display functionality.

48. Koeppel S. (2007). Assessment of Policy Instruments for Reducing GREENHOUSE GAS Emissions From Buildings. France: United Nations Environment Programme.
49. Darby, S. (2000). Making it obvious: designing feedback into energy consumption. Proceedings of the 2nd International Conference on Energy Efficiency in Household Appliances and Lighting. Italy: Italian Association of Energy Economists/EC-SAVE Programme.
50. Founter. (2008). Get smart: bring meters into the 21st century. Retrieved March 18, 2012, from: http://www.founter.com/uploads/pdfs/Get%20Smart%20%28UK%29.pdf
51. Darby, S. (April 2006). The effectiveness of feedback on energy consumption. A review for DEFRA of the literature on metering, billing and direct displays. UK: Environmental Change Institute, University of Oxford.
52. Aclara Energy Management Application. (2012) Independent Research Finds Evidence that Aclara Spurs Behaviour Change and Conservation Among Consumers. Retrieved from: http://www.aclaratech.com/CaseStudiesList/Aclara_Energy_Analysis_Impact_Analysis_Research_Relults_Fact_Sheet_09_22_10.pdf

4.3 Voluntary Certification and Labelling

Voluntary certification and labelling programmes engage product suppliers who label their energy efficient lighting products to inform end users about product energy performance. Greater awareness of energy performance enables end users to make informed purchasing decisions and contributes to developing a stronger market for all energy efficient products.[53] Experience indicates that end users recognize and accept such labelling efforts when they are utilized across a wide range of products and appliances, not only lamps.

Voluntary labelling is effective if is combined with integrated awareness campaigns that demonstrate the benefits of energy efficient lighting products to purchasers and manufacturers. Voluntary labels are implemented in countries as diverse as Brazil, Hong Kong, India and Thailand. Only highly efficient lamps are likely to be labelled, because manufacturers and retailers have no incentive to label inefficient lamps. Voluntary labelling programmes can serve as a bridge to mandatory programmes, particularly if a country is new to labelling and has limited resources.[54] A well-defined voluntary period can prepare industry and end users for eventual mandatory, comparative labelling, but this approach is not suitable for endorsement labels.

Advantages

Voluntary lamp labelling programmes are cost-effective means to secure substantial energy savings and reduce GHG emissions. The resulting energy savings are relatively simple to quantify and can be readily verified. Voluntary programmes require less legislation and data analyses than do mandatory programmes. They are easier to implement with respect to obtaining producer buy-in and participation, because they do not require the phase-out of existing products.[55]

A voluntary programme provides a learning experience for both the implementing agency and industry, allowing each to adjust and understand its role and responsibilities prior to launching a mandatory programme. Voluntary labelling programmes are more flexible and adaptable than mandatory labelling programmes because their non-binding and non-regulatory approach requires less lead time, less stakeholder analysis, and offers more marketing flexibility.

Constraints

Voluntary labelling programmes require a considerable amount of time and effort to build awareness with end users and retailers. They require a large investment to persuade manufacturers to participate. High rates of non-participation among lamp producers can erode confidence in voluntary programmes. If labelled lamps remain consistently and substantially more expensive than unlabelled lamps, end users may not purchase the labelled, efficient lamps. Programmes should have a market sampling mechanism to identify incorrectly or inaccurately labelled products, and, have a testing mechanism to ensure that labelled products perform as claimed.

Key Factors for Success

Any voluntary lamp labelling programme must be designed to appeal to each country's particular situation and marketing preferences. From the outset, policymakers should assess the benefits and suitability of the policy approach in the broader context of a country's energy policy goals. Endorsement labelling programmes may not require regulatory input, but they should still involve a transparent process with consistent procedures.

Successful voluntary labelling programmes have messages that are simple and recognizable. They are complemented by a communications campaign, so that end users will know what the labels mean and how to read them. Campaigns must focus on the energy and economic benefits of the programme. However, in some countries, messages that promote a sense of national pride may resonate more strongly than those that are focused solely on energy performance information. The perception of a programme benefiting a country or national economy can motivate end users and producers to participate in a labelling programme.

Programme launches should be supported by workshops, government lobbying, and outreach to industry. Stakeholders should be involved throughout the development of the programme. All participants, including relevant government ministries and departments, must be aware of and accept their programme obligations. Producers that participate may improve end user perception of their products, but those manufacturers who do not participate may find themselves at a market disadvantage.

Retail supply chain support is important for ensuring a steady supply of labelled products. Supply must be coordinated with demand, so the retailers need to know in advance when a communications campaign is expected to stimulate sales. When a high level of demand occurs, then lamp suppliers may lower prices to stimulate even more purchases. Retailers benefit from labelling programmes that are backed by product performance specifications because they can have confidence in offering high-quality efficient lamps that are certified to perform well for their customers.

Voluntary programmes should be designed to have a strong monitoring, verification and enforcement (MVE) scheme to identify and handle instances of non-compliance. Even though participation in a programme is voluntary, enforcement is still required and can include the penalties of removal of endorsement and the associated negative publicity. Programme administrators can further protect their label and brand identity with copyrights, service marks or trademarks, to discourage misuses of labels.[56]

53. Paton, R.B. (2004). Two Pathways to Energy Efficiency: An Energy Star Case Study. Human Ecology Review, 11(3). 247-259. Retrieved from: http://www.humanecologyreview.org/pastissues/her113/paton.pdf
54. UNDP/GEF (2010). Barrier removal to the cost-effective development and implementation of energy efficiency standards and labelling project (BRESL).
55. OECD. (1999). Voluntary Approaches for Environmental Policy: An Assessment. France: OECD
56. Vreuls H. (2005). Evaluating Energy Efficiency Policy Measures & DSM Programs. France: IEADSM.

Voluntary labelling programmes for lamps should include non energy performance metrics such as lifetime, colour, lumen maintenance and other characteristics that increase customer satisfaction with efficient products. Many successful voluntary programmes also require end user product performance warranties.

Case Study: North America — ENERGY STAR Program

In 1992, the US Environmental Protection Agency (EPA) introduced ENERGY STAR as a voluntary labelling programme designed to identify and promote energy efficient products to reduce greenhouse gas emissions. It is also used widely in Canada. The program augments mandatory energy efficiency regulations with a highly visible and comprehensive label to permanently transform markets for energy-consuming products. ENERGY STAR initiatives involve interrelated strategies including:

- Developing technical specifications for the label
- Labelling energy efficient products
- Providing objective information to end users
- Working with national, regional, and local groups to promote energy efficiency
- Lowering the costs of owning energy efficient equipment and products through alternative financing

For lighting, the ENERGY STAR label designates that a product is energy efficient and is high quality. Previously, ENERGY STAR offered lamp specifications tailored to specific technologies, such as CFLs and LED lamps.[57] Currently ENERGY STAR is working with industry and stakeholders to develop a new, technology-neutral specification for lamps.

Case Study: Hong Kong — Energy Efficiency Labelling Scheme

The Energy Efficiency Labelling Scheme[58] is an energy conservation initiative of the government of the Hong Kong Special Administrative Region. Under the scheme, some types of appliances incorporate an energy label to inform end users about energy consumption and efficiency. The labelling scheme was initially launched to encourage manufacturers and importers of electrical equipment to design and promote more energy efficient products and phase-out less efficient models. The goals are to:

- Create greater public awareness of energy conservation and environmental improvement needs
- Provide readily available, pre-purchase information on energy consumption and efficiency data, to enable end users to select more energy efficient products
- Stimulate manufacturers and the market to phase-out less energy efficient lamps
- Realize actual energy savings and environmental improvements

The scheme prepared stakeholders for a mandatory programme that was implemented in 2008, the Hong Kong Mandatory Energy Efficiency Labelling Scheme, which includes CFLs.[59]

Additional Resources

- ENERGY STAR (2012) website: www.energystar.gov
- CLASPonline (2012). List of voluntary labelling programmes for CFLs. List of voluntary labelling programmes for LEDs.

4.4 Public Leadership and Demonstration

Public leadership programmes target the public sector, which is one of the largest energy end users in any country. Reduced energy bills generate savings that can be reinvested in other public priorities. Effectively designed energy efficient lamp installations in government buildings can create positive public opinion, providing an incentive to the private sector to follow the example of the public sector.[60] Government procurements of energy efficient lamps in very large quantities help to lower per unit prices for private sector purchasers, too. Government procurements may also attract new product suppliers into a country that seeks to diversify its energy efficient products market.

Advantages

Public leadership programmes help reduce government expense budgets, save taxpayers money and demonstrate that investing in energy efficient lighting is cost effective. With a focus on large office buildings, schools and universities, hospitals, military facilities and street lighting, successful programmes can have a strong multiplier effect. They also help create or increase the market for lighting energy service companies that offer energy service performance contracts, a private sector approach to maintenance and financing.

Constraints

Lack of upfront financing and technical expertise can hamper public demonstration programmes.

57. U.S. EPA ENERGY STAR Compact Fluorescent Lamps (CFLs, V4.3), and, Integral LED Lamp (V1.4) will be replaced by a technology-neutral lamp specification, anticipated to be released in 2012. Refer to the Partners pages of the ENERGY STAR website for current information and for stakeholder comments: http://www.energystar.gov
58. EMSD Hong Kong. (2012). Hong Kong Voluntary Energy efficiency Labelling Scheme. Retrieved March 8, 2012, from: http://www.emsd.gov.hk/emsd/eng/pee/eels_vlntry.shtml.
59. Ibid
60. Harris, J. Aebischer B., Glickman J., Magnin G., Meier A. & Viegand J. (2004). Public Sector Leadership: Transforming the Market for Efficient Products and Services. Pepsonline, Retrieved from: http://www.pepsonline.org/publications/Public%20Sector%20Leadership.pdf.

Key Factors for Success

The success of a public leadership programme depends on adequate funding for procurement, technical training and communication. Involving lighting experts and energy managers is key to the success of such programmes. Any public leadership programme should include an evaluation component, so that results are monitored and verified, adding credibility and assuring savings. These programmes should be leveraged to create a positive impression for end users to follow suit.

Case Study: Mexico—Energy Efficient Lighting in Mexican Federal Buildings[61]

In the early 1990s, the Mexican National Commission for Energy Conservation began a programme of energy audits in the public sector. By 1996, more than 120 energy audits had been performed in federal buildings. The energy audits demonstrated that more than half of the energy used in public buildings could be attributed to lighting systems. The existing systems were mainly fluorescent lamps, but only 16% of these were energy efficient. By 1998, after assessing 90 buildings, the Commission concluded that if all the recommended measures were implemented, a total demand reduction of 21% could be achieved - equivalent to 19 GWh per year, or 3.5 MW of avoided generating capacity. The estimated investment of 1.5 million USD would be recovered in 17 months.

The programme illustrated the value of targeting two types of energy saving measures - technological, to upgrade or replace obsolete equipment, and operational, to improve the use of existing equipment with little or no capital cost. Based on the audit information, the Commission decided to launch a major, voluntary pilot programme called '100 Public Buildings'. Throughout the various stages of the '100 Public Buildings' programme, the Commission provided training and technical assistance to building operators. These operators eventually acquired the theoretical and practical knowledge to conduct their own assessments under the supervision of the Commission staff.

By the end of 2001, almost 900 buildings were registered under the APF programme, representing about 4.6 million m^2 of public floor space. After three years of operation, the programme achieved a reduction in energy use of the order of 100 GWh, saving the equivalent of 7.4 million USD. Mexico's government buildings have achieved significant results, not only in electricity and cost savings but also in terms of cooperation among different government agencies, training of personnel, and private sector investment opportunities for lighting designers and suppliers.

Additional Resources

- CONUEE (2012) Protocolo de actividades Para la implementación de acciones de eficiencia energética en inmuebles, flotas vehiculares E instalaciones de la administración publica federal.
- Sustainable Shelby (2012). Full implementation plan strategies.
- Doris E., Cochran J. & Vorum M. (December 2009). Energy Efficiency Policy in the United States: Overview of Trends at Different Levels of Government US: NREL.
- Harris, J. Aebischer B., Glickman J., Magnin G., Meier A. & Viegand J. (2004). Public Sector Leadership: Transforming the Market for Efficient Products and Services. Pepsonline.

5. Supporting Local Lamp Manufacturers

In countries that have lamp manufacturing facilities, the phase-out of inefficient lamps may raise concerns about local economic development and industry employment. Governments can support business conversion, expanded production, and increased sales of energy efficient products. These activities can reduce the potentially adverse economic impact for manufacturers, related industries, and services providers. Supporting the employees by training or hiring in a new production facility could be part of a transition strategy. The optimal mix of policy measures must take into account the differences between institutional, cultural, and behavioural factors in the region affected by the policy.[62]

Policy proposals that impact the local lighting industry must be developed in coordination with the local industry itself and with other relevant government agencies to ensure their support and rapid implementation. This approach increases the effectiveness of a phase out programme and will influence the supply and the demand for energy efficient lighting products.

The development of National Efficient Lighting Strategies with dates, technical parameters and details about the new lamp requirements will give strong and manageable signals to local manufacturers about the impending changes so that they can decide if and how they will adapt their operations. They will likely need technical and financial assistance if they decide to manufacture more advanced and efficient lamps. If they presently manufacture incandescent lamps, for example, the transition to manufacturing LED lamps can be challenging because it requires different skills, facilities, equipment, and also, a different supply chain.

Governments can support industrial conversion via subsidies or reduced taxes. Government economic development agencies can partner with the private sector to attract financing, particularly from development banks or donor institutions (see Section 3). Policies that support business conversion and expanded production and sales of efficient lamps should be developed based on research on international best practices, with an understanding of the local market and all of the parties and channels impacted.

61. McGrory L.V.W., Harris J., Lapeyre M.B., Campbell S., Cava M.D., Martinez J.G., Meyer S. & Romo A. M.(2011). Market Leadership by Example: Government Sector Energy Efficiency in Developing Countries., Retrieved from: http://pdf.usaid.gov/pdf_docs/PNADJ121.pdf.
62. Martinot, E., Sinton, J.E. and Haddad, B.M. (1997). International Technology Transfer for Climate Change Mitigation and the Cases of Russia and China. Annual Review of Energy and the Environment 22, 357-401. Retrieved from: http://martinot.info/Martinot_et_al_AR22.pdf.

Case Study: China – The Phasing-out of Incandescent Lamps and Energy Saving Lamps Promotion (PILESLAMP)

Since the 1990s, the Peoples Republic of China steadily has been improving its national capability to produce high quality, efficient lamps. China is the major global supplier of CFLs. However, until recently, China was still manufacturing more than four billion inefficient incandescent lamp annually, with many for domestic sale. In 2009, when China announced that it would investigate the potential for phasing-out inefficient lamps, the need to assist manufacturers to transition to the production of more efficient lighting products became acute.

China's National Development and Reform Commission is working closely with the industry's representative body, the China Association of Lighting Industry, to bring a broad coalition of stakeholders together to support industry transition. With the support of UNDP/GEF, China initiated "The Phasing-out of Incandescent Lamps and Energy Saving Lamps Promotion" project to develop and deliver a coherent strategy for industry transition. The objective of the strategy is to look beyond the simple technical aspects of how to move from the production of one lamp technology to another. Rather, the strategy aims to enable transition of the industry to be driven by market demand, and, to create the supporting infrastructure that will enable more environmentally friendly production of high quality, energy efficient lamps.

Since PILESLAMP began in late 2009, progress has been rapid and has included:

Training for more than 1,100 staff from 31 manufacturers on business development and conversion strategies, and support with the technical issues involving in transitioning from incandescent lamp manufacturing to the production of CFLs and LED lamps. Further, the project has supported five pilot projects to demonstrate the business benefits of transition. The two most advanced of these conversions has already resulted in the discontinuation of the production of 175 million incandescent lamps per year, with industry-wide reductions many times this figure as other manufacturers 100% self-finance their conversions, based on compelling business cases.

- Strengthening of the quality of raw materials and components through training and technical support for 300 staff from 50 manufacturers supplying glass, electrical components and phosphors for efficient lamp production.

- The upgrading of private sector lamp testing laboratories to assist with quality control and product development and to assist with formal accreditation from national and international bodies.

- 100 manufacturers have been supported in achieving ISO 9000 Quality Control Certification, 50 of which have received comprehensive training in cleaner production techniques and minimising use of hazardous substances.

- Four recycling centres are now operating to recover mercury from spent lamps. Three of these centres primarily focus on the recycling of lamps that have not met quality standards during production or lamps that have reached the end of life and been collected from larger commercial users. To date these centres have processed approximately four million lamps and recovered over 10 kg of mercury.

Given the success of the industry transformation programme, at the end of 2011 China formally announced the national phase-out of all inefficient incandescent lamps by 2016.

Additional Resources

- UNDP Russia. (2012). Transforming the Market for Efficient Lighting, FSP (2010-2014). The objective of the project is to transform the lighting market in Russia through promotion of EEL technologies and systems, and phasing-out inefficient lighting.

- GEF (2012) Vietnam: Phasing out Incandescent Lamps through Lighting Market Transformation in Vietnam. The project targets the cessation of incandescent lamp production and sales and the promotion of high quality, energy -saving lamps through reforms at industrial and policy levels.

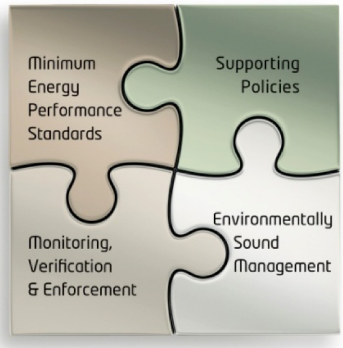
Conclusions

While there is a wide range of policy tools for designing and implementing energy efficient lighting programmes, effective options for the phase-out of inefficient lamps should primarily focus on the residential market, where the adoption of energy efficient lighting tends to be slower due to cost and information barriers. For this market, options include:

- Minimum energy performance standards (MEPS)
- Mandatory labelling and certification
- Voluntary certification and labelling
- Cooperative procurement, subsidies, rebates and giveaways
- Tax increases or exemptions
- Awareness raising, promotion and education
- Instalment payments or on-bill financing

MEPS are the most sustainable option for achieving high levels of energy efficiency and for phasing out inefficient lamps. To be effective, MEPS must be carefully implemented. Performance levels and programme requirements must be developed with stakeholders' input to obtain maximum buy-in and participation. Once implemented, MEPS programmes need to be monitored, evaluated, updated, and revised, as necessary. The most important factor for programme success is a functional system of monitoring, control, and testing facilities capable of ensuring enforcement and full compliance of products (see Section 4).

The success of any efficient lighting programme depends on the selection and combination of other policies to meet the specific needs of a country and the particular objectives of a phase-out scheme. Other policy options should be used to support the implementation of MEPS in order to reduce the use of inefficient lamps while promoting the demand for MEPS-compliant high efficiency lamps. An integrated policy approach positions MEPS as the cornerstone of a sustainable national efficient lighting strategy.



Lack of information for end users and limited availability of products are two main barriers to improving lighting energy efficiency. Policy options to address these obstacles and to support MEPS implementation include labelling and certification, as well as cooperative procurement and subsidies, rebates and giveaways. The labelling of efficient lighting products – either voluntary or mandatory – and product certification provide end users with clear and trustworthy information to overcome awareness and decision barriers. The implementation of bulk or cooperative procurement and subsidies, rebates and giveaways can complement existing lighting distribution channels to increase awareness and rapid introduction of energy efficient lamps.

Labelling and certification programmes as well as procurement, subsidy, rebate and giveaway initiatives should include strong stakeholder engagement, lighting industry collaboration, and industry incentives to participate and promote more efficient products.
The design of these programmes must take into account the impacts on manufacturers and retailers; address the issue of fair competition; and promote quality products to avoid unintended consequences in the market. It is important to thoroughly identify the technical criteria for energy efficient lamps and to support a long-term, self-sustaining energy efficient lighting market.

New policy initiatives should take into account the design of similar programmes around the world, and involve the establishment of monitoring, verification and enforcement regimes to control compliance and reduce instances of non-compliance with MEPS, labelling, and procurement requirements. Finally, as incandescent lamps tend to be a commonly traded commodity, it may be practical to align MEPS with trading partners, or work towards regional harmonization.

Section 3

Financing the Transition to Energy Efficient Lighting

Table of Contents

Introduction

Implementing a national efficient lighting strategy and the national phase-out of inefficient lamps requires significant funding to overcome market barriers and to establish supporting infrastructure. Resources, primarily financial, but also human, technological and institutional, are required to effectively implement an integrated policy approach.

Identifying and securing financial resources to support a national efficient lighting strategy and complementary activities such as communication campaigns and compliance programmes can be difficult for developing countries that lack an energy efficiency infrastructure. However, experiences from many countries show that investments in energy efficient lighting can be highly cost-effective.

Advanced planning and analysis efforts focusing on finance and resource requirements are essential to allow for a national discussion and agreement on significant issues such as; funding sources, cost-sharing arrangements; and, the type and duration of resources required for a comprehensive phase-out programme. These issues are much more difficult to address once a programme is under way, and may increase costs or create delays that can affect the programme momentum.

Early and thorough planning may also allow governments the option of securing more than one source of funding and apply each to a suitable component of an integrated approach. For example, multilateral funding can help expansion of policies; bilateral funding can be applied towards MEPS development; voluntary carbon market funding can be used for complementary activities such as giveaway or rebates. End-of-life management funding could be sourced internally, through extended producer responsibility approaches or other voluntary or regulatory means.

For countries with resource constraints, regional or international cooperation offers the potential to gain additional resources and to provide access to additional capacities to support a national phase-out initiative. Elements of a phase-out programme, such as testing capabilities, market verification of compliant products, and even consumer labelling or energy performance standards, can lend themselves to a regional or bilateral approach when countries share common borders, trade, or language.

Regional or bilateral cooperation to increase the adoption of high quality, energy efficient lighting products can provide countries and regions with ways to reduce common implementation costs while increasing the potential to mitigate the effects of climate change and enhance international collaboration. In addition, regional recycling systems can be the optimal solution in cases where national approaches are not financially viable to support the recycling of lamps in one single country.

1. Financing National Efficient Lighting Strategies

1.1 Domestic Sources

The most direct way for governments to pay for energy efficient lighting programmes is to allocate funds from the domestic budget. This is usually the easiest option with the least administrative resource requirement. It also allows a country to retain all savings within a revolving fund used to support other components of the transition, or other energy efficiency projects. Many lighting phase-out programmes are financed internally, for example, in Argentina, Brazil, Cuba, Lebanon and South Africa. Another option is to involve electric utility companies. The financial and technical capacities of utilities can be engaged by governments to successfully implement energy efficient lighting programmes.

1.1.1 Government Administered Programmes

Description

The phase-out of inefficient lamps can be entirely financed from a nation's domestic budget. A self-funded programme is the easiest and most direct way to pay for various components of the transition. Moreover, there are some elements that are the exclusive responsibility of governments and can only be financed from administration budgets such as; developing integrated phase-out policies, establishing MEPS, enforcement of product quality schemes; and establishing environmentally sound management practices and facilities.

The main barrier may not be a lack of domestic sources of capital but underdeveloped institutional systems and the ability to access funds for energy efficiency projects. Therefore, mechanisms to capture opportunities to promote energy efficient lighting need to be created or strengthened in close cooperation with those responsible for overall finance planning and resource allocation, such as national ministries of finance or industry.

Many governments regularly finance some, or all of the components of energy efficient lighting programmes, from domestic budgets. Some governments have used cash from operating budgets to initiate activities such as:

- Revolving investment funds — an initial investment of domestic money is provided for energy efficient lighting projects. As savings accrue from avoided electricity costs, some or all of the savings can be used to replenish the revolving fund. As the energy savings compound, so do the returns to the revolving fund; profits can grow quickly through reinvested revenues.[1]

- Capital budgeting programmes—small projects with high internal rates of return can be scheduled for implementation during the budget year for which they are approved. Large projects can be scheduled for implementation over the full time period during which the capital budget is in place (i.e. five year capital implementation plan).[2]
- Tariffs
- Bill assessment

Advantages

Government programmes can generate financing for the phase-out of inefficient lamps. When a government leads, other stakeholders are more willing to support and collaborate in the process. All of the savings from increased energy efficiency can be retained internally and the government can then use these funds to be reinvested in the country. Utilizing domestic sources of finance helps a country avoid interest rates or transaction fees that the use of private sector funding may incur.

Constraints

Most developing countries face budget and capacity limitations. The main constraint with revolving funds is the relatively long period of time required to realize the full electricity savings.

Key Factors for Success

In order to succeed, governments need to:

- Recognize lighting energy efficiency as a priority
- Provide a strong, long-term commitment to cost-effective energy efficiency
- Commit or secure sufficient and stable programme funding to deliver energy efficiency, where cost-effective
- Identify a department or departments, such as energy or environment, to promote and coordinate the process
- Recognize and involve electrical utilities, the private sector and civil society stakeholders to obtain their support

If a government lacks finances for energy efficient programmes, fiscal policies or instalment payments could be used to pay for the cost of efficient lighting (see Section 2)

Additional Resources

- Zelinski, R.W. and D.R. Gatlin (1998) Financing energy efficiency in buildings. Rebuild America Guide series. US: US Department of Energy.
- UNEP Finance Initiative (2012), Energy Efficiency Financing in Buildings online training course.

Case Study: Lebanon, Compact Fluorescent Lamp Action Plan[3]

Lebanon faces many challenges in the electricity sector including: power and energy shortages; lack of investment; high fuel costs; inefficient, older power plants; high technical and commercial transmission and distribution losses; and a distorted tariff structure. In an attempt to address these challenges, the Lebanese government has committed to implementing a programme to replace 3 million incandescent lamps with CFLs. The distribution of these lamps is expected to reduce electricity demand by a minimum of 160 MW, save approximately 76 million USD annually for consumers over a period of four years and reduce annual carbon emissions by nearly 245,000 Mt.

The CFL Action Plan, which began in 2010, is led by the Lebanese Center for Energy Conservation which is working together with municipalities, Électricité du Liban, civil society and the Lebanese Standards Institutions to develop a voluntary energy efficiency standard for CFLs. The 7 million USD cost of the programme will be co-funded through a carbon development mechanism (CDM) project. The objective is to replace three 100W inefficient incandescent lamps with three 23W CFLs in one million homes, resulting in an expected annual savings of approximately 28 USD per household.

To complement and support the lamp campaign, the Ministry of Energy and Water launched a nationwide public awareness campaign on CFLs and their benefits in October 2010. It informed the public how to replace inefficient incandescent lamps with CFLs, with an emphasis on the benefits of CFLs and their proper disposal. The Industrial Research Institute has established a testing facility for CFLs that will benefit this programme.

Case Study: India - Karnataka Self-Financed CFL Recycling Program[4]

Working with local suppliers to promote the principles of extended producer responsibility, the Karnataka Environment Department in Bangalore, India developed a proposal for the local government and the manufacturers of CFLs to recycle used lamps in Karnataka. This plan was accepted by both the government and local suppliers. As a result, the Environment Department signed a memorandum of understanding with manufacturers in 2011 to recycle used CFLs in Bangalore through a network of eight recyclers located throughout Karnataka.

1. Zelinski R.W. and D.R. Gatlin. (1998) Financing energy efficiency in buildings. Rebuild America Guide series. U.S. Department of Energy
2. Ibid.
3. UNEP. (2011). Draft Regional Report on Efficient lighting in the Middle East and North Africa. Retrieved from http://www.enlighten-initiative.org/Portals/94/documents/Draft%20Report%20on%20Efficient%20Light- ing%20in%20Middle%20East%20and%20North%20Africa.pdf
4. Hunasavadi, S. (October 21, 2010). Daily News and Analysis (2012). Karnataka Environment Department Aims Dual Benefit by Recycling CFLs. Retrieved on March 8, 2012, from http://www.dnaindia.com/bangalore/report_karnataka-environment-dept-aims-dual-benefit-by-recycling-cfls_1455825

A process was established whereby consumers handing in used CFLs will receive a discount towards the purchase of new lamps. Karnataka officials are predicting that the combination of recycling and consumer discount will lead to further reductions in CFL prices for end users. Subsequently, Bangalore announced the state government's plan to promote the sale and usage of CFLs throughout Bangalore based on the Karnataka experience.

1.1.2 Utility Administered Programmes

An electric utility's interest in implementing a phase-out programme may be motivated by both economic and operational benefits. Utilities are influenced by governmental regulations and by specific requests for support from governments to pursue particular societal benefits, for example, reducing the number of power cuts in a region. The involvement of utilities is also often required when a phase-out programme is financed directly by a government and/or national agency responsible for energy efficiency.

Typically, reduced energy revenue and unit sales to end users are offset by the reduction in transmission and distribution losses from the energy saved; by the reduction or avoidance of capital costs for new power generation; and/or transmission and distribution capacity especially during peak hours. Many developing countries have shortages of generating capacity and implementing a programme to phase-out inefficient lamps can be an effective means for delaying capital expenditures. It also reduces demand and consumption from subsidized customers (residential, agricultural, or municipal) whose rates can be lower than the utility's cost of providing electrical service. Thus, the utility has a financial incentive to promote and invest in end-use energy efficiency, as a way to reduce losses and for the opportunity to sell the saved energy at a higher price and thereby potentially increase revenues.

Another mechanism that can be used to give incentives to utilities to promote energy efficiency is decoupling, a ratemaking policy that separates an electric utility's fixed cost recovery from the amount of electricity it sells. With decoupling, revenues are periodically "trued-up" to the predetermined revenue requirement using an automatic rate adjustment.[5] It guarantees utilities that if they promote efficiency, they will be compensated with appropriate rates that cover fixed costs. Typical adjustments would only be 2% to 3%. Rate changes due to decoupling should place a minimal burden on end users and some jurisdictions apply rate increase caps to protect consumers.[6]

Advantages

The financial and technical capacity of electric utilities is a major asset that can be enlisted by governments to implement energy efficient lighting programmes. In cooperation with government, utility administrators can:

- Offer direct payments in the form of rebates, provide credit support and use billing tools to collect finance payments
- Inform end user customers about financing and energy efficiency benefits
- Procure large quantities of energy efficient lamps
- Distribute efficient lamps and collect inefficient lamps
- Stimulate the interest of financial institutions
- Track changes in energy demand and consumption resulting from programme implementation
- Lower transaction costs by combining multiple projects

Constraints

Efficient lighting programmes that are self-financed by electric utilities may have constraints. Utility companies may not be able to act quickly. Additionally, they may lack sufficient funds, resources, and legal authority to implement activities such as monitoring, verification and enforcement. Decreased electricity sales may reduce revenue below costs, potentially disrupting the company's financial stability. There may also be a possibility that a large electrical utility could exert undue influence in the market, for example, in the selection of suppliers.

Key Factors for Success

A mechanism to separate or 'decouple' electricity sales from utility revenue may be needed for privately owned utilities. A public power utility may not find it necessary to implement such mechanisms because the utility has different goals and a distinct business model. The key factors in gaining support for any phase-out programme involve a good working relationship with the utility regulatory body, as well as comprehensive customer education.

Additional Resources

- APPA. The Effect of Energy Efficiency Programmes on Electric Utility Revenue Requirements. US: American Public Power Association.
- EGIA (2012). 5th Rocky Mountain Utility Efficiency Exchange.
- US Department of Energy. (2012). Energy Incentive Programmes.
- National Association of Regulatory Utility Commissioners. (September 2007). The National Association of Regulatory Utility Commissioners, Decoupling For Electric & Gas Utilities: Frequently Asked Questions (FAQ). US: NARUC.

5. The National Association of Regulatory Utility Commissioners (2007), Decoupling For Electric & Gas Utilities: Frequently Asked Questions (FAQ). Retrieved on March 1, 2012 from http://epa.gov/statelocalclimate/documents/pdf/supp_mat_decoupling_elec_gas_utilities.pdf
6. Bacino, J. (2007). Utility Decoupling: Giving Utilities Incentives to Promote Energy Efficiency, Retrieved on March 1, 2012 from http://www.progressivestates.org/blog/672/utility-decoupling-giving-utilities-incentives-to-promote-energy-efficiency

Case Study: Morocco – INARA Programme

In early 2007, Morocco's Office National de l'Electricité (the "Office") conducted a national study on the lighting market for its residential customers.[7] The study identified an average of 5.1 replaceable 80 W incandescent lamps per household. It also investigated consumer interest in replacing the inefficient incandescent lamps and the preferred means of payment (cash versus credit). These results helped in configuring the INARA efficient lighting programme.

In 2008, the Government of Morocco and electricity distributors signed the National Plan for Priority Actions, which included the INARA programme.[8] The INARA programme was based on the distribution of five CFLs per household and seven CFLs per public administration building. The first stage of the programme consisted of replacing 5 million inefficient incandescent lamps, with an overall objective of 15 million inefficient lamps with CFLs. The process that was followed for the programme included:

- A CFL international tender was launched by the Office to procure CFLs for the programme[9]
- An awareness campaign was designed and implemented to include a strong visual identity both for the programme (INARA Mascot) and for the CFLs (unbranded with an Office logo)
- The government decreased customs duties on CFL imports
- CFLs were distributed door-to-door to replace the inefficient lamps in homes and some administration facilities, as well as schools and other public buildings
- Customers paid 1 dirham per CFL, the sum of which was integrated into monthly electricity bills over 24 months[10]
- For 24 months, the Office guaranteed free replacements for lamps that failed or were defective
- The Office collected spent and defective lamps and returned them to the supplier for disposal and recycling

Throughout 2010, the programme achieved positive outcomes both for the consumers (22 % energy savings for households and 34% for public administrations) and for the utility (177 MW of peak load decrease).

Case Study: U.S.A., State of California Decoupling Experience

California has extensive experience with decoupling, having operated such a mechanism in the electricity sector since 1981. The programme has been successful and reduced rate volatility. Today California uses 55% less energy per capita than the nationwide average. From 2006 to 2008, California utilities invested two billion dollars in efficiency improvement. Every dollar invested by the utilities in efficiency measures has generated more than two dollars in savings for customers.[11] Regulators permit independently owned utilities to spend ratepayer funds on energy efficiency programmes, and in return, offer a schedule of financial rewards if the utilities can document in detail that they run the programmes well and deliver the targeted savings.

1.2 Private Sector Funding

Some commercial financial institutions understand the compelling aspects of energy efficiency and are developing suitable financing products, marketing strategies and appraisal methods so that they can determine reasonable default projections and identify promising projects. The economics and financing of efficient lighting programmes is seen as being attractive and offers the private sector sufficient incentive to invest in energy efficient lighting programmes.[12]

Private-sector financing sources include; bank loans, leasing, third-party financing or performance contracting, project financing, private funds such as ethical/green investment funds, or local community co-operative support. All of these mechanisms have been used to fund commercial projects on various scales, from upgrading the efficiency of lighting in commercial spaces to replacing or installing efficient municipal street lighting. To date, however, there has been minimal private sector funding of energy efficient consumer lighting programmes. This can be explained by the administrative costs which would usually exceed the investment opportunity of collecting interest on each lamp replacement. Multi-residential projects or larger programmes, such as financing loans for utilities' programmes, may be more profitable for private sector-funded activities. Private sector funds often expect repayment and thus, are not suitable for non- market activities such as developing policy or conducting consumer surveys.

1.3 Non-Domestic Funding

Even though domestic funding is the easiest option for funding efficient lighting transition strategies, some developing countries that do not have internal resources to finance certain elements of a phase-out programme, could seek external sources of finance. External sources can provide the necessary resources to initiate phase-out programmes, attract additional domestic or private resources, and accelerate efficient lighting adoption by low-income households.

The allocation of funds must be carefully planned and include a comprehensive evaluation to verify programme effectiveness. Obtaining external funding is a complex process requiring administrative effort and time. External sources of financing may only partially finance a phase-out of inefficient lamps, and so funds must be matched with domestic public or private resources to provide the total budget needed for a phase-out programme.

7. Guasmi, F. en.lighten initiative (2012) Morocco experience in moving towards the transition to efficient lighting. Retrieved on March 1, 2012, from http://www.enlighten-initiative.org/Portals/94/documents/beirut/Morocco%20experience%20in%20moving%20towards%20the%20transition%20to%20efficient%20lighting.pdf
8. El Hafidil, A. MEM Maroc (2012). Plan National d'Action Prioritaires et Gouvernance du Secteur Electrique. Retrieved on March 1, 2012, from http://www.mem.gov.ma/Assises2009/PDF/Expose/pnap.pdf.
9. The standards used for the chosen CFLs were based on compliance tests made by an accredited international laboratory: IEC 60968, IEC 60969 and RoHS.
10. One Dirham (DH) corresponds approximately to 0.12 USD.
11. Bacino, J. (2007) Utility Decoupling: Giving Utilities Incentives to Promote Energy Efficiency, Retrieved on March 1, 2012 from http://www.progressivestates.org/blog/672/utility-decoupling-giving-utilities-incentives-to-promote-energy-efficiency
12. Limaye, D.R., Sarkar, A. & Singh J. (December 2009). Large-Scale Residential Energy Efficiency Programmes Based on CFLs. The World Bank ESMAP.

1.3.1 International Donors and Lending Institutions

Many international development banks, private and corporate foundations and non-governmental organizations recognise the economic, political, social, and environmental benefits of energy efficient technologies. As donors they have increased their financial support and professional guidance for efficient lighting programmes in developing and emerging countries. Their support can leverage policy development, stakeholder coordination, feasibility studies and pilot projects. Multilateral donors and lenders are regional or international development banks, while bilateral donors typically are single country development or aid agencies.

1.3.2 Multilateral Donors[13]

Multilateral donors can be grouped into three main categories:

- Multilateral development banks
- Multilateral financial institutions
- Sub-regional banks

Multilateral Development Banks

These banks have a broad membership, including developing countries (typically borrowers) and developed countries (typically donor investors). They are not limited to member countries from the specific region of the regional development bank. Multilateral Development Banks include: World Bank Group (including the International Finance Corporation), African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank Group.

Multilateral Financial Institutions

Multilateral financial institutions, such as the European Investment Bank, typically have a narrower membership than the multilateral development banks do, and they focus on special sectors or activities.

Sub-Regional Banks

Some sub-regional banks are established for development purposes and serve as multilateral donors. They are owned by groups of countries (typically borrowers) and include: Corporacion Andina de Fomento, Caribbean Development Bank , Central American Bank for Economic Integration, East African Development Bank, and, West African Development Bank.

1.3.3 Multilateral Donor Funding

Multilateral donor funding typically takes the form of loans, grants, funds, special projects, and other financial mechanisms. Support may be linked to advisory services and technical assistance. Examples of donors and programmes include:

- Global Environment Facility (GEF)
- USAID ECO-Asia Clean Development and Climate Program
- World Bank Climate Investment Funds (CIF)

Global Environment Facility (GEF)

The Global Environment Facility (GEF) is a key partner of the en.lighten initiative and an independent financial organisation whose purpose is to address global environmental issues while supporting national sustainable development initiatives.[14] The GEF unites 182 member governments in partnership with international institutions, non-governmental organisations, and the private sector. Since its establishment in 1991, it has grown to become the largest funder of projects to improve the global environment. It has allocated 9.5 billion USD, supplemented by more than 42 billion USD in co-financing, for more than 2,700 projects in over 165 developing countries and countries with economies in transition. Through its Small Grants Program (SGP), the GEF has also made more than 12,000 small grants directly to non-governmental and community organisations, totalling 495 million USD.

The GEF has supported the efforts of a wide range of countries in the promotion of energy efficient lighting. Forty GEF projects that address energy efficient lighting have recently been approved or will be endorsed in the near future. The projects are implemented primarily by the World Bank, United Nations Development Programme (UNDP) and UNEP.[15]

Many of the national projects supported by GEF share the common objective of progressively phasing out inefficient incandescent lamps by restricting their supply through policies, legal measures, and the promotion of demand for energy efficient lighting products. This can be achieved by the improvement of efficient lighting standards and policy frameworks (China, Kazakhstan, Nigeria, Russia and Vietnam), the transformation of the local lighting production market (China and Vietnam), or as the result of consumer awareness campaigns and giveaway programmes (Togo).

13. World Bank (2012). Multilateral and Bilateral Development Agencies. Retrieved on March 8, 2012, from http://web.worldbank.org/wbsite/external/extaboutus/0,,contentmdk:20040612~menupk:41694~pagepk:51123644~pipk:329829~thesite pk:29708,00.html
14. GEF (2012). GEF Financing adaptation action. Retrieved on March 8, 2012, from www.gefweb.org
15. The World Bank with GEF support is assisting Haiti, Mexico and Togo in their efforts to move to efficient lighting; UNDP is providing support to China, Ukraine, Russia, Egypt and Kazakhstan and Nigeria also with GEF support. UNEP, with the support of GEF, is providing support to phase out incandescent lamps in Vietnam, Peru, Morocco and Cote d'Ivoire.

Case Study – Russia - GEF Project Funding: Transforming the Market for Efficient Lighting[16]

This project is four-year collaboration between the GEF, UNDP and Russia, with the GEF contributing 7 million USD to the total project cost of over 28 million USD. The goal of this project is to reduce Russia's GHG emissions by transforming the Russian lighting market towards more energy efficient lighting technologies and phasing out inefficient lighting products.

The project will develop and adopt energy performance and product quality standards. It will implement national and regional policies for phasing out inefficient lamps and promote effective enforcement and control mechanisms. The supply chain for energy efficient lighting will be strengthened through market research and monitoring and support for the development of new, energy efficient lighting products. The project will transform the national lighting market by promoting efficient technologies including CFLs and LED lamps. It is expected that within ten years after project completion, Russia will be able to capture 60% of its energy saving potential in the lighting sector. Additional savings will amount to 31 bln KWh per year and annual greenhouse gas emission reductions of 15.5 million tons of CO_2.

Case Study: Philippines - GEF Capacity Building Funding: Investment in Energy Research and Testing

The UNDP assisted the Philippines Department of Energy to formulate and implement the Philippines Efficient Lighting Market Transformation Project. The project addresses barriers to widespread utilization of energy efficient lighting systems in the Philippines by accelerating the integration of energy efficient lighting programmes into planned DOE activities.

One of the project's objectives was institutional capacity-building. The Department received funding to develop and operate a lighting testing laboratory as part of its Energy Research and Testing Laboratory Services. However, the capacity of the laboratory was not adequate to meet the additional technical demand, volume, and scale of the project. The programme management office worked with UNDP to identify the steps needed for the laboratory to meet the requirements of ISO/IEC 17025 accreditation for the testing of discharge lamps, electronic ballasts and luminaires.

As a result of the UNDP and Department's cooperation, the laboratory met the project's objective of opening the local market to the benefits of the use of efficient lighting by putting in place an ISO 17025 certified lighting laboratory to monitor compliance of products to minimum energy performance standards. The Department also met its objective for acquiring regional laboratory accreditation and upgraded its testing capabilities, while its staff acquired certificates for the successful completion of training.

USAID ECO-Asia Clean Development and Climate Program

The Clean Development and Climate Program (ECO-Asia) is a regional program of the United States Agency for International Development.[17] The program supports regional policy and market transformation in Asia to promote investments in clean energy technologies. ECO-Asia develops a combination of national and regional activities in partnership with Asian governments, cities, and other organisations to promote regional dialogue in sharing and replicating innovation across Asia.

Since 2007, ECO-Asia has built partnerships to help establish specific clean energy technologies and practices that can immediately address Asia's energy challenges and reduce greenhouse gas emissions. Key partners for the program include; national policy institutions, utilities, energy ministries, state-level governments, banks, investors, and clean energy project developers. ECO-Asia is active in six countries (China, India, Indonesia, Philippines, Thailand, and Vietnam) and works in partnership with the countries to catalyze policy and finance solutions for clean energy through targeted assistance, training, regional cooperation, and knowledge sharing.

World Bank Climate Investment Funds (CIF)

The World Bank Climate Investment Funds help developing countries pilot low-emission and climate-friendly projects.[18] The funds include the Clean Technology Fund and the Strategic Climate Fund.[19] The Clean Technology Fund offers financing for large-scale, country-initiated, energy efficiency, transportation and renewable energy projects that are designed to help achieve national development objectives. As of September 2010, pledges from G8 countries totalled 4.4 billion USD, with every dollar of funding expected to leverage eight dollars from other sources. Projects are expected to help reduce approximately 1.5 billion tonnes of GHGs over the next several years, roughly comparable to a third of the annual emissions of the European Union.

Case Study: Mexico - Clean Technology Fund Project Implementation Funding

Mexico launched the Special Climate Change Programme in 2009 to reduce greenhouse gas emissions by more than 40% annually by 2030 without sacrificing economic development. The strategy includes a sweeping transformation of the domestic home appliance market to increase energy efficiency and offset the projected 4.8% annual increase in electricity demand. To phase-out inefficient appliances, Clean Technology Fund concessional financing will support a credit line for low-interest consumer loans, complementing a World Bank loan that will support a rebate programme. The financing scheme will be offered through some of the country's largest retail markets.

To ensure a seamless technology transition during the phase-out programme, the government is establishing recycling facilities for spent lamps and local testing facilities. Local manufacturers and distributors are receiving support to shift to the new technologies, and public awareness campaigns are alerting consumers to the advantages of an energy efficient lifestyle. The programme is expected to

16. UNDP (2012) Transforming the Market for Efficient Lighting in the Russian Federation. Retrieved on March 1, 2012, from http://www.undp-light.ru/. and on 9 May 2012 from: http://www.undp-light.ru/en/
17. "The Asia Lighting Compact (ALC), Clean Energy Asia. (2012). A partnership comprising governments, regional lighting associations and the world". Retrieved on March 8, 2012, from http://www.cleanenergyasia.net/library/new-partnership-push-energy- efficient-lighting-across-asia.
18. http://www.worldbank.org/cif (accessed 07/2011)
19. http://www.climateinvestmentfunds.or/cif (accesses 07/2011)

encourage Mexican appliance manufacturers to produce more energy efficient models in response to the increased consumer demand. For this project, CTF funding of 500 million USD is expected to leverage 5.4 billion USD.

1.3.4 Bilateral Donors

Bilateral donors offer financial assistance from their countries to developing countries for the design and implementation of sustainable programmes and projects. Donors pursue specific geographical, political, and sectoral objectives. These funding sources can be leveraged for activities such as laboratory capacity building, measurement, verification and enforcement activities, or environmentally sound management for lighting products.

Bilateral donors include:

- Australian Agency for International Development
- Austrian Development Agency
- Agencia Española de Cooperación Internacional para el Desarrollo
- Canadian International Development Agency
- Danish Development Agency
- Department for International Development Cooperation (Finland)
- Agence Française de Développement
- Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
- Irish Aid
- Japan Bank for International Cooperation
- Japan International Cooperation Agency
- Kreditanstalt fur Wiederaufbau
- Netherlands Development Cooperation
- New Zealand Aid Program
- Norwegian Agency for Development Cooperation
- Swedish International Development Cooperation Agency
- Swiss Agency for Development and Cooperation
- U.K. Department for International Development
- U.S. Agency for International Development

Case Study: Asia - USAID and Australia Department of Climate Change and Energy Efficiency: lites.asia[20]

Most Asian countries recognise that the widespread adoption of CFLs and LED lamps has the potential to help Asia to address energy efficiency, energy security and climate change concerns. However, low-quality lighting products represent a significant barrier to the full adoption of the technology and to the realisation of consumer and environmental benefits.

lites.asia arose out of a meeting in October 2009, when representatives from Australia, China, India, Indonesia, Philippines, Sri Lanka, Thailand and Vietnam met to discuss the potential benefits of regional co-operation on the development of lighting standards. lites.asia was created as a mechanism for Asian policy makers identify the areas of CFL and LED quality that may concern consumers, potential solutions to these areas of concerns, and whether these solutions could be harmonised across the Asian region. lites.asia is supported by the governments of Australia and the United States of America as part of the APP (Asia-Pacific Partnership) on Clean Development and Climate.

Case Study: Sri Lanka - USAID Capacity Building Funding: The Regional Centre for Lighting[21]

USAID funded the establishment of the Regional Centre for Lighting within the Sri Lanka Sustainable Energy Authority. The knowledge partner for this initiative is Rensselaer Polytechnic Institute's Lighting Research Center. Goals include:

- Advancing sustainable lighting in South Asia
- Increasing consumer awareness and affordability of reliable, energy efficient lighting technologies to reduce electricity
- demand
- Prompting the regional manufacturing of energy efficient lighting products to improve the economy of the region;
- Training and educating the workforce in the region to create sustainable lighting in south Asia

1.3.5 Advantages and Constraints of Multilateral and Bilateral Funding

Advantages

Multilateral and bilateral financing are important resources for inefficient lamp phase-out programmes. In developing countries they help to initiate many efficient lighting programmes and can help to secure additional medium- and long-term financing. When they are successfully implemented, they demonstrate leadership and can encourage neighbouring countries to initiate phase-out programmes.

20. http://www.litesasia/
21. RCL (2011). USAID and SLSEA sign the Memorandum of Understanding to create RCL. Retrieved on July, 2011, from http://www.rclsa.net

Constraints

Political relations among countries can influence the priorities for both multilateral and bilateral financing and also can affect the design of inefficient lamp phase-out programmes due to strategic and economic interests and market potentials. When external sources of funding are required, close harmonization with national efficient lighting initiatives will avoid wasted resources resulting from uncoordinated efforts. Governments must decide how to best allocate available funding resources; if funds for efficient lighting programmes are available from international donors then local and private sector investors may look for other investment opportunities. Longer term, this may create a gap in funding if international funding becomes less available. Thus governments should consider ways to keep local and private sector investors informed of the benefits of efficient lighting programmes, so that they remain interested and ready to invest when their resources are needed.

Key Factors for Success

Multilateral and bilateral funding efforts need to work closely with governments to identify, finance and implement the appropriate distribution mechanisms that can successfully deliver the programmes to end users. Best practices include:

- Consensus on integrated policy approaches and the appropriate roles for government agency recipients
- Adapting international solutions to the culture, needs and requirements of local markets
- Flexible schemes that can evolve with changes in local market conditions
- Multi-year commitments from donors to support a National Efficient Lighting Strategy that goes beyond simple giveaway or rebate programmes and considers and integrated approach

1.4 Carbon Financing

Carbon financing market mechanisms facilitate the buying and selling of carbon emissions credits. Such markets allow carbon reduction efforts for a given government or private-sector body to be quantified and purchased by another entity to offset its own carbon emissions and help achieve its emission reduction targets. Some carbon financing mechanisms are associated with CFL giveaway or bulk procurement programmes.

Examples of carbon financing include:

- Clean Development Mechanism (CDM)
- Nationally Appropriate Mitigation Actions (NAMAs)
- World Bank, The Carbon Partnership Facility (CPF)
- Voluntary carbon finance

1.4.1 Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM) is a flexible, market-based mechanism permitted under the Kyoto Protocol to help signatory countries meet their emission targets while encouraging developing countries and the private sector to contribute to emission reduction efforts. The mechanism is based on emission reduction (or removal) projects carried out in developing countries to earn certified emission reduction (CER) credits.[22] Such credits can be traded and/or sold to industrialised countries to help them meet their emission reduction targets under the Kyoto Protocol. CDM is designed to stimulate sustainable development and emission reductions while providing industrialised countries with some degree of flexibility in how they meet their emission reduction targets.

CDM projects must qualify through a rigorous registration-and-issuance process that is designed to ensure measurable, reportable, verifiable emission reductions.[23] CDM is overseen by an Executive Board and operates under the guidance of the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC).[24]

According to the Project Cycle Search of the UNFCCC and the CDM/Joint Implementation Pipeline developed by the UNEP RISØ Centre, 18 efficient lighting projects have been approved by the UNFCCC Executive Board (China, India, Mexico, and South Africa), 14 are in India, and 31 await validation.[25]

Advantages

The main advantage of any CDM project is that the costs will ultimately be incurred by third parties. With CDM funding, it may be possible to extend and increase the use of energy efficient lamps to low-income groups that might not otherwise be able to afford the initial cost of CFLs. The CDM buyer bears the initial cost of the products in exchange for the CERs generated by project delivery to low-income or rural areas.

CDM projects may include advisory services or technical assistance as part of the project development. In the case of an efficient-lighting CDM initiative, the project could help to implement and support regulatory measures by addressing issues related to the financial barriers and improving consumer awareness of efficient lighting issues.[26]

22. This includes non-Annex I countries that do not have an emissions reduction target under the Protocol.
23. Limaye, D.R., Sarkar, A. & Singh J. (December 2009). Large-Scale Residential Energy Efficiency Programmes Based on CFLs. The World Bank ESMAP
24. UNFCCC (2012). Demand-side activities for efficient lighting technologies. Retrieved on March 8, 2012, from http://cdm.unfccc.int/methodologies/DB/5RMYBVTQ83H9CJA99M2392TSNO9IUJ.
25. UNEP RISO Centre (2012). CDM projects grouped in types. Retrieved on March 8, 2012, from http://cdmpipeline.org/cdm-projects-type.htm
26. Sarkar, A. and Singh, J. (October 2009). Financing Energy Efficiency in Developing Countries – Lessons Learned and Remaining Challenges. Retrieved on March 8, 2012, from http://www.usea.org/Programmes/EUPP/gee/presentations/Wednesday/ Singh_Notes_ESMAP_EE_Financing_Scale_Up_Energy_Policy_draft.pdf

Constraints

Projects must meet stringent criteria to qualify for the CDM, so implementation may be restricted to projects that fall within the clear boundaries of defined methodologies developed by the UNFCCC. For energy efficient lighting programmes, two specific methodologies have been developed.[27]

Difficulties that can occur when implementing CDM projects include:

- Complex monitoring requirements
- Need for initial funding source to launch the program, but conversely, such funding putting the "additionality" of the GHG reductions at risk
- Cash flow challenges due to the timing of the sale of CER credits
- Problems with the stability of the electrical grid
- Unpredictable patterns of electrical use by consumers

Financial support for a CDM project usually is received at the end of the project, after the CERs have been awarded. The delay in support can be offset by the selling of 'expected' credits from the projects before the credits are realised, but doing so reduces the value of the affected CERs due to the risk of the project not performing as expected. CDM projects support the distribution of efficient lamps in exchange for inefficient lamps, as well as the related awareness raising and communication activities. Other aspects of national efficient lighting strategies may not be eligible for funding as CDM projects.

The provision of the Protocol expires in 2012 and its future remains uncertain because there was no formal decision taken on CDM during the Conference of the Parties (COP) 17th meeting in December 2011. It has been delayed until COP18 at the end of 2012.

Key Factors for Success

Factors that enable CDM efficient lighting project implementation include:

- Participation of experienced institutions and project developers
- Availability of data to develop CDM baselines and feasibility studies
- Availability of robust and efficient monitoring methodologies
- A supportive environment for businesses to operate which includes the ability to enforce contracts and consistent regulations
- Ensuring that the lamps used in the programme comply with quality and energy performance requirements
- MVE system in place established to avoid non-compliance

Additional Resources

- UNFCCC (2012). About CDMs.
- Fenhann J. & Hinostroza M. (2011) CDM Information and Guidebook (third edition). Denmark: UNEP Risoe Centre
- Holm Olsen, K. & Fenhann, J. (2008). A Reformed CDM – including new Mechanisms for Sustainable Development. UNEP Risø Centre.

Case Study: India - CFL Financing (CDM 1754)[28]

CDM 1754 is one of three CDM lighting projects implemented by OSRAM and RWE Power in India. The project began in 2009 and involved replacing inefficient incandescent lamps with CFLs (financed by OSRAM and RWE Power) in approximately 700,000 households in the Visakhapatnam region. CFL components were imported from Germany and Italy to India for assembly. The distribution of the CFLs was carried out by locally recruited and trained teams. During distribution, the inefficient incandescent lamps were collected, destroyed, and recycled. All participating households were informed in detail how to use and handle the CFLs properly.

In the first monitoring report, issued in June 2010, the project developers indicated that during the period from February 2009 through March 2010, the project achieved 30,915 tonnes of CO_2 emission reductions. The final value was lower than the expected value of 32,433 tonnes CO_2, so the project developers requested the issuance of 26,532 CERs.[29]

Case Study: Rwanda - CFL Distribution[30]

In 2010, the Rwanda Energy Corporation, Rwanda Water Supply Corporation and the International Bank for Reconstruction and Development joined forces on a CDM project to improve electrical distribution and energy efficiency in Rwanda. The project included the distribution of CFLs as an energy efficient alternative to inefficient incandescent lamps. The project consisted of four main phases:

- Phase 1 was completed from August to September 2007 with the distribution and exchange of 50,000 CFLs for free to consumers. A maximum of two CFLs were provided in exchange for inefficient incandescent lamps
- Phase 2 began in September 2008 with the distribution of 150,000 CFLs across the residential sector, with up to five CFLs per household at a price of RWF 200 (0.37 USD) per lamp and the exchange of inefficient incandescent lamps
- Phase 3 was implemented in mid-2009, involving the distribution of 200,000 CFLs
- Phase 4 was implemented from mid-2010 to early 2011, with the distribution of 400,000 CFLs.

27. UNFCCC. (2011). CDM methodology (updated version). Germany: UNFCCC
28. UNFCCC (2012). Visakhapatnam (India) OSRAM CFL distribution CDM Project. Retrieved on March 8, 2012 from http://cdm.unfccc.int/Projects/DB/TUEV-SUED1206629154.85/history
29. Ibid.
30. UNFCCC (2012). Rwanda Electrogaz Compact Fluorescent Lamp (CFL) Distribution Project. Retrieved on March 8, 2012 from http://cdm.unfccc.int/Projects/Validation/DB/26PMKJ754ZO5ISWE8AWM5HC6HSY49K/view.html

In addition to the lamp exchange programme, new electricity customers receive CFLs along with their electricity meter. Overall, the project should displace 238,578 tonnes of CO_2 in the 10 year fixed crediting period, generating an equivalent amount of CERs.[31]

1.4.2 Nationally Appropriate Mitigation Actions (NAMAs)

Nationally Appropriate Mitigation Actions (NAMAs) are voluntary emission reduction measures carried out by developing countriesfor which international financial, technological and capacity-building support is being sought.[32] They differ from legally-binding obligations for developed countries and are based on the national circumstances, strategies of sustainable development, and the priorities of the country to which they apply. NAMAs must be based on measurable, reportable, and verifiable technologies. They may occur at various levels (i.e. project, sector, or national) on varying scales, and they provide a framework for integrating low-carbon, climate environmentally-friendly practices strategically across all sectors within a national economy.

There have not been any NAMAs implemented to date because the UNFCCC negotiations on NAMAs are ongoing. The Conference of the Parties agreed to establish an online NAMA registry by COP18 in late 2012 to allow developing party countries to list NAMAs seeking international support. General guidelines for the measurement, reporting and verification of domestically supported NAMAs will also be developed during 2012.[33]

Three types of NAMAs are emerging:

- **Unilateral** - domestically funded and unilaterally implemented
- **Supported** - implemented with financial, technological and/or capacity-building support from developed countries
- **Credited** - implemented with funding from carbon offset credits generated for the amount of emission reductions that are achieved. Most developing countries however, argue that NAMAs should not be used to offset quantified emission reduction limitations and objectives but rather, should be differentiated from existing offset mechanisms such as CDMs.

Examples of NAMAs include:

- Voluntary agreements, education, and information measures
- Laws and regulations
- Standards and labelling schemes
- Technology adaptation and transfer programmes
- Financial instruments
- Incentives and cap and trade programmes
- Energy efficiency measures
- Research and development
- Demonstration projects for low carbon growth
- Sustainable development programmes and measures
- Capacity building and data gathering activities

Advantages

NAMAs go beyond the CDM project-by-project focus that can result in emissions reductions in a given sector being offset or overcome by emissions increases from other sources in the same sector. NAMAs are expected to support an enhanced scale of activity from a wider set of participants and provide a method for all nations to contribute to solving climate challenges.

Constraints

While the UNFCCC negotiations continue, many options for NAMA design are being considered. There is not yet a clear definition of what constitutes a NAMA but eventually approved projects can seek financing, just as CDM registered projects can sell CERs. Fully operational NAMAs probably will be based on post-2012 financing mechanisms, with associated pilot projects. Therefore, it may be several years before NAMAs constitute viable options for efficient lamp programmes.

Additional Resources

- Pole S. & Puhl I. (2011). How to develop a NAMA by scaling-up ongoing programmatic CDM activities on the road from PoA to NAMAs. Germany: KfW Bankengruppe
- Asselt H.V., Berseus J. Gupta J. & Haug C. (2010). Nationally appropriate mitigation actions (NAMAs) in developing countries: Challenges and opportunities. Netherlands: Netherlands Environmental Assessment Agency

31. UNFCCC (2012). AENOR. CDM Validation Report. (reference 2008/0018/CDM/005). Retrieved on June 5, 2011, from http://cdm.unfccc.int/Projects/Validation/DB/26PMKJ754ZO5ISWE8AWM5HC6HSY49K/view.html
32. UNEP (2012).Introduction to The Concepts of Nationally Appropriate Mitigation Actions. Retrieved on March 8, 2012, from http://www.unep.org/climatechange/mitigation/sean-cc/Por-tals/141/doc_resources/Intorduction%20to%20the%20concepts%20of%20Nationally%20Appropriate%20Mitigation%20Actions.pdf
33. Climate Focus (2012) CP17/CMP17 Durban Debrief. Retrieved on March 8, 2012, from http://www.climatefocus.com/documents/files/cp17cmp7_durban_debrief.pdf

1.4.3 The World Bank Carbon Partnership Facility

The Carbon Partnership Facility (CPF) utilizes scaled-up, programmatic approaches, such as the Program of Activities, to enable carbon finance to support partner country initiatives in their effort to move towards low-carbon economies. It also targets areas that have not been reached effectively by CDM in the past, such as energy efficiency, and will pilot city-wide carbon finance programmes. The CPF intends to develop programmatic and sector-based approaches in developing countries to reduce GHG emissions. It will be used in areas including the power sector and energy efficiency.

The CPF is comprised of two trust funds: 1) the Carbon Asset Development Fund (CADF) to prepare and implement emission-reduction programmes, and 2) the Carbon Fund (CF) to purchase carbon credits from the pool of emission reduction programmes. CADF will finance the development of the emission reduction programmes and the related due diligence, including by providing grant resources. A portion of the carbon credits generated by the emission reduction programmes will be purchased by the CF using financial contributions from developed country governments and the private sector. The remaining credits can be sold to the market by the sellers.

Advantages

CPF will support investments and programmes that have a potential long-term and large-scale impact on emission reductions. To do this, the CPF intends to enter into purchase agreements initially up to 2022 and potentially well beyond. These programmes would enable carbon finance transactions that encompass large programmes or an entire sector or sub-sectors of the economy. CPF is one of the carbon finance programmes that could enable emission reduction opportunities for efficient lighting programmes after 2012.

Constraints

Large-scale support is provided only to country level programmes. In addition, the payment is usually received at the end of the project, after the certification of emission reduction.

Key Factors for Success

One important aspect of this work is to package development finance from the World Bank's lending instruments with carbon finance, Global Environmental Facility grants, and concessional loans from the Clean Technology Fund in support of climate change mitigation programmes. Another important aspect is availability of robust monitoring systems to keep track of emission reductions associated with the project.

Additional Resources

Carbon Partnership Facility (2012). The World Bank Carbon Partnership Facility

1.4.4 Voluntary Carbon Finance

In a voluntary carbon finance market, individuals and businesses voluntarily offset the impact of their own carbon emissions by funding projects that reduce carbon emissions elsewhere. Typically, the end users measure their own emissions and purchase an equal number of carbon offsets.[34]

Although voluntary market buyers can use Certified Emission Reductions (CERs) to offset their emissions, most of the voluntary carbon market uses a verified emissions reduction (VER) scheme. As the voluntary market has evolved without regulation in multiple markets, there is no single process for accrediting a VER, although a number of independent standards are emerging. Currently, the main international standards are the Voluntary Carbon Standard (VCS) and the Gold Standard.[35,36] These standards attempt to replicate the screening processes of the CDM to ensure that VERs deliver additional carbon savings.[37] The voluntary carbon market grew rapidly between 2005 and 2007 but still constituted only 1% of the compliance market in 2007.

Advantages

Voluntary carbon finance introduces flexibility to carbon markets. CDM is part of a legally binding international protocol, so its systems and procedures must be highly regulated and specific. The complexity and rigidity of the CDM administrative and review process may inadvertently result in the exclusion of worthwhile projects. The voluntary carbon finance market actively seeks to fill the gaps left by the CDM.

Registering a project with the CDM and certifying the emission reductions that it delivers carries a significant cost that many smaller projects cannot bear. The voluntary market can support such projects for much lower transaction costs and therefore, can be particularly useful for small pilot projects. The voluntary market is not part of the international framework, so it can continue beyond the timeframe of the current protocol. This offers some security to project developers that intend to run projects spanning two protocol periods.

34. Taiyab, N. International Institute for Environment and Development (2012). Exploring the market for voluntary carbon offsets. Retrieved on March 8, 2012, from http://pubs.iied.org/pdfs/G00268.pdf
35. Verified Carbon Standard (2012). Retrieved on March 8, 2012, from http://www.v-c-s.org
36. The Global Standard (2012). Retrieved on March 8, 2012, from http://www.cdmgoldstandard.org
37. The VCS attempts to deliver this assurance with more flexibility and less cost than CDM, while the Gold Standard aims to ensure that the projects funded also deliver sustainable development benefits to the local community.

Constraints

While the CDM is part of an international carbon market with a market price, the voluntary market to date, has typically operated on a 'cost-plus model' (the real cost of making the project viable plus any other charges passed on by the provider/broker) for VERs. As a result, VERs retail at a lower price than CERs - typically around 50 % of the CER value. Due to the nature of the carbon market, the value of CERs fluctuates widely but VER values have been more stable. Because the voluntary market is much smaller than the carbon market, there are fewer opportunities for VER sales. The voluntary market is not mandated, so the market for VERs could decrease or disappear if the trend of using carbon offsets diminishes.

Key Factors for Success

Success of the voluntary carbon market depends on:

- Suitability and profitability of projects
- Applicability of technology
- Additional local or secondary benefits from project implementation
- Support from national and local governments for project development

Additional Resources

Hamilton, K., Sjardin, M., Peters-Stanley, M. and Marcello, T. (2010). Building Bridges State of the Voluntary Carbon Markets 2010 A Report by Ecosystem Marketplace & Bloomberg New Energy Finance.

Table 5: Summary of options for applying financial resources to energy efficient lighting programme components

Programme components		Government programmes	Electric utility programmes	Private funding	Multilateral donors	Bilateral donors	Carbon financing
Development of MEPS		✓		✓	✓		
Supporting policies	Mandatory and voluntary product labelling and certification	✓	✓		✓	✓	
	Bulk procurement	✓	✓	✓	✓	✓	✓
	Tax incentives	✓					
	Subsidies	✓			✓	✓	
	Rebates and giveaways	✓	✓	✓	✓	✓	✓[38]
	Instalment (on-bill) payments	✓	✓				
	Awareness raising, promotion and education	✓	✓	✓	✓	✓	✓[39]
	Public leadership and demonstration	✓	✓	✓	✓	✓	✓
Product quality compliance activities	Monitoring and Verification	✓	✓	✓	✓	✓	
	Enforcement	✓					
Environmentally Sound Management	Collection	✓	✓	✓	✓	✓	
	Recycling	✓	✓	✓	✓	✓	
	Disposal	✓		✓	✓	✓	

38. As part of a giveaway programme.
39. Ibid.

2. Regional Cooperation for Cost-Sharing

Regional cooperation can include comprehensive, multidimensional objectives involving government, market, and civil society.[40] Stakeholders come together in formal or informal networks or coalitions. Regional cooperation can achieve positive results by sharing resources for energy efficient lighting policies and programmes. Organizations helping to coordinate activities may include:

- Operational agencies, such as the UNDP and UNEP
- Service providers, such as The Global Efficient Lighting Centre – UNEP Collaborating Centre for Energy Efficient Lighting which offers testing and laboratory services
- Organizations that develop internationally harmonized specifications, labels and other standardized tools, such as Collaborative Labelling and Appliance Standards Program (CLASP)[41]

Many energy efficient lighting programmes are initiated each year at regional, national and local levels. Inadvertently, these programmes may duplicate effort, conflict, or cause confusion among trading partners. A regional planning initiative creates integrated framework to coordinate such programmes so that they do not conflict and they achieve their results in a cost-effective manner.[42] For a successful regional cooperation initiative, consensus among the stakeholders is critical. Suggestions for promoting collaboration include:

- Conducting roundtables and other consensus-building activities to reach agreement about particular issues, policies, guidelines, standards, and other subjects related to energy efficiency
- Identifying liaisons in each country to take lead and conduct local activities
- Creating bilateral activities
- Conducting in-person or online events to share experiences and information
- Developing an infrastructure for communication among stakeholders

For the phase-out of inefficient lamps, regional cooperation can include:

- Developing a regional efficient lighting roadmap to identify topics for cooperation and to identify ways to share resources and build regional markets for efficient lighting products
- Establishing or harmonizing lighting specifications and standards that include energy performance and quality criteria
- Agreeing on monitoring, verification and enforcement protocols (see Section 4). Activities such as verification of labels, mutual recognition of test results, or sampling and checking MEPS compliance can be improved through regional or bilateral agreements
- Expanding and enhancing lamp testing facilities and capabilities can reduce costs to individual countries and help establish a network of trained professionals. For example, individual countries could specialize in some aspects of testing, and cooperate with regional partners for other aspects of testing.
- Establishing regional resources for environmentally sound management could include collection and recycling systems and information programmes. The Basel Convention and many national laws establish strict guidelines for the movement of hazardous wastes to other countries, but exceptions can be made if certain conditions are met by the proposed programme. A country or group of countries planning to collaborate in the establishment of a regional recycling programme should consult with the Basel Convention Secretariat and its Regional Centres to obtain information and guidance.
- Pooling resources and making use of the available structures and capacities within regions can improve the effectiveness, mutual reinforcement, and synergy among country programmes and make them more cost effective and less confusing to the public. Regional coordination and planning is also crucial for the success of projects that are large, complex, have cross-border and trade implications, or that are important for more than one government to address.[43]

Case Study: Asia - Barrier Removal to the Cost-effective Development and Implementation of Energy Efficiency Standards and Labelling[44]

In 2005, the United Nations Development Programme and the Global Environment Facility began a five-year international cooperation project with Bangladesh, China, Indonesia, Pakistan, Thailand, and Vietnam. The BRESL programme was expected to deliver an average 10% reduction in total residential and commercial peak energy use in partner countries by the year 2030. The goal was to reduce carbon emissions by an estimated 23.4 million metric tons (MMT) per year (cumulative total of about 34.5 MMT) by the end of the project. By 2031, carbon emissions are projected to be 268.7 MMT lower per year (cumulative total of about 3,787 MMT), for a reduction of 9.4 % in annual emissions. The three main goals of BRESL are:

- To rapidly accelerate the adoption and implementation of an energy standards and labelling programme in the region
- To facilitate harmonization of test procedures, standards, and labels among developing countries in the region
- To help transform the manufacture and sale of energy efficient appliances, including CFLs

The programme resulted in four countries developing new and coordinated minimum efficiency standards for CFLs, fluorescent ballasts, air conditioners, refrigerators, and electric motors. They also established common criteria for energy efficient labelling schemes for new or improved appliances and equipment. The programme resulted in regional coordination and energy standards and labelling programmes in at least five participating countries.

40. Gomez-Mera, L. (2008). How 'New' is the 'New Regionalism' in the Americas? The case of MERCOSUR. The Journal of International Relations and Development, 11, 279-308.
41. CLASPonline (2012). Retrieved on March 8, 2012, from http://www.clasponline.org/
42. Devlin, R., and Estevadeordal, A. (2002). Trade and Cooperation: A Regional Public Goods Approach. IPECC (2012). Retrieved on March 8, 2012, from http://www.pecc.org/publications/papers/trade-papers/1_SII/8-devlin.pdf
43. Association of Wisconsin Regional Planning Commissions (2012). Benefits of Regionalism. Retrieved on March 8, 2012, from http://www.awrpc.org/Regionalism.html
44. BRESL (2011). BRESL Initiative. Barrier Removal to the Cost Effective Development and Implementation of Energy Efficiency Standards and Labeling Project. Retrieved on March 8, 2012 from http://www.bresl.com

Case Study: Asia Pacific Laboratory Accreditation Cooperation (APLAC)[45]

APLAC is an organization of laboratories, reference material producers, and inspection and accreditation bodies in the Asia Pacific Region, formalized in April 1995. Under its constitution, APLAC members commit to cooperate to improve testing, calibration and inspection standards and related activities (including reference material production) within the region. Their responsibility also includes enhancing the free trade objectives of the region, and between the region and other international economies.

The main objectives of APLAC are to provide a forum for the exchange of information and to promote discussion among organizations that are interested in laboratory and inspection body accreditation; to improve the standard of accreditation services provided by members, the mutual recognition among full members, and international acceptance of their results; to build and maintain confidence among the partners; and, to cooperate with other national, regional and international bodies with similar or complementary objectives. Ultimately, sharing knowledge and resources from across the region has generated a cost effective mechanism through which to develop experience in this area.

Fourteen member countries have subscribed to a mutual recognition arrangement (testing, calibration, ISO 15189, inspection, and reference material production), but the most important aspect is to establish confidence among the signatory accreditation bodies. The mutual recognition agreement includes elements designed to ensure conformity with the stated requirements in order to establish and maintain mutual confidence in the technical competence of APLAC signatories and accredited laboratories, inspection bodies, and reference material producers. APLAC is a member of the International Laboratory Accreditation Cooperation (ILAC).

Case Study: Guatemala - Green Lead[46]

Green Lead provides Central America with services for battery recycling. Although it does not involve lighting products, it shows how hazardous materials and wastes treatment can be addressed in a region. Acumuladores Iberia S.A., of Guatemala City is an automotive battery recycler that identified a sound business opportunity after being invited to participate in the implementation of a project to recycle used lead acid batteries from all over Central America.[47] Their plant was underutilized which provided a major environmental and commercial opportunity for the entire Central American region, which had previously only been served by recycling facilities in northern Mexico.

Although the Acumuladores Iberia plant already complied with Guatemalan environmental, health, and safety legislation in order to import and process used lead acid batteries, they were also required to comply with the Basel Convention and conform to the Basel Technical Guidelines for the Environmentally Sound Recovery of Used Lead Acid Batteries. Since 2008, Acumuladores Iberia has worked in partnership with the government and regional parties and responsibility now resides with the, for the implementation of the Regional Strategy for the Environmentally Sound Recycling of used lead acid batteries in Central America. Due to the regional approach, there was an increase of used batteries sent from other Central American countries to the Guatemalan recycling plant which has meant that the operation is now almost at capacity.

Green Lead economically viable, technologically efficient, and environmentally sound regional approach.[48] Even if it may not be possible to generalize the case of Guatemala to all Parties to the Basel Convention, a similar regional strategy for the collection, recycling and sound disposal of end of life lamps containing harmful substances could be developed, when it is not economically viable to recycle end-of-life lamps at the national level.

Additional Resources

- Regional Center for Lighting (2012), A Road Map for Solid State Lighting Transformation in South Asia.
- South Asia Regional Initiative for Energy (2011).
- The African Experts Meeting on the 10 YFP (2005). The African 10 Year Framework Program (10YFP) on Sustainable Consumption and Production.

Conclusions

Many governments cite the lack of funding and underdeveloped infrastructure as barriers to initiating a national transition to energy efficient lighting. Clearly, the initial resource outlay for such a conversion is significant, especially for those countries that have not yet committed resources towards basic investments in energy efficiency. Without adequate resources to support the implementation of phase-out policy approaches and critical complementary activities such as compliance measures, the effectiveness of a phase-out programme can be compromised.

Experiences from other nations demonstrate that the transition to energy efficient lighting has been highly cost-effective. Argentina, Brazil, Cuba and South Africa demonstrate that what is needed in the beginning is not necessarily funding, but rather the political will to commit to a transition to energy efficient lighting. Nevertheless, a successful transition requires both long-term policy commitment as well as investments in institutions and systems at each implementation level.

45. Ton M., Pont P.D., Gomez J. F. P., Beaulne P. and& Kumar S. (2009). Phasing in Quality. Harmonization of Harmonization of CFLs to Help Asia Address Climate Change. Retrieved on March 8, 2012, from http://www.asialighting.org/images/pdf/Phasing_in_Quality_March_2009.pdf
46. Green Lead (2008). Green Lead Initiative Retrieved on March 8, 2012, from http://www.greenlead.com/
47. CRCB Centroamerica y Mexico. (2011). Empresa recicladora de baterías de vehículos recibe dos premios en v edición del premio centroamericano a la producción más limpia. Retrieved in June 2011, from http://www.sica.int/busqueda/Noticias.aspx?IDItem=58274&IDCat=3&IdEnt=889&Idm=1&IdmStyle=1
48. International Lead Association, (2012). Lead Action 21, Case Study. Retrieved on March 8, 2012, from http://www.ldaint.org/UserFiles/File/casestudies/CaseStudies_Guatemala.pdf

Investing in four areas will ensure a successful and integrated policy approach:

- Development of MEPS
- Design and implementation of supporting policies
- Establishing measurement, verification and enforcement schemes
- Establishing environmentally sound management for lighting products

National conditions and approaches to phase-out programmes can vary; therefore, a detailed country-specific cost/benefit analysis will be required to help identify resource and funding requirements as well as available domestic resources. Country Lighting Assessments developed by the en.lighten initiative could serve as the basis for conducting this analysis.

Early and thorough planning and analysis of finance and resource requirements are essential. This allows for national consultation and agreement on significant issues such as; funding sources, cost-sharing arrangements and the type and duration of resources needed for a phase-out programme. These issues are difficult to address after a programme is under way, and may increase costs or create delays.

Heightened global concerns over climate change, along with increased availability of financial mechanisms, means that governments today have the opportunity to access more than one source of funding to finance a transition to energy efficient lighting. Governments that secure more than one funding resource can allocate each to a suitable component. For example, bilateral funding could be used for developing MEPS while voluntary carbon market funding could be used for implementing efficient lamp giveaway or rebate activities. The case studies describe programmes around the world which can provide references for agencies that are responsible for identifying and securing sources of funding. Lamps are a commonly traded commodity, so it may be practical to share costs and secure funds for phase-out activities with trading partners, or work towards regional cooperation to lower administrative and procurement expenses.

For countries with resource constraints, regional or international cooperation offers a potential option to add and expand resources or to provide access to additional capacities to support a national efficient lighting strategy and inefficient lamp phase-out programme. MEPS, testing capabilities, market verification of compliant products, and consumer labelling lend themselves to a regional or bilateral approach when countries share common borders, trade, or language. Regional or bilateral cooperation to increase the adoption of quality energy efficient lighting products can provide countries and regions with ways to reduce implementation costs while increasing the potential to mitigate the effects of climate change.

Some governments regard energy efficiency as a priority for energy security. Accessing external sources of funding for energy efficient lighting projects requires that governments provide a strong, long-term national commitment to a cost-effective strategy, to persuade funding agencies to commit sufficient resources. Countries need to develop integrated and sustainable national efficient lighting strategies that demonstrate to donors that they are genuinely committed to implementing a comprehensive transition.

Section 4
Ensuring Product Availability and Conformance

Table of Contents

Introduction

National policies and programmes that support the phase-out of inefficient lighting significantly improve energy efficiency, reduce electrical demand and reduce GHG emissions. Measurement, verification and enforcement (MVE) schemes increase compliance and are an essential part of a national efficient lighting strategy. MVE activities directly support a country's minimum energy performance standards (MEPS) (see Section 2).[1]

Compliance activities protect the market from products that fail to perform as declared or required; ensure that consumer satisfaction is in line with their expectations; and, ensure that policymakers, government regulators, programme administrators and other officials meet their programme objectives. Compliance activities also protect suppliers by ensuring that they are all subject to the same programme entry conditions.

Without continuous compliance procedures, non-compliant products compromise the effectiveness of efficient lighting programmes and policies. For example, the results of recent international and regional surveys indicate that a savings of over 4,000 TWh (equivalent to over 2,000 $MtCO_2$), may be lost due to non-compliant products being sold between 2010 and 2030, throughout all energy efficient programmes on a global basis.[2] These studies emphasize the need to improve MVE structures and practices in most countries and that investment in these procedures has been shown to be highly cost-effective[3]. Beyond MEPS, labelling of products, particularly efficient lamps, and rigorous MVE are favoured by many governments that encourage the entry of more energy efficient lighting products into their marketplace.[4]

MVE policies and schemes can be described by four areas of focus[5]:

- The rationale for and value of monitoring, verification and enforcement (MVE) and its objectives in the lighting sector
- The essentials of an MVE scheme in lighting programme implementation: programme entry conditions, which define programme-specific elements of monitoring, verification and testing, and various options for handling non-compliant products in the market
- Policy recommendations for MVE: policy options and priorities for policymakers and programme managers regarding MVE
- implementation and integration with standards and labelling programmes
- Developing and strengthening test capacity and regional cooperation; strengthening laboratories and expanding capacity; and, how regional cooperation can increase the effectiveness of MVE, while reducing costs

MVE testing and laboratory infrastructure requires significant effort and investment, especially for lamps, which are available in many models and which require frequent testing of numerous types. Regional cooperation on GHG emissions reduction opens considerable opportunity to improve enforcement capacity through the sharing of test capacities and results of testing and verification. Sharing essential programme information can enhance the capacity and skills of countries to monitor, verify, and enforce energy efficiency regulations. Cooperation promotes best practices while lowering costs. The increased adoption and use of high-quality, efficient lamps helps countries increase energy efficiency and improves international collaboration on common clean energy challenges and GHG emissions reduction.

1. Monitoring, Verification and Enforcement (MVE)

While MVE activities can support standards and labelling programmes, the potential for maximizing energy savings, and for the effective elimination or phasing out of the most inefficient lighting products, rests with an effective MEPS programme (see Section 2). Complementary and continuous compliance activities ensure that transition programmes achieve successful results. The goal of MVE activities is to ensure the integrity of programmes by minimising the cost of non-compliance. They encompass a wide range of actions[6]:

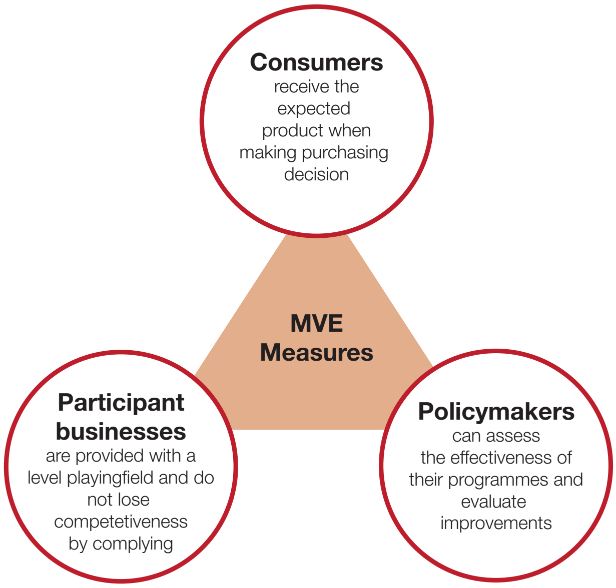
- **Monitoring** is a measurement process through which any party can use to check product efficiency. It involves measuring performance claims against a nominated standard in a consistent manner, using accurate instrumentation applied by qualified staff in controlled conditions. It is also the process by which the successes of energy programmes are measured
- **Verification** is the measurement process whereby declarations of conformance by lighting suppliers are confirmed, often by independent third parties. This action can be commissioned by the supplier (to confirm claims), but may be conducted by other parties, such as competitors or regulators, to challenge declarations
- **Enforcement** is the action taken by programme administrators or other responsible parties against suppliers of non-compliant products, as a result of finding fault through either monitoring or verification. Enforcement requires rigorous and transparent monitoring and verification processes

1. Although a generic reference to standards and labelling programmes is used, these policy approaches can be combined or used separately. MVE activities are crucial to ensure the long-term success of any standards programme.
2. OECD/IEA. (2007). Mind the Gap. Paris
3. For example, the MVE expenditure of countries with the most effective compliance regimes represents only 0.2% of the savings resulting from optimizing compliance. Saving More Energy Through Compliance: International, Monitoring, Verification and Enforcement Conference, 14-16 September 2010.
4. This section draws on two publications that offer guidance relevant to lighting related compliance issues: 1) CLASP. (2010). Compliance Counts: A Practitioner's Guidebook on Best Practice Monitoring, Verification, and Enforcement for Appliance Standards & Labelling. Washington, DC: Mark Ellis and Zoe Pilven; Mark Ellis & Associates and 2) OECD/IEA. (2010). Monitoring, Verification and Enforcement: Improving Compliance within Equipment Energy Efficiency Programmes. Paris.
5. Incorporating best practices from measurement, verification and enforcement (MVE) and evaluation, measurement and verification (EMV).
6. OECD/IEA. (2010). Monitoring, Verification and Enforcement: Improving compliance within equipment energy efficiency programmes. Paris.

1.1 Why is MVE Important?

Establishing a comprehensive compliance regime ensures the effectiveness of MEPS to deliver more energy savings and reduced GHG emissions. Achieving high rates of compliance yields overall benefits for all stakeholders. For industry, it means operating in a fair market that encourages investment and technological innovation. Consumers enjoy reduced energy costs and increased availability of quality lighting products at fair prices and governments achieve key environmental and economic policy objectives.

Figure 1: Benefit of MVE measures for energy efficiency actions



"Industry believes that the most important issue is ensuring fair competition in the market. To that extent, industry calls for effective market surveillance able to check the compliance of products placed on the market to the declared energy efficiency values. Fair competition and fair compliance checking go hand-in-hand to enhance market transparency for the benefit of consumers.
Paolo Falcioni, Vice Director General, Conseil Européen de la Construction d'appareils Domestiques CECED

Conseil Européen de la Construction d'appareils Domestiques (CECED)"

As with any policy action, there are both short and long-term benefits for including compliance measures, along with associated risks from not adopting them:

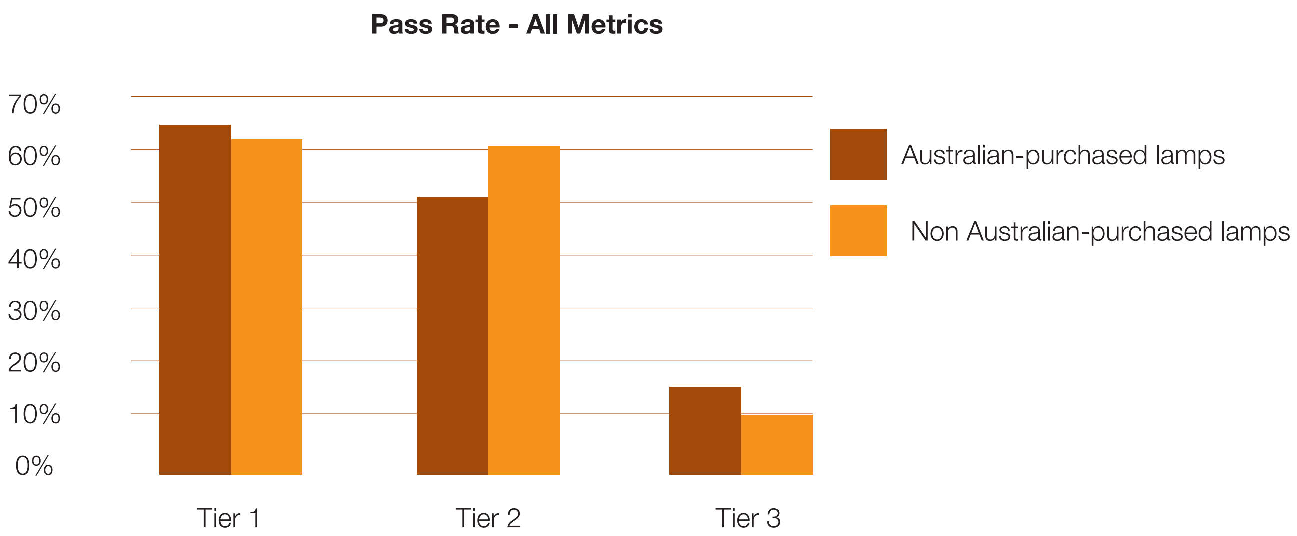
- High compliance rates safeguard the investment made by governments in assuring the credibility of their transition strategies
- Failure to address non-compliance leads to serious long-term consequences due to erosion of consumer confidence. Instances of non-compliance (where consumers have paid for performance that they do not receive) seriously erode credibility which will require a considerable effort to re-establish confidence
- High compliance rates also safeguard the investment made by compliant industry participants in order to manufacture and supply energy efficient products
- Without adequate enforcement, the compliant industry participant is penalized through a loss of economic returns and competitive advantage, leading to a disincentive to invest in innovation
- Improving compliance rates is likely to improve key outcomes such as greater energy savings and reduced GHG emissions
- Understanding rates of compliance is a prerequisite for accurately forecasting the outcomes of MEPS programmes

Developing and maintaining a strong compliance regime for lighting products may appear overwhelming and resource-intensive, given the scope of the standards requirements as well as the range of processes required. However, the benefits demonstrate that investment in compliance and enforcement regimes has a major impact on the success of programmes.

The risk of not having a strong compliance regime can be significant, especially when considered in a regional context. The U.S. Agency for International Development's analysis of the Asian CFL market in 2007 estimated that the total market share of low-quality CFLs produced in Asia (those for which there is no evidence of product testing and registration, and/or which have a rated lifetime of less than 6,000 hours) averaged close to 50% of the market.[7] A follow up benchmark testing project in 2009 confirmed this initial finding. Figure 2 below shows the results from testing lamps available on the Asian and Australian markets against various quality thresholds. Note the decreasing passing percentage as lamps are compared against Tier 3, which represent international or 'export-level' performance.[8]

7. USAID. (2007). Confidence in Quality: Harmonization of CFLs to Help Asia Address Climate Change. Bangkok, Thailand. Retrieved on May 26, 2012. Retrieved from http://usaid.eco-asia.org/programs/cdcp/ConfidenceCFLQuality.html
8. USAID. (2010). Testing for Quality: Benchmarking Energy-Saving Lamps in Asia. Bangkok, Thailand. Retrieved on May 26, 2012. Retrieved from http://usaid.eco-asia.org/programs/cdcp/benchmarking-energy-saving-lamps.html

Figure 2: Test results for Australia - and Asia - purchased lamps against quality thresholds[9]



1.2 Objectives of MVE

A central and overriding objective of compliance activities is to demonstrate the value of energy efficiency programmes and policies by providing accurate, transparent and consistent assessments of their methods and performance. MVE can help to determine how much of the savings can be attributable to an energy efficient lighting programme. Comparing programme savings to baseline levels - where no market intervention has taken place - allows programme managers to examine and report the effects of individual measures, as well as entire energy efficiency programmes. Estimating the quantitative effects of energy efficiency programmes is termed 'impact evaluation.' MVE enables the comparison of benefits and programme costs.[10] Determining how well a lighting programme is designed and implemented can be another key objective.

For other stakeholders, particularly for lighting producers, the objective of MVE is to ensure a level playing field, avoiding situations where suppliers of compliant lighting products who incur the increased costs of compliance, could lose out to non-compliant competitors who avoid these costs by falsely claiming to meet the standard. For consumers, MVE ensures that products perform as described and warranted by the supplier. For all stakeholders, it is important that goods sold do actually meet MEPS requirements, and that label claims are accurate.

A 2008 U.S. Agency for International Development study in Asia found that suppliers have the capacity to make enough high-quality CFLs for Asia, but the absence of consistent MVE efforts in the region benefited suppliers of low-quality, low-cost CFLs. While there were sufficient numbers of CFL manufacturers with the capacity to produce quality CFLs for the Asian market, the Asian market continues to be flooded with substandard products. Poor quality products can be manufactured at a lower cost, disadvantaging suppliers of higher quality, higher initial cost CFLs.[11]

To summarize, the objectives for MVE in lighting programmes need to address the interests of each stakeholder group:

- Assess product and market compliance levels - a product evaluation process should routinely evaluate lighting products available in the market. Industry participants need to be assured that all of their competitors are subject to the same requirements and scrutiny.
- Reduce or eliminate non-compliant lighting products - a transparent framework should deal with products that are found to be non-compliant. Often, the risk of exposure of non-compliance, rather than actual sanctions against manufacturers who attempt to mislead consumers, provides sufficient motivation for manufacturers to comply. Also, the visibility of the enforcement process has a significant effect on the rate of compliance.
- Verify that MEPS are implemented as designed - A process should be established for programme data analysis and evaluation to inform sensible decisions about the future direction or further development of lighting policy. With this information, government agencies have evidence to inform future standards and labelling negotiations with the lighting industry.
- Inform stakeholders about programme performance - MVE for lighting programmes should survey the market to collect sufficient data to determine how the standards and labelling programme is working. The most obvious benefit of MVE is the subsequent availability of information on the effectiveness of the lighting policy or programme. Data collection can also inform governments to better allocate resources and/or meet their international commitments.

9. Ibid.
10. The benefits may include, but are not limited to: lower GHG emissions, improved public health, lower energy prices, job creation, increased income, improved national security, and reduced construction expenses for utilities.
11. USAID. (2008). Phasing in Quality: Harmonization of CFLs to help Asia Address Climate Change. Bangkok, Thailand. Retrieved on May 26, 2012. Retrieved from http://usaid.eco-asia.org/programs/cdcp/phasing_in_quality.html

2. Implementing MVE for Lighting Programmes

Policymakers and programme implementers should integrate robust MVE activities into every aspect of their National Efficient Lighting Strategy. Careful, advanced planning and integration of MVE ensures that the programme can be implemented without delay, confusion, repetition or waste. The planning stage must include relevant regulators and industry and consumer stakeholders who can comment on proposals and critique concepts.

Early and thorough planning allows stakeholders to discuss and agree on significant issues such as funding, cost-sharing and types of information disclosure. Underestimating compliance costs can have major consequences for government agencies, because obtaining significant post-implementation funding outside budget cycles is a difficult and time-consuming. Similarly, getting agreement ahead of time on the level and format of data to be made public, as well as where to house the data, helps to perpetuate stakeholder trust. While improved MVE elements can be added to programmes at later stages, the add-on requirements may trigger significant stakeholder complaint, criticism and cost.

2.1 Programme Entry Conditions

A survey of MVE regimes and activities in selected countries[12] revealed that over 80% of countries have some form of compulsory entry condition for efficient lighting products, whereby suppliers must provide specific information or make a declaration about their products' energy performance. The majority of national lighting programmes use the information provided by suppliers for communication with end users to help them identify which individual product models are covered and what their energy performance standards are.

Key Factors for Success

MVE activities and needs can be defined and developed based on a particular programme's entry conditions and integrated into the overall programme implementation. MVE implementation should include self-declarations by importers and suppliers containing confirmation of compliance. A tool such as a centralized list or online registry that identifies products which have satisfied programme requirements is valuable. If there is a centralized list, claims of unregistered or uncertified products appearing in the marketplace can be verified quickly and inexpensively, and it can assist in the identification of products requiring closer inspection and possibly verification testing.

Case Study: Some Examples of Entry Conditions Worldwide

- In Canada, suppliers must ensure that an energy efficiency verification mark from a certification organization, accredited by the Standards Council of Canada is on a product before it can be sold
- Chile requires suppliers to certify their products through a third party institution prior to entering the market
- In Australia, all products within the scope of mandatory standards and labelling programmes must register the details of all models prior to being sold
- In the United Kingdom, test reports are not required to be lodged as a condition of participation but suppliers are usually obliged to produce this type of information as justification upon request
- In Korea, manufacturers must allow the inspection and testing of their own factories as part of the quality assurance process

Additional Resources

- Super-Efficient Equipment and Appliance Deployment Initiative.
- APEC Energy Standard Information System.
- Energy Efficiency Policies for Appliances.

2.2 Monitoring (Market Surveillance)

Monitoring activities ensure compliance with lighting standards or labelling programme requirements, once the programme is underway and products are in the marketplace. Thus, monitoring is sometimes called 'market surveillance.' Internet and other forms of distance selling also fall within the scope of market surveillance. Market surveillance is one way to check for compliance with legal or programme requirements, as well as to retrieve programme data. Therefore, the design of monitoring activities depends on programme specific obligations that identify which governmental or independent bodies are responsible for certain activities.

Requirements for, and the allocation of, market surveillance resources are dependent upon the programme design and intent, whether the market surveillance is needed to support a labelling programme, a MEPS programme, or both. Approaches include:

- Market surveillance for energy labels
- Market surveillance for MEPS
- Complaint-based market surveillance
- Legislative framework and division of labour for market surveillance

Regardless of programme design and intent, both MEPS and labelling programmes need to develop a transparent product sampling methodology and sufficient testing capacity to ensure that products in the market are sampled and tested on a regular basis.

12. CLASP. (2010). Survey of MVE regimes and activities in selected countries. Washington, D.C

2.2.1 Market Surveillance for Energy Labels

Market surveillance is particularly applicable to labelling programmes for lighting products because there is a significant amount of declared information provided directly on the label itself, or available indirectly via registration or self-certification schemes. Market surveillance includes visual checks in retail outlets or other distribution points to verify that lamps available in the market carry a label that is compliant with the applicable regulations or programme rules. Products in the market must also be sampled and tested to verify that they do meet the label claims

Key Factors for Success

Surveillance of compliance with labelling requirements is simple and inexpensive to carry out with the support of junior staff. Following the initial checks, cases of non-compliance can be identified for follow-up. Products should be sampled and tested on a regular basis to verify labelling claims and minor labelling infringements are best responded to swiftly via notification, fines, or other sanctions prescribed in the MVE scheme.

Additional Resources

- Appliance Testing for Energy Label Evaluation Project
- Market surveillance and EU energy labelling from a consumer viewpoint
- Ecodesign and Market Surveillance

2.2.2 Market Surveillance for MEPS

Market surveillance of MEPS helps to identify products in the marketplace that are not compliant with energy efficiency requirements, which can be a challenging and resource intensive undertaking. This will depend on the MEPS requirements identified for a particular lamp type, which can range from lamp efficacy levels, to a wide range of requirements that may include: start time, colour temperature and average life. If labelling is not required, then none of this information will appear directly on the lamp label, but may be available indirectly via registration or self-certification schemes or general information provided online by the manufacturer. A market surveillance programme for lamps must include regular and transparent market sampling and testing to ensure that lamps meet MEPS performance requirements.

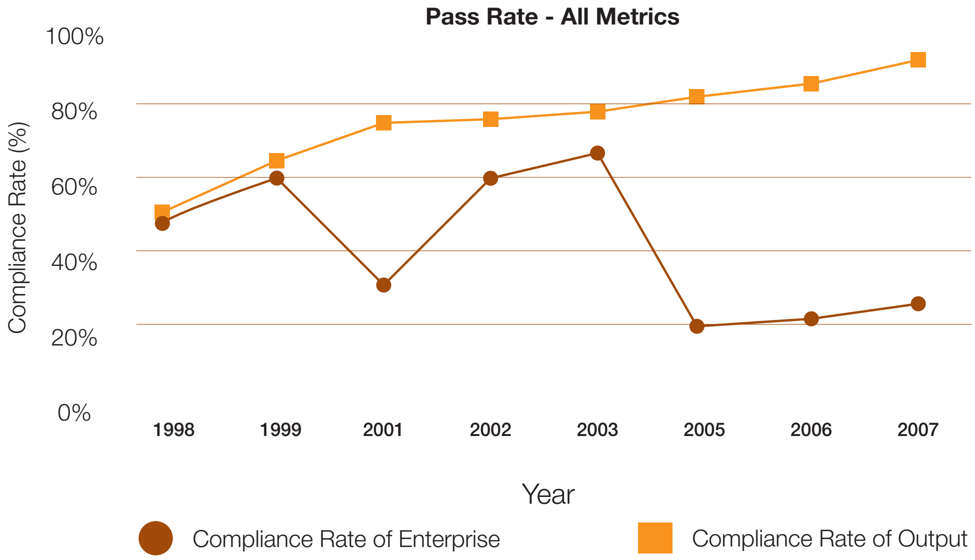
Key Factors for Success

Market surveillance of lighting products can be challenging, because lighting products subject only to MEPS are unlikely to carry performance declarations. Performance claims maybe verified by accessing the necessary registration details or self-certification files; however, comparison to MEPS levels may be difficult to do during field surveys. Ideally, expert surveillance staff with an appropriate level of technical knowledge may be required to determine MEPS compliance.

Case Study: China – CFL Market Surveillance

Since 1998, China has conducted an annual National Supervision and Inspection test on CFLs. The tests are carried out for CFLs sampled at factories, as well as CFLs sampled in the marketplace. In 1998, the compliance rates were about 50% for both conditions. Since then, the compliance rate for total CFL manufacturing output has increased to nearly 90% (Figure 3). The trend toward improved quality, as well as China's capability to gather data that can confirm this trend clearly show the value of market surveillance.

Figure 3: Compliance rates for total CFL output in China



Source: NLTC 2009 and USAID, 2010.13 Note: no data available for years 2000 and 2004.

13. USAID. (2010).Quality Control and Market Surveillance of Compact Fluorescent Lamps in China. Bangkok, Thailand. Retrieved on May 26, 2012. Retrieved from http://usaid.eco-asia.org/programs/cdcp/quality-supervision-cfl-china.html

Case Study: U.S.A. – Extended CFL Average Life

Regular sampling and testing provides additional value beyond just market surveillance purposes. It can also help to develop laboratory testing experience, and can provide data for market trends. For example, the US ENERGY STAR[14] programme's data showed that the average life claims of CFLs available in the US were increasing from the required 6000 hours to 8000 hours. As a result, the programme revised the entry conditions, and more importantly, the educational materials, to reflect the higher values, thereby increasing consumer confidence in CFLs.[15]

Additional Resources

- Ecodesign and Market Surveillance
- Questions to the Technical Subgroup of the Ecodesign Consultation Forum on the draft energy labelling and draft ecodesign regulations

2.2.3 Complaint-Based Market Surveillance

Complaints provide a valuable service to programme administrators because their successful handling can be a powerful tool. Complaints should be easily filed and promptly investigated in order to maintain credibility. To maximize the reach of this approach, it is necessary to enlist the support of competitors and civil society stakeholders.

Key Factors for Success

Specifics regarding implementation of complaint-based market surveillance include:

- Programme participants are more likely to be able to detect or at least reasonably suspect non-compliance, and should be encouraged to do their own checking
- Complainants should be allowed to stay anonymous; otherwise participants may be unwilling to lodge complaints for fear of retaliatory complaints from their competitors
- Market surveillance authorities should not rely solely on tip-off information but devise their own procedures to carry out systematic and effective compliance checks

Case Study: India –Leveraging a Consumer Interest Organization[16]

In India, the Voluntary Organization in Interest of Consumer Education provides consumers with guidance to make informed choice about products and services. It was one of the first organizations to independently evaluate CFLs for performance. In 2009, the organisation followed up with a comprehensive evaluation of India's major CFL brands for quality and mercury content. Their evaluation demonstrated a difference in product quality by comparing the results from before and after the Indian Bureau of Standards issued CFL standards for India. The organisation presented its findings of non-compliance to the public, and notified the manufacturers with non-compliant products as well as the Bureau of Indian Standards.

Case study: European Union – RAPEX System[17]

Telephone or online "hot lines" make it easy for individuals to report for non-compliant to MVE authorities. Reporting allows for swift action to be taken. In the European Union, the RAPEX System allows for the rapid exchange of information between member states and the Commission to prevent or restrict the marketing or use of products posing a serious risk to the health and safety of consumers.

Additional Resources

- Reactive Market Surveillance
- Information portal for the Consumers' Association of Canada

2.2.4 MVE Legislative Framework and Division of Labour

Framework legislation describes the activities that are undertaken to ensure compliance when a third party is centrally involved in implementing the MVE program. This applies where independent certification authorities are involved in the verification process.[18]

Key Factors for Success

In order to implement a legislative framework, the parties who will be responsible for market surveillance activities need to be identified. A great degree of attention to coordination is required to ensure that compliance activities remain appropriate to the scale, scope and objectives of the energy efficiency programme. A clear delineation of authority needs to be established, particularly in setting an appropriate parameters where activities undertaken by the programme cease and the case is taken over by the enforcement authority for more stringent types of sanctions.

Case Study: Multiple Countries – National Certification Authorities

14. http://www.energystar.gov/
15. US ENERGY STAR introduction to Draft Version 3.0 of CFL specifications
16. http://www.consumer-voice.org/Comparative-Product-Testing.aspx
17. European Commission. (2010). Keeping European Consumers Safe, Annual Report. The Directorate-General for Health and Consumers.
18. In Europe, legislation is promulgated by the European Parliament, but the responsibility for MVE implementation rests with the Member States.

The Ecodesign Framework Directive in the European Union (2005/32/EC) requires member states to establish a Market Surveillance Authority that has the authority to check products, request relevant information from manufacturers and ensure the withdrawal from the market of non-compliant products. It also requires that penalties shall be 'effective, proportionate and dissuasive, taking into account the extent of non-compliance and the number of units of non-complying products placed on the Community market'

In Germany and Spain, regional governments are responsible for market surveillance and enforcement for EU Energy Directives.

Other countries with centralized government structures have different agencies responsible for compliance. For example, responsibility for compliance with the mandatory labelling programme in Argentina resides with the Secretariat of Commerce, while overall management is provided by the Secretariat of Energy.

In Mexico, the 'Ley Federal Sobre Metrología y Normalización' establishes the roles and responsibilities for public and private organizations within the MVE regime. These include the National Metrology Center, accreditation entities, and certification organizations.

In Canada the Energy Efficiency Act (1992) and the Energy Efficiency Regulations (1995) specify the use of energy efficient verification mark from a certification organization accredited by the Standards Council of Canada which must be carried by all products manufactured or entering Canada.

In the U.S.A., the Federal Trade Commission has responsibility for mandatory energy labelling but the Department of Energy has responsibility for MVE.

Additional Resources

CLASP: A Survey of Monitoring, Verification and Enforcement Regimes and Activities in Selected Countries.

2.3 Verification

The verification process begins with market surveillance and ends with an enforcement action. Verification testing involves checking whether an energy performance product performs as claimed. Without confirming the accuracy of energy label claims or minimum energy performance levels, there can be only limited enforcement as a result of the market surveillance activity. Verification testing may vary depending upon the design of the MVE system. Where entry conditions do not require certification, verification testing is used as the main method of checking performance.

A verification system is the process, often legislated, to determine whether the declared safety requirements and energy performance of equipment available on the market is accurate. Testing is the core means of determining whether energy performance claims have been met. The five main forms of verification testing, in order of ascending stringency, are:

- **Registration verification** - confirms that registered products meet the requirements for registration, as part of the programme entry conditions
- **Screening or check testing** - typically used to provide a preliminary assessment of products which are likely to fail a full verification test. Fewer duplicate tests are made, laboratory or staff undertaking the tests may not be accredited, or not all of the test requirements are undertaken
- **Third party certification** - review and confirmation by an independent and competent third party that the manufacturer or supplier's claim of conformity adheres to the specified procedure
- **Full procedure verification tests** - ensures that the specified procedure is followed precisely in an accredited laboratory (ideally) and where all measurements and records stipulated in the procedure have been followed. Full procedure verification testing would normally be the process that precedes an enforcement action
- **Benchmark testing** - ensures that a complete check of products available in the market, conducted on a regular basis in a systematic manner

2.3.1 Registration Verification

This is the first verification step: to ensure that registered products meet the requirements for registration, as part of the programme entry conditions. It requires a review of the information submitted by the manufacturers to determine whether or not the information submitted is complete and to verify that the product meets the programme's quality and performance requirements.

Advantages

- Verification process does not require field visits
- Very low cost
- Ensure programme credibility

Constraints

- Only verifies submitted information, not actual products in the market
- May require the reviewer to have experience in interpreting test data

Key Factors for Success

The process should be set up so that all participants understand the requirements and the information that must be submitted. The process should be transparent, although the product information submitted by manufacturers may be considered business sensitive and thus, must be kept strictly confidential order for manufacturers to agree to participate.

2.3.2 Screening or Check Testing

These tests provide a preliminary assessment of lighting products on the market to verify the claims on the energy label and/or compliance with MEPS and/or to identify those that are likely to fail a full verification test. Screening tests may not adhere to the full procedure n that fewer duplicate tests are made, laboratory or staff conducting the tests may not be accredited, or not all of the test requirements are completed.

Advantages

- May require less resources and time than full procedure tests
- Can provide the community and stakeholders with data on accuracy of the labelling scheme and compliance by suppliers
- Assures quality and transparency of the programme and maintains high levels of credibility both with consumers and manufacturers

Constraints

- Requires a comprehensive sampling methodology to ensure market coverage
- Requires more resources and testing experience than registration verification
- A defined process is needed for non-compliant products

Key Factors for Success

For check testing to be effective, the process should focus on effective, but less intensive tests. For example, focusing on tests that measure lamp efficacy or initial failure rates instead of more time consuming assessments such as lifetime testing, may provide initial results regarding product quality. Further, it is likely that full procedural tests will be required once non-compliant products are identified before enforcement can take place.

2.3.3 Third-Party Certification

Third-party certification requires that suppliers subject their products to independent, accredited laboratories for testing. Suppliers must then obtain certification from these institutions regarding the claims on the energy label and/or compliance with MEPS in order to satisfy programme entry conditions

Advantages

- Suppliers responsible for the costs of testing and certification
- Simplifies verification process of accuracy of the labelling scheme and compliance by suppliers
- Maintains high levels of credibility both with consumers and manufacturers

Constraints

- Suppliers may restrict participation due to costs
- Requires open access to third-party laboratories and certification organizations
- Suppliers who have invested in their own testing facilities may be placed at a cost disadvantage

Key Factors for Success

For third-party certification to be effective, participants must all have equal and open access to third-party and certification organizations. This requires a developed system of test laboratories with enough experience and capacity to handle the likely test volume. A regional testing system and capacity sharing may be cost effective when countries cannot justify or support their own laboratory facilities.

2.3.4 Full Procedure Verification Testing

These tests ensure MEPS programme credibility. Ideally, the specified procedure is followed precisely in an accredited laboratory where all measurements and records stipulated in the procedure are followed. The results can then be used for programme qualification purposes or for enforcement.

Advantages

- Removes any uncertainty from the qualification or enforcement process
- Ensures accuracy of the labelling scheme and compliance by suppliers
- Maintains high levels of credibility both with consumers and manufacturers

Constraints

- Can be resource intensive
- Requires well-designed market sampling protocols
- May require access to laboratories capable of testing large quantities of lamps simultaneously.

Key Factors for Success

Regular verification testing requires a developed system of test laboratories with enough experience and capacity to handle the volume and the broad resources to implement a credible testing schedule. Full procedure verification testing would normally be followed with the support of both programme entry verification and subsequent enforcement action. Additionally, where capacity and experience are needed, a regional testing system and capacity sharing may provide some options.

2.3.5 Benchmark Testing

Like full procedure verification testing, benchmark testing requires a thorough sampling of products on the market, and the testing of products using a thorough procedure. Unlike full procedure verification testing, benchmark testing may also include assessing non-compliant products in order for regulators and programme manager to obtain a better sense of the market.

Advantages

- Evaluates robustness of test method
- Gives an understanding of quality and range of performance of products in the marketplace
- Assists manufacturers to identify problems in advance of mandatory requirements under MEPS legislation
- Maintains high levels of credibility with both consumers and manufacturers

Constraints

- Resource intensive
- Requires well-designed market sampling protocols
- May require access to laboratories capable of high volumes

Key Factors for Success

Benchmark testing also requires a developed system of test laboratories with enough experience and capacity to handle the volume. Benchmark testing would normally be followed with the support of new MEPSs or effective enforcement action. It also requires capacity and experience, and a regional testing regime and capacity sharing may provide some options.

Additional Resources

- Australia's Check Testing Program and its Application to Lighting Products
- DOE Verification Testing in Support of ENERGY STAR
- Reference Document for Energy Efficiency Standards & Labeling in Central America

Testing processes can be established on the basis of the safety and/or performance criteria used in the standards, depending on the verification purpose (such as MEPS, labelling requirements, national lamp testing standards and international reference standards). These include, but are not limited to, the following categories:

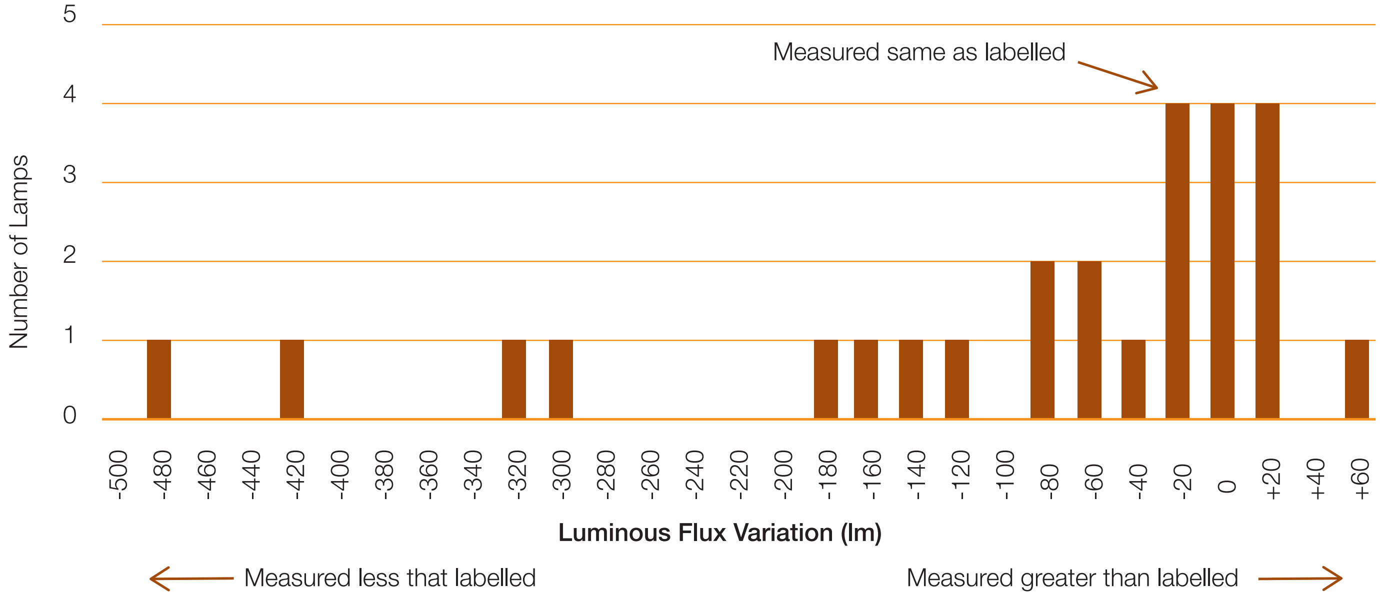
- Safety (electrical and mechanical/physical)
- Photometric parameters (or performance criteria, including: luminous efficacy)
- Colorimetric parameters (or light quality criteria, including: colour rendering, correlated colour temperature, and colour consistency)
- Toxic and hazardous compounds content (including mercury)
- Other lamp performance and operational characteristics (start-up time, lumen maintenance and average life)

Case Study: Australia – Verifying Performance Claims by LED Lamp Manufacturers

Agents responsible for MVE should track market trends and changes in product performance and also become familiar with the intricacies of testing any new lighting technology that offers promise for increasing lighting energy efficiency. Australia's Department of Climate Change and Energy Efficiency based its LED lamp testing programmes on the lessons learned from the market introduction of CFLs. The Department surveyed the lamp market to ensure that manufacturers' claims were accurate. Figure 4 summarizes their findings regarding misleading claims in the Australian market.[19]

19. Steve Coyne, Presentation to lites.asia Nov 2 & 3 2011, Singapore

Figure 4: Results of tests of luminous flux comparing measured data versus labeled claims.



Source: DCCEE, 2010.

2.4 Enforcement

An enforcement strategy is a set of responses to incidents of non-compliance, coupled with a progressive action plan for their application depending on:

- Severity of the non-compliance
- Range of sanctions that are available
- Type of programme (mandatory or voluntary)
- Quality of the evidence supporting the claim of non-compliance
- Responsiveness of the party responsible for the non-compliance
- Potential to rectify non-compliance

Advantages

If compliance is enforced, participants will be encouraged to comply when the potential costs of non-compliance, whether financial or to the participant's reputation, are greater than its benefits. In circumstances where non-compliance could be as much as 20% to 50%, better compliance is a more cost-effective option than attempting to recover that energy by regulating an entirely new product type (IEA, 2008b).[20] In a climate of historically low levels of enforcement, a modest investment in enhancing compliance is hugely cost effective in improving policy measures undertaken by government and industry.

Constraints

The authority for enforcement needs to be clearly established from the programme start. If programme participants consider that there is only a small chance of a transgression being discovered and that the associated penalty is also low, there will be little motivation to comply. Enforcement actions may also result in an adversarial relationship with the non-compliant programme participant if they do not accept responsibility;

Key Factors for Success

Enforcement, including remediation, is most effective when the response to the detection of transgressions is immediate.

- Enforcement processes with a limited range of possible responses tend to be unwieldy and often require high levels of proof, which makes them impractical in dealing with minor transgressions
- A wide range of sanctions allows the enforcement authority to respond quickly, and is less costly and more effective. For example, sanctions can range from giving notification and identifying a correction period for minor transgressions, to delisting products from qualified products list or public notification, to legal actions and sanctions, including suspension and fines.
- Where sanctions are necessary, they should be sufficient to outweigh the benefits of non-compliance in order to be an effective deterrent
- Only a relatively small number of major enforcement actions are required to alert industry to the ramifications of non-compliance

Additional Resources

- Energy Efficiency Promotion Policy and Activities in Thailand
- Refrigerator Energy Labelling and MEPS Compliance in the Australian Market
- Australian experience with enforcement and check testing
- IEA study to review existing global appliance standards and codes: Meeting energy efficiency goals: Enhancing compliance, monitoring and evaluation, International Energy Agency, reported in the Chair's summary, Paris, 28-29 February 2008

20. IEA. (2008). Meeting energy efficiency goals: Enhancing compliance, monitoring and evaluation. Reported in the Chair's summary. Paris. 28-29 February 2008.

3. Developing and Strengthening Test Capacity

3.1 Developing Test Capacity

As phase-out schemes are implemented around the world, they will trigger a substantial increase in demand for higher efficiency lamps. The introduction of MVE programmes to support these initiatives will lead to a parallel growth in the demand for testing facilities capable of verifying the performance and quality of these alternatives. Countries may establish laboratories or expand capacity for testing. They may also support laboratory registration and accreditation for the domestic lighting industry.

Establishing reliable laboratory capacity from the ground up is very expensive and time consuming, terms of both set-up time and the time required to develop a test history and experience. It also carries a significant ongoing cost in terms of building maintenance, equipment, and staff wages and training costs.

Considerations when developing testing capacity, especially new facilities, include:

- **Frequency of testing** – if testing is only required for occasional product development, then having a fully accredited laboratory will not be cost effective
- **Volume of testing** – this depends on both the size and composition of the market, as well as programme implementation. A large market with many suppliers and products will require testing for many products, while a voluntary labelling programme in a smaller or homogenous market with a limited number of suppliers will not require the testing laboratory to handle as much volume
- **Certification of products** – if testing is required to provide the certification of products to international standards then unaccredited laboratories will not be able to fulfil the requirement. Usually products are already submitted for safety certification
- **Independent compliance testing support** – if independent compliance tests are required, manufacturers may prefer to have access to product testing that can accommodate design, production and testing. In some cases, this may mean an on-site or local laboratory, in other cases; it may mean a manufacturer's own laboratory or a contracted test laboratory familiar with their products
- **Product range or testing scope** – developing testing capacity for one type of lighting product only, such as CFLs, may not be adaptable if there be a shift in market demand for another product such as LED lamps
- **Local production support** – If new manufacturers enter the market, they may need access to local testing capacity (not necessarily independent third-party or accredited), which may be enough to guide product development and quality control of mass production[22]
- **Availability and accessibility of capacity elsewhere** – it is more common for product testing to be performed at an international location, by an experienced, accredited laboratory with sufficient capacity and the ability to turn around results quickly
- **Development of complementary capacities** – the option to share capacity with neighbouring states and/or trade partners is often overlooked. An example would be reciprocating the test capacity for one type of lighting product, such as LED lamps, in return for use of test facilities for a different type of product, such as CFLs

When considering market surveillance and enforcement activities, it is essential the authority has a full suite of enforcement actions available to it: not only criminal or civil sanctions, but a wider range of administrative provisions which can be used to encourage any business to become compliant and to discourage business to be non-compliant.

The authority can then choose either a partnership or adversarial approach depending on the circumstances. The first option builds a relationship with the company, helping them comply with the legislation and getting them to accept social responsibility for their products. The second approach should be used when the partnership approach does not result in compliance. In this case, a full suite of legal powers, formal procedures, administrative notices, and a capacity to litigate need to be available and used proportionally. Enforcement effectiveness can be measured in terms of compliance by local, national, international and global companies all of which should comply with the legislation.

Hans-Paul Siderius, Chair, IEA Efficient Electrical End-use Equipment Implementing Agreement and Agents[21]

3.2 Strengthening Test Capacities

If lighting testing capacity already exists or if future needs warrant it, then the next step is to determine the level of activities and services that will require support. The following actions can be taken to guide the levels of investment that will be required:

- Assess existing capacities, including staff competencies and needs for training
- Determine immediate, and estimate future, levels of testing required
- Identify the types and physical dimensions of lamps that require testing
- Identify which international standard testing protocols will be used for the tests
- Clarify test capacity needs (for example, determine how many lamps will be tested simultaneously
- Define the type of laboratory equipment, calibration and maintenance required to fulfil these needs
- Decide whether the test results have to be shared with others (e.g.. with other governments)

The above steps will provide an outline of the testing capacity and laboratory requirements, and will help determine the immediate investment cost and the long term running costs for the type of laboratory necessary to meet these requirements.

Utilities and governments operating efficient lamp programmes may choose to maintain a national set of lamp performance test results.

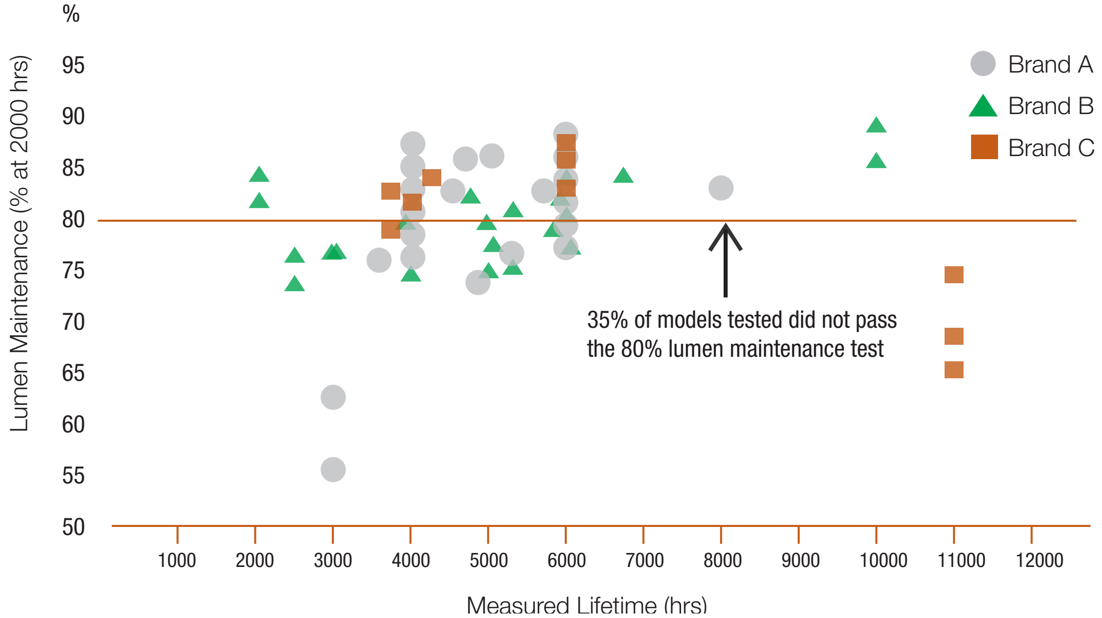
21. NL Agency, Netherlands IEA. (2010). End-Use Equipment Energy Efficiency Programmes. How Australia uses MVE in its equipment energy efficiency programme. London. Shane Holt. http://www.iea-4e.org/files/otherfiles/0000/0099/Shane_Holt.pdf
22. CLASP. (2010). Compliance Counts: A Practitioner's Guidebook on Best Practice Monitoring, Verification, and Enforcement for Appliance Standards & Labelling. Washington, DC: Mark Ellis and Zoe Pilven; Mark Ellis and Associates.

The data allow officials to benchmark the performance of lamps in their market against national, regional and international standards. Additionally, the pooling of test results can add to a common set of data by which other governments can benchmark the performance of lamps in their marketplaces. Some agencies lack the resources, authority, or available capacity for actual product testing. As a result, test data on lamps are available only sporadically, even as the number of brands and products proliferate.

Case Study: Philippines –Department of Energy CFL Testing Program[23]

The Philippines Department of Energy has one of the more comprehensive publicly available sets of tested CFL quality performance data within Asia. The data originates from the publicly funded and operated and accredited Lighting and Appliances Testing Laboratory. The Department tested 323 CFL models covering 27 brands available in the market during 2004 and 2005, and found that one-third of the models did not maintain light output satisfactorily over their average life.[24]

Figure 5: Results from Philippines Department of Energy testing of CFL performance



Source: Philippines Departement of Energy

3.3 Testing Activities and Services

The presence of inferior quality lamps in the market represents a significant barrier to the implementation of an effective energy efficiency programme. Products that do not perform as claimed decrease the actual electrical energy savings and climate change mitigation effects of efficient lighting programmes. Unless there is a means of checking the accuracy of energy label claims or MEPS, there can be only limited enforcement. Testing activities and related services are a key element to ensure performance and quality of lamps and the success of inefficient lamp phase-out programmes. Testing activities should support manufacturing, provide market access, and ensure market protection as part of a comprehensive MVE programme. As part of a National Efficient Lighting Strategy regulators should:

- Adopt internationally-recognized testing protocols for measuring the performance of lighting products
- Encourage the adoption of these testing protocols by local testing services
- Provide input to the process of developing a systematic approach to international testing
- Coordinate testing and calibration of testing equipment, and, share data

3.3.1 Manufacturing Support

Valid market test data is required to support realistic standards for lamp performance. Additionally, manufacturers have access to information obtained from the research and development of new lamps, where prototypes and samples must be evaluated to verify actual performance versus design specification. Manufacturers also test and evaluate the performance of their products during manufacturing to assure consistent production and product quality.

Test results may be required by regulators and customers to demonstrate that a manufacturer’s product conforms to established performance specifications. Such substantiation is necessary when products are certified and the certification system requires the demonstration of a quality management system for production. Product certification marks provide clear evidence that a product has undergone independent, third-party testing and certification, performed by an accredited/recognized testing and certification organization. The display of certification marks may only be used on qualified products under license from the laboratory that tested the product and confirmed that it conforms to applicable national, international or other standards for performance, such as those of the International Organization for Standardization.

23. Data supplied by the Philippines Department of Energy to USAID.
24. USAID. (2007). Confidence in Quality. Retrieved on May 26, 2012. Retrieved from http://usaid.eco-asia.org/programs/cdcp/ConfidenceCFLQuality.html

To qualify for certification marks, manufacturers submit samples of their products to a testing laboratory. The laboratory evaluates these products under controlled conditions to determine whether they meet applicable standards for certification. Only product designs that successfully pass all required tests are entitled to bear the certification mark. To ensure that the product continues to comply with the applicable standards over time, the laboratory (as a certification agent) may conduct a series of unannounced, on-site inspections. If the inspection finds that a product does not meet the requirements during these follow-up inspections, corrective action is required which may include reworking, recalling and/or delisting the product. Valid market test data is also very useful in the case of a customer compensation claim where a manufacturer may have to prove the reliability of its testing as part of a legal proceeding.

Test results may also be mandatory for safety-related reasons. For example, the CE Marking system not only helps to reinforce the European Union's health, safety and environmental protection requirements, but also to support fair competition amongst suppliers who need to adhere to the same requirements (see below).

European Union - CE Marking

Manufacturers' Responsibility
The CE marking is always affixed by the manufacturer or an authorised representative, but only after the necessary conformity assessment procedure has been performed. This means that, before being affixed with the CE marking and being placed on the market, the product must be subject to the conformity assessment procedure provided for in one or more of the applicable directives. The directives establish whether the conformity assessment may be performed by the manufacturer or if the intervention of a third party (the notified body) is needed.

Importers' and Distributors' Responsibilities
While manufacturers are responsible for ensuring product compliance and affixing the CE marking, importers and distributors also play an important role in making sure that only products complying with legislation and bearing the CE marking are placed on the market. When goods are produced in third countries and the manufacturer is not represented in the European Economic Area, importers must make sure that the products placed by them on the market comply with the applicable requirements and do not present a risk to the European public. The importer must verify that the manufacturer outside the EU has undertaken the necessary steps and that the documentation is available upon request and should also make sure that contact with the manufacturer can always be established.

Further along in the supply chain, distributors play an important role in ensuring that only compliant products are on the market and must act with due care to ensure that their handling of the product does not adversely affect its compliance. The distributor must also have a basic knowledge of the legal requirements – including which products must bear the CE marking and the accompanying documentation – and should be able to identify products that are clearly not in compliance.

Distributors must be able to demonstrate to national authorities that they have acted with due care and have affirmation from the manufacturer or the importer that the necessary measures have been taken. Furthermore, a distributor must be able to assist the national authority in its efforts to receive the required documentation.

Verification of compliance with applicable quality and safety specifications is generally carried out by a third party, usually an independent test laboratory. Certification bodies may either run their own test laboratories (testing and certification needs to be organizationally separated) or obtain test results from accredited test laboratories. Laboratories must implement and maintain a quality management system according to ISO 17025.

To begin the product testing and certification process, a product manufacturer may request a project estimate from one or more laboratories. Once the manufacturer receives the estimate(s), they choose a laboratory based on factors such as price and delivery time. The manufacturer provides product samples to the laboratory along with data such as a materials list, schematic diagrams and information about the components used in the product. Upon successful completion of evaluation and testing, the manufacturer will receive confirmation from the laboratory, typically in the form of a descriptive test results report, which specifies that the product does comply with the applicable requirements. The product will then be publicly listed by the certification body, and the manufacturer can label the product with the certification mark.

Listed and labelled: what is the difference?

Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to an authority with jurisdiction for the evaluation of a product or service. Periodic inspection or evaluation is conducted and the listing states that the equipment, material or services either meets appropriate designated standards, or has been tested and found suitable for a specified purpose.

Labelled. Equipment or materials to which a label has been attached, or showing the symbol or other identifying mark of an organization that is acceptable to the authority with jurisdiction for the evaluation of a product. Periodic inspection of labelled equipment or materials is conducted the organization responsible for the label.

3.3.2 Market Access

Product testing and reporting is often required for registration of the product with a compliance program and to certify its adherence to the applicable performance and safety specifications thus, allowing market access. Many inefficient lamp phase-out programmes are based on MEPS and quality requirements for lamps that have to be met to allow access to market. These requirements are country dependent and may vary from one programme to another.

3.3.3 Variations in Scope

The scope of MEPS and labelling programmes for lamps includes integral lamp types where electronic control gear is integrated into the product and cannot be removed. Most programmes specify the lamp base type and size, and, the applications for the lamps, such as non-directional (omnidirectional) for household use, for indoor or outdoor use, and for general illumination or specialty purposes. Some programmes have different requirements for lamps with covers (for example, CFLs with a plastic or glass candle, globe or bulb-shaped cover).

3.3.4 Variations in Energy Efficiency Requirements

In almost all lamp MEPS and labelling programmes, energy efficiency is defined as initial luminous efficacy, measured in terms of the luminous flux or light output (lumens) of a lamp divided by the total input power demand (watts). The text below refers mainly to CFLs. LED lamp requirements and testing protocols are still being developed for international consensus.

To determine luminous efficacy for CFLs, two key test procedures are used: the most common procedure for is the International Electrotechnical Commission (IEC) 60969-2001 'Self-ballasted lamps for general lighting services - Performance requirements,' on which Australia, Brazil, China, EU, Japan, South Korea base their test procedures. The U.S.A. and Canada differ, following the American National Standards Institute ANSI C78.5-1997 test procedure. The primary difference is that the North American performance criteria include a rapid cycle or stress test and interim life test. With both CFL test procedures however, similar technical performance criteria is covered (albeit with differing values or sample requirements discussed below) and include lumen maintenance, average life, colour rendering index, power factor, mercury content, starting time and incandescent lamp equivalence (initial light output).

3.3.5 Technical Performance Criteria

Sample size: Despite similar test procedures, sample sizes differ between countries and thus may have implications for technical performance measurements and testing expenses. The EU requires the largest test sample size with 20 samples. China requires 12 samples, Brazil requires 11 and Australia, Canada and the U.S.A. require 10 samples.

Lumen maintenance: Lumen maintenance measures luminous flux or lumen output at a given time in the life of the lamp. It is expressed as a percentage of the initial luminous flux. Australia, Brazil, Canada, China, EU and U.S.A. require at least 80% initial output at 2000 hours.

Average life (also referred to as average rated life): An important performance criterion is the average life of CFLs, generally defined as the time at which 50% of a large sample of lamp units (operated on a specified on/off schedule) ceases to operate. Australia, Canada, China and EU set a minimum threshold of 6000 hours. Australia also specifies an average life of at least 10,000 hours for highest efficiency CFLs. The EU specifies a higher survival rate of 70% at 6000 hours in Stage 5 of its inefficient lamp phase-out MEPS programme. Brazil's specification is expressed differently, as one failure in 10 bulbs, after 2000 hours of operation.

Colour rendering: Colour rendering is measured as the lamp's ability to render true hues according to a colour rendering index (CRI) where a low CRI of 20 indicates poor colour rendering of illuminated surfaces and a rating of 100 means that there is no colour distortion compared to the light emitted by a standard lamp. Most CFL programmes require a CRI of at least 80.
Starting times: This is the amount of time it takes for a lamp to reach stabilized light output after being switched on.

Power factor: Most lamp MEPS and labelling programmes specify a power factors. Many set the minimum at 0.50 for CFLs less than 25W (above 25W > 0.90).

Mercury content: Mercury content of CFLs is a health and safety concern for consumers. Many programmes set a maximum mercury content level for CFLs. Of the programmes that regulate mercury content, all except the EU have set the mercury content limit at 5.0 mg for CFLs of input power demand less than 25 W. The EU requirement is more stringent at 4.0 mg for all CFLs (See Section 5).

Incandescent lamp light output comparisons ("equivalence"): To assist consumers who are accustomed to choosing lamps based on wattage and expected light output of incandescent lamps, many countries regulate the claims made for equivalency on lamp labels. Specific luminous flux values for claimed incandescent lamp equivalency values are included in the programmes of Australia, Brazil, EU, U.S.A. and others. The specific luminous flux values for a given incandescent equivalent wattage differ slightly between the programmes, due to variations in lamp products and typical electrical operating conditions for each country or region.

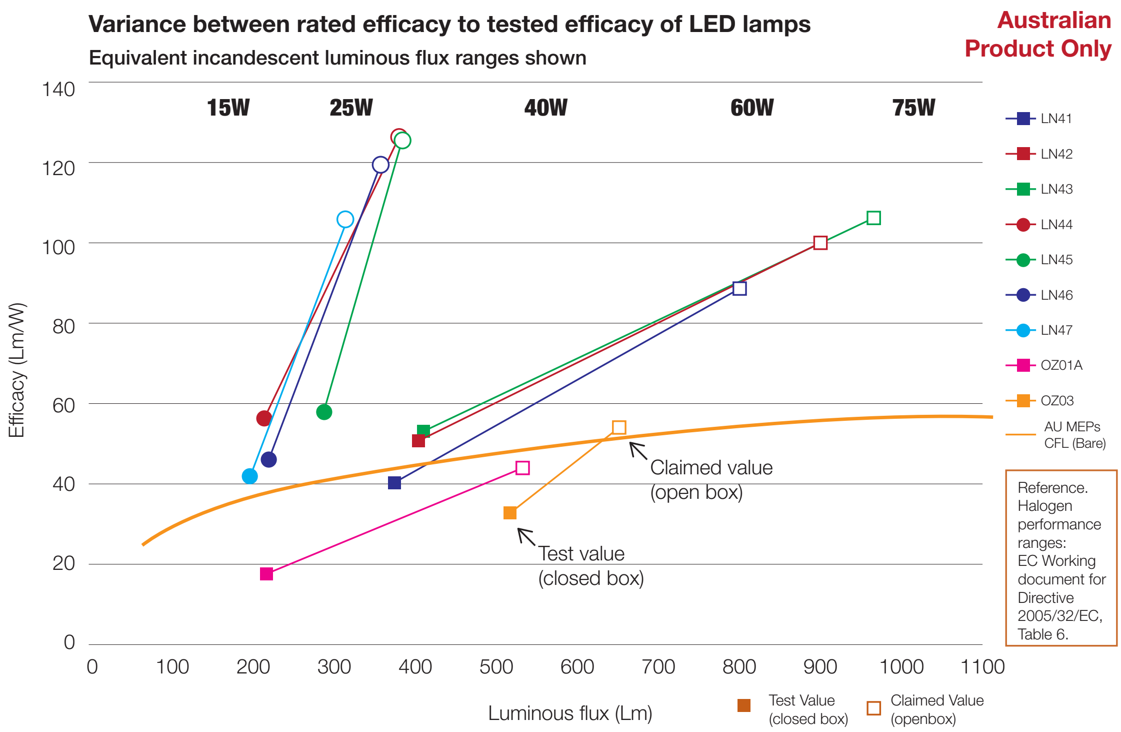
3.3.6 Market Protection

Regulators overseeing MVE implementation require some level of testing capacity to enable ongoing market surveillance and enforcement to ensure that lamps in the market remain compliant. Test results are used to confirm compliance or to request corrective action, such as the withdrawal of product certification in cases of non-compliance. Therefore, such tests should only be performed by accredited and competent laboratories, as withdrawal of certification has economic consequences for manufactures and so must be based only on reliable test results.

Case Study: Australia – Market Protection for LED Lamps in Australia

Australia's Department of Climate Change and Energy Efficiency continually tracks product efficiency claims and publishes reports of anonymous results to discourage exaggerated claims in the market by manufacturers. Figure 6, shows some results of the Department's testing of LED lamps.

Figure 6: Sample of typical test results published by the Department of Climate Change and Energy Efficiency



Source: Department of Climate Change and Energy Efficiency.

Compliance tests are sample based. The actual compliance of the mass-produced CFL with the specification needs to be assured by enforcement testing: product samples are bought randomly by the enforcement agency/certification body on the markets and are independently tested. Examples of a typical process to be followed include three main activities: product selection, product testing and evaluation, action in case of product failure.

3.3.7 Product Selection Includes:

Nomination: To increase the statistical significance of the results, generally a request is made for five samples for each selected product (in some cases, fewer samples may be supplied due to factors such as cost, size, and limited availability). If possible, the samples are procured from at least three retail/distribution channels at three geographic locations. This minimizes the possibility of selecting products from the same 'batch' and diluting the results.

Procurement: To increase the statistical significance of the results, generally a request is made for five samples for each selected product (in some cases, fewer samples may be supplied due to factors such as cost, size, and limited availability). If possible, the samples are procured from at least three retail/distribution channels at three geographic locations. This minimizes the possibility of selecting products from the same 'batch' and diluting the results.

Timing: Testing protocols and scope must keep pace with the rapid development of technology and the corresponding increase in the number of approved products.

3.3.8 Product Testing and Evaluation Includes:

Selection of a testing laboratory: Before procuring products, the responsible body selects one or more laboratories to conduct testing. Laboratory selection is based on several factors, including technical credentials, the ability to test the number of selected products within the given timeframe, and total cost to the programme. To maintain impartiality, manufacturer-based laboratories should not be considered.

Testing overview: All tests are conducted in accordance with relevant standards and include measurement of a number of metrics depending on the standards to be evaluated.

Evaluation of test results: For a product to retain its approved status and its right to use the label, the test results must comply with the labelling requirements.

3.3.9 Actions in Case of Product Failure:

Failure determination: Upon receiving notification of lamps that have failed to meet requirements, the responsible body needs to review the information to determine that the failure is not due to an administrative error, laboratory error, or performance deviation (within a tolerated range). In such cases, the organization may decide that no further action will be taken.

Supplier notification and dispute process: If upon review, the responsible body determines that the failed product warrants disqualification, they then notify the manufacturer and provide an adequate period for their response analysis on the product, including re-testing. If the product passes the re-test, then no additional actions will be needed.

Disqualification process: If the product fails the requirement re-test, then the responsible body will need to complete the pre-determined disqualification procedure. These actions can include: the immediate cessation of unit shipment and labelling, removal from the MEPS registry, and removal of MEPS or qualification references from related marketing materials

3.4 Types of Laboratories and Accreditation Systems

Laboratories are independent organizations accredited by various governmental or national bodies to provide testing to national, regional or global standards. These laboratories are used by manufacturers to test products and certify that the products meet applicable standards. When a product is certified, the manufacturer is licensed to use the appropriate approval mark issued by the certification body. The laboratory also makes available to the public a list of the products it has certified.

The services offered by the laboratories include testing and/or certification of the original product design ('prototype') and regular follow-up inspections conducted at the factory where the mark is applied to the product to ensure that the products continue to conform to the standards.

3.4.1 Types of Laboratories

Various testing activities require different types of laboratory facilities and equipment. All testing laboratories should produce reliable and consistent results. However, the level of accuracy and formal laboratory accreditation required depends on the testing activity being undertaken. Generally laboratories are only capable of and certified for providing testing for a certain type of lighting product, material or performance factor, and may not necessarily be qualified for testing other lighting products or materials.

A laboratory may offer services related to photometric and radiometric light measurement techniques for lamps and lighting systems.

These include:

- Determination of luminous flux of lamps and systems
- Determination of luminous intensity, illuminance, and spatial light distribution patterns
- Determination of spectral radiant density
- Calculation of lamp characteristics based on measured spectral power distribution, such as colorimetric values of lamps
- Colour rendering of lamps
- Standardized biological characteristics of light sources with regard to skin and eyes
- Threshold-limiting change of colour of standardized materials
- Determination of light and radiation-related characteristics for lamps based on product standards, guidelines and directives
- Determination of spectrally resolved reflection and transmission properties of planar materials

Usually lamps are operated in standardized conditions according to IEC specifications.

3.4.2 IEC 17025 Requirements

There is no standard dedicated solely to lighting-specific testing laboratories. However, the international standard BS EN ISO/IEC 17025:2005, 'General requirements for the competence of testing and calibration laboratories' describes a comprehensive quality and management system for test and calibration laboratories for implementing a quality system which improves their ability to consistently produce valid results.

This standard is comprised of two principal sections, Management Requirements and Technical Requirements. The former aligns broadly with ISO 9001, 'Quality management systems', and is related to the operation and effectiveness of the quality management system within the laboratory. The latter covers issues such as: the technical competence and ethical behaviour of the staff; participation in proficiency testing; and, the use of properly defined test/calibration procedures.

Some of the noteworthy elements of ISO/IEC 17025 include requirements that laboratories shall:

- Have a policy that sets out quality objectives, commitments and operational procedures
- Employ experienced personnel who have the education and training needed to conduct the tests
- Have the physical plant facilities and test equipment needed for proper testing
- Ensure that measuring equipment is accurate and calibrated and that calibration records are maintained
- Maintain a record of all original observations, test data and calculations
- Maintain arrangements to ensure the freedom of laboratory management and personnel from any undue internal or external commercial, financial or other pressures and influences that may adversely affect the quality of their work

Laboratories must consistently maintain the impartiality of product testing. Demonstration of impartiality that is consistent with the requirements of ISO/IEC1702 includes but is not limited to:

- Organization chart showing that the responsibilities, authorities, and inter-relationships of all personnel who manage, perform or verify laboratory results are free from influence that may adversely affect the quality of their work;
- Dates of internal audits, audit findings, and any corrective actions taken;
- Any customer complaints and corrective actions taken;
- Original testing records containing sufficient information for repeatability, including the names of staff who participated;
- Evidence that laboratory employees participate in and regularly pass ethics and compliance audits;
- Mechanisms are established for reporting and responding to attempts to exert undue influence on test results.

3.4.3 Laboratory Accreditation

Laboratory accreditation is the procedure by which an authoritative body gives formal recognition that an organization or person is competent to carry out specific tasks (ISO/IEC 17025, 2004). This is of particular importance for full procedure verification testing, as accreditation reinforces the integrity of the laboratory undertaking the tests; the results of which will form the main body of evidence in a major enforcement action. Laboratory accreditation is not only good for maintaining a laboratory's high-quality testing, but also beneficial for showing, enhancing and maintaining its capability.

Accreditation defines a laboratory's scope in terms of the standards that the laboratory is able to test against, i.e. the laboratory must specify which products and aspects of performance it is qualified to assess. Laboratories can be classified into three broad types based on their level of accreditation:

- Local, unaccredited
- Nationally accredited
- Internationally accredited

Local, Unaccredited Laboratories: These laboratories are usually manufacturer-run and are used for product development and internal quality control. There is generally no regulatory requirement for these laboratories to be accredited, although the operator may be required to prove the reliability of its testing if the quality of the product is called into question.

Nationally Accredited Laboratories: These laboratories can be manufacturer or government owned or independent, and are certified to the standard specified by a country's national accreditation body. This may be BS EN ISO/IEC 17025:2005 or a country-specific standard which details the laboratory requirements. These laboratories are normally considered appropriate for product quality testing for registration at the national level where joint recognition agreements exist. When laboratories are operated by manufacturers, it is typical that they are managed and operated independently from the company's manufacturing activities and they are not normally used for random national testing.

International Accreditation: Internationally accredited laboratories provide testing facilities that are able to certify the quality of products for registration at an international level and to randomly test products against national and international standards. International certification usually requires that the national body awarding the accreditation (usually to BS EN ISO/IEC 17025:2005) has, in turn been, accredited to the international standard, ISO/IEC 17011:2004, 'Conformity assessment - General requirements for accreditation bodies accrediting conformity assessment bodies'. This standard sets out a uniform set of requirements for organizations that verify the activities of conformity, from testing, inspection and management system certification to personnel and certification and calibration.

This guarantees that the individual accreditation bodies recognized under this standard are providing comparable service and acknowledge each other's accreditations. Thus, ISO/IEC17025 is also the basis for calibration and testing laboratory accreditation from an accreditation body but since it is about testing competence, accreditation is simply a formal recognition of a demonstration of such competence.

The ISO/IEC 17011:2004 by International Laboratory Accreditation Cooperation (ILAC) promotes the development of a global network of accredited testing, calibration and inspection facilities that can be relied on to provide accurate data. Working under the umbrella of ILAC, regional bodies have also been established to manage the activities required for mutual recognition of testing results. These include:

- European Co-operation for Accreditation (EA)
- Asia Pacific Laboratory Accreditation Cooperation (APLAC)
- Southern African Development Community Accreditation (SADCA)
- InterAmerican Accreditation Cooperation (IAAC)

4. Suggestions for Establishing MVE Programmes

1. Quality is essential – low quality products can critically undermine efficient lighting strategies and efforts to mitigate GHG emissions. Policymakers need to recognize that the prevalence of low-quality lighting products, including CFLs and LED lamps, constitute a significant barrier to the effectiveness of energy efficiency policies.

2. Governments should plan and budget for MVE activities. Consideration should also be given to whether these requirements need to be included within legislation or through administrative arrangements.

3. The lack of readily available records on MVE surveillance and verification activities suggests that there is more that can be done to publicize compliance processes and their results. Governments should maintain records of MVE programmes for lighting products, including surveillance and verification activities, and make them available publicly in order to highlight the risks of non-compliance.

4. Governments should also keep better records of enforcement actions and make them available publicly to ensure that stakeholders are aware of the range and frequency of enforcement activities.

5. Use available performance standards - an initial step for the harmonization process is the identification of common performance characteristics for lighting products that ensure energy, light output and lifetime performance.

6. Regionally shared testing – establishing reliable laboratory testing capacity from the ground up is very expensive and time consuming. In addition, the credibility of a facility's test results means that the laboratory must obtain accreditation at the local, national, or international level, which adds additional expense. It is more common for product testing to be performed at an international location, by an experienced, accredited laboratory with sufficient capacity and the ability to turn results around quickly. Countries within a region should therefore, share a common laboratory.

7. Use available regional and global programmes and institutions - there are many regional initiatives that can serve as vehicles for developing or strengthening regional harmonization efforts. The UNEP/GEF en.lighten initiative Global Partnership Programme provides technical advice to countries for the development and implementation of effective product quality surveillance mechanisms at national, regional and global levels and gives technical advice on how to establish national or regional lighting laboratories and quality management systems.

Conclusions

Successful MVE implementation requires long-term policy commitment, as well as investments in training and support at each implementation level. The UN has recognized the global threat associated with the proliferation of low-quality goods that are, generally in breach of technical regulations and intellectual property rights, sold at prices that exclude fair competition. These products can pose serious threats to human health and safety as well as generate pollution and contribute to environmental degradation.

At the country level, MVE is about measuring and ensuring compliance for energy efficient lighting products. This is especially critical to maximize the potential for energy savings and for the effective elimination or phase-out of the most inefficient lighting products by a MEPS programme. To counter the existence of poor product quality, a country's policy response should be to strengthen market surveillance to ensure that non-compliant lighting products are removed from the market through enhanced collaboration with regulators, public authorities acting in cooperation with industry, civil society stakeholders and others. This requires training for new programme managers. It also highlights the need for information sharing, inter- and intra-agency, and applying a checklist approach in order to avoid simple mistakes.

At the regional level, governments and lighting suppliers can work together to develop a common, harmonized approach to maximize available resources. Stakeholders within a region can work together and coordinate actions to increase MVE effectiveness. The sharing of information, harmonization of standards, and cross-border cooperation can result in a regional quality control system that significantly increases consumer confidence.

Section 5
Safeguarding the Environment and Health

Table of Contents

Introduction

Environmentally sound management incorporates the concept of life-cycle management, giving regulators a suitable framework to analyse and manage the performance of goods and services in terms of their impact on the environment. Life-cycle management can reduce a product's carbon, material and water footprints, and improve social and economic performance.[1] When life-cycle management is applied to lamps, performance should be analysed at the following stages:

- Lamp production
- Lamp usage
- End-of-life treatment of spent lamps

To optimize the life-cycle benefit of lamps, it is important to minimize the environmental impacts that occur during each phase of a lamp's life.

The phase-out of inefficient lighting is an effective solution to reducing energy consumption and, therefore, preventing climate change. From a life-cycle perspective, phasing out inefficient incandescent lamps and replacing them with CFLs and LED lamps significantly reduces CO_2 emissions and mercury pollution from fossil fuel burning. In all aspects of a lamp's life cycle, reducing electrical demand and hours of use are by far the most significant and positive changes to be made. However, because CFLs contain mercury, a more integrated policy approach is required, one that follows the principles of pollution prevention and environmentally sound management. This approach includes maximizing energy efficiency and lamp life and minimizing toxicity at the design and manufacturing stages, while instituting the sustainable management of spent lamps.

This is consistent with global international policies that reduce and safely manage hazardous waste, such as the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, and the on-going Intergovernmental Negotiating Committee's efforts to prepare a legally binding agreement on reducing mercury pollution.[2] Additionally, several national and regional collection systems have been mandated by law in the last few years to facilitate recycling of materials as well as safe disposal of hazardous substances contained in CFLs and other types of lamps.

The three phases of the life-cycle of lamps are:

Production: summarizes the various production techniques for metal filament (incandescent) lamps, CFLs and LED lamps and discusses hazardous substances, as the production phase is a natural point of intervention for hazardous substance regulators in the product life-cycle. Emphasis is placed on regulating the level of mercury in CFLs.

Usage: focuses on the environmental impact of lamps during the usage phase and health and safety aspects of lighting including the steps to take in case of the breakage.

End-of-Life: focuses on the end-of-life management of spent lamps, highlighting current regulatory frameworks, examples of best practices in establishing, managing and financing end-of-life collection; recycling and environmentally sound management; and disposal of mercury-added lamps.

1. Production

Different production techniques are used for metal filament lamps, CFLs and LED lamps. Each method has advantages and disadvantages from an environmental and performance standpoint such as dosing accuracy, as well as risks to human health during manufacturing. As with all manufacturing processes, occupational health of workers is very important and proper precautions and regular inspections by local enforcement bodies must be established.

The production phase is a natural point of intervention for hazardous substance regulators in the product life cycle. The European Union Restriction of Hazardous Substances (RoHS) Directive is considered the international benchmark for regulating use and level of hazardous substances in the electrical and electronic sector.

1.1 Lamp Manufacturing

1.1.1 Filament Lamps

The manufacturing technique of metal filament (incandescent and tungsten halogen) lamps is similar. These lamps use glass or quartz glass, a tungsten filament and an inert gas filling. The light emitting part is a tungsten wire mounted on metal guides and sealed inside a capsule. The glass capsule and (optionally) an outer glass bulb are heated in gas flames for shaping and fusing. If the lamp is simply a small capsule, metal lead wires protrude at the base to serve as electrical contacts. If the lamp has an outer glass bulb, a metal end-cap with a screw base or pin-base or other type of standardized connector makes the electrical contact. Some tungsten halogen lamps contain other components, including ceramics. Some contain a small amount of lead solder. The environmental impact of this

1. Power, W. (2009). Life Cycle Management: How business uses it to decrease footprint create opportunities and make value chains more sustainable. Paris, France: UNEP, Brussels, Belgium: SETAC.
2. Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury opted by the Conference of the Parties at the tenth meeting in 2011. Retrieved February 1, 2012, from: http://www.basel.int/Portals/4/Basel%20Convention/docs/techmatters/mercury/guidelines/UNEP-CHW-10-6-Add_2_rev_1.pdf

manufacturing process is mainly determined by the energy required to make and shape glass bulbs. Occupational health issues mainly are related to risks such as burns and mechanical safety of machinery.

1.1.2 Fluorescent Lamps

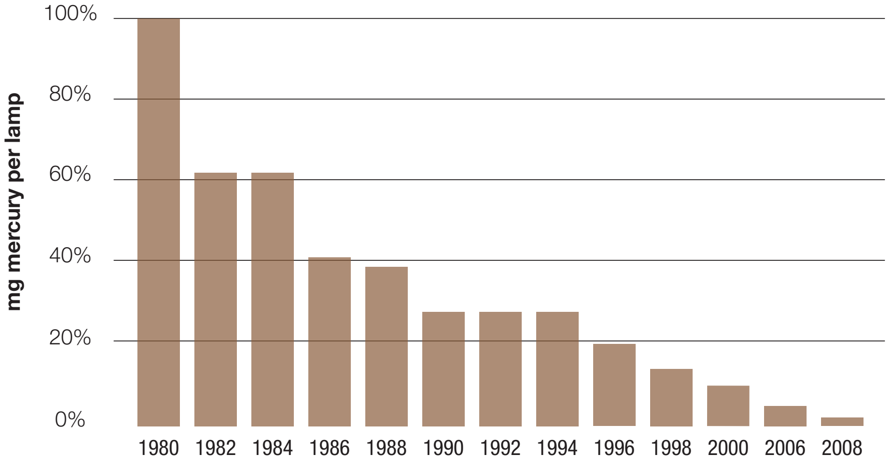
CFLs are made of glass, some metals (aluminum, nickel, iron, tungsten and sometimes lead), plastics, flame retardant chemicals and phosphors. The manufacturing of the CFL involves a specific process whereby the glass is shaped into a tubular form and the phosphor coating and electrodes are applied inside the tube. The assembly and soldering processes are similar to those used in the electronics industry where lead solder is used in many regions of the world but is increasingly being replaced by lead-free soldering technology. The phosphors help produce high lamp efficiency and colour rendering. The types and quantities of phosphors vary depending on the desired colour temperature and colour rendering. CFLs contain several grams of phosphors, depending on size and type.

All fluorescent lamps function similarly. Light is emitted when mercury vapour is excited by electricity running between two electrodes in the base of the lamp. The mercury vapour emits ultraviolet light (UV), which in turn excites the tube's internal phosphor coating, causing it to emit visible radiation (light). No other element emits UV in this way so it is essential to use a small amount of mercury in every fluorescent lamp. The mercury is "dosed" or inserted in pure liquid form, or, as a dosing unit (a mercury-containing component such as a capsule, ring, sponge, or, as an amalgam, a stable solid that includes mercury combined with other metals.

Dosing Techniques Used in Manufacturing CFLs

Technological advancements in the lighting industry, driven by occupational health concerns, increasing public pressure, legislation and sometimes voluntary industry initiatives, have resulted in a significant reduction in the amount of mercury used in many types of fluorescent lamps over the last two decades.[3] These developments enabled new environmental regulations such as the European Union's Restriction of Hazardous Substances (RoHS)[4] to increasingly limit the allowable mercury content in CFLs. Manufacturers have developed technology that enables a small amount of mercury to be 'dosed' or placed inside a CFL. Modern dosing units present very low risk of exposure to workers when compared with less safe and older dosing techniques, such as manual pipette dosing in open air.

Figure 1: Reduction of the mercury content in fluorescent lamps over the last 28 years[5]



Manual Injection of Liquid Mercury

Manual liquid mercury dosing by a needle, "pipette" or sprayer in open air is an outdated technology that offers little control and is therefore considered a less accurate dosing method than modern techniques.[6] If proper precautions are not taken, manual insertion of liquid mercury in a lamp results in higher levels of mercury vapour in production areas and higher risk for the health and safety of workers.[7] The implication of use of this dosing technology is that it is virtually impossible to comply with legal requirements to dose mercury to amounts below 3 mg per lamp. This technique should be phased out. Countries should discourage the use of imprecise and unsafe manual liquid-mercury open-air dosing. This can be achieved by mandating lower mercury limits for lamps and by thorough MVE.

Dosing Units

Responsible lamp manufacturers have introduced several high-precision (amalgam and non-amalgam) dosing unit techniques. Dosing units contain a precise amount of mercury (in various forms, such as strips and pellets) which is then inserted into the lamp. Mercury is released from the integrated dosing units after the lamp has been sealed. The threat of mercury exposure to workers is therefore

3. ENERGY STAR. (2012). Frequently Asked Questions Information on Compact Fluorescent Light Bulbs (CFLs) and Mercury. Retrieved March 29, 2012, from: http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf
4. European Parliament and of the Council. (2002, February 13) Directive 2002/95/EC of The European Parliament and of The Council of 27 January 2003 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment. Official Journal of the European Union, L37/19-L37/23. Retrieved from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:037:0019:0023:en:PDF
5. European Lamp Companies Federation. (2011). Environmental Aspects of Lamps. Retrieved November 25, 2011 from: http://www.elcfed.org/documents/090811_elc_brochure_environmental_aspects_lamps_updated_final.pdf
6. Corazza, A., Boffito C. (2008). Mercury dosing solutions for fluorescent lamps. Journal of Physics D: Applied Physics. 41(14), 144007.
7. Liang Y-X, Sun R-K, Chen Z-Q, and Li L-H. (1993, February). Psychological effects of low exposure to mercury vapour: application of a computer administered neurobehavioral evaluation system. Environ. Res. 60(2), 320-327.

minimized and can be controlled by mercury vapour monitoring at sites and regular medical examination of employees. The dosing units are produced in specialized production facilities assuring high accuracy of mercury content and, therefore, enable low (<3 mg) amounts of mercury to be dosed into lamps.[8] Even amounts below 1.5 mg can be dosed with variability lower than 10%.[9] The dosing units are easily controlled and relatively safe when used in lamp production.

In many manufacturing countries, occupational safety laws regulate the handling of toxic materials. If a country has (or plans to start) CFL production, these laws should be revised to include provisions on lamp production to ensure safe working conditions.

Modern, precise mercury dosing methods offer compelling environmental, health and performance advantages over the use of older, manual liquid mercury dosing techniques. Countries should discourage the use of imprecise manual liquid-mercury open-air dosing – and encourage further the use of precise mercury dosing unit techniques

Some studies show the additional safety features that can be achieved from using amalgams. These include: lower ambient mercury emissions during production and in the event of lamp breakage; and, performance benefits such as more stable light output, wider optimum operating temperature range and better performance in higher temperature applications. These features enable CFLs to be used and operated efficiently in enclosed luminaires. However, according to some manufacturers, amalgam technique may affect the other performance parameters of CFLs, possibly causing slow starting behaviour and limited use in dimming applications. Nonetheless, by setting lower mercury limits in regulations, outdated dosing techniques, which are both less accurate and less safe, will no longer be feasible.

Significant efforts should be made to improve the fluorescent lamp manufacturing process and therefore reduce mercury emissions and health risks associated with mercury exposure of the workers. Within the fluorescent lamp manufacturing facility, mercury emissions may occur from “purification and transfer of mercury, mercury injection operation, and from broken lamps, spills and waste materials” causing not only air contamination but also potential health risk to the workers.[10] In cases of unsafe dosing techniques mercury workers are put under chronic, dangerous contact with mercury.[11]

1.1.3 LED lamps

The manufacturing of LED lamps involves a combination of different technologies. The LED chip is manufactured by the semiconductor industry, using many chemicals in a closed-cycle process that poses low exposure risk to workers. This is currently the most expensive step in the LED production process and it accounts for the higher price level for LED lamps versus CFLs.

The manufacture of the LED lamp is based on an electronics assembly process that may involve soldering. In the EU, the Restriction of Hazardous Substances (RoHS) Directive resulted in a nearly complete phase-out of lead content in many electronic products, where technically possible. This regulation also affects production outside the EU as many manufacturers offer RoHS-compliant lamps to customers worldwide. However, lead soldering is still used in many regions in the world to manufacture CFLs and LED and incandescent lamps.

A recent life-cycle assessment concluded that LED lamp product manufacturing uses approximately three times more energy than does the manufacturing of a CFL with comparable light output.[12] The study notes that the manufacturing phase represents approximately 8.8% of total life-cycle energy and is far outweighed by the use phase of LED.

2. International Best Practice for Regulating Hazardous Substances

2.1 The Importance of Regulating the Use and Levels of Hazardous Substances in Lamp Manufacturing

Technical advances in production processes and materials have enabled manufacturers to reduce the amount of mercury in CFLs without compromising light output or average life. The requirement to set strict mercury and other hazardous substance limits on CFLs is the foundation for an overall strategy to promote sustainable and efficient lamps.

With widespread adoption of CFLs and increasing government sensitivity to the mercury issue, activities have been started to reduce hazardous substances in mercury-added lamps. These include voluntary efforts in the U.S.A. such as ENERGY STAR and the National Electronic Manufacturer’s Association (NEMA) programme, as well as mandatory regulations promulgated in China, EU, and the State of California. The European Union’s Restriction of Hazardous Substances (RoHS) Directive is often cited as the best practice for reducing mercury in consumer products.

8. European Lamp Companies Federation. (2011). Round Robin Test report, Mercury Determination in Fluorescent Lamps. Retrieved March 29, 2012, from: http://www.elcfed.org/documents/Round%20Robin%20Test%20Report%201%2002.pdf
9. Corazza, A., Boffito C. (2008). Mercury dosing solutions for fluorescent lamps. Journal of Physics D: Applied Physics. 41(14). 144007.
10. Hu Y, Cheng H, Mercury risk from fluorescent lamps in China: Current status and future perspective, Environ Int (2012), doi:10.1016/j.envint.2012.01.006
11. According to UNEP/WHO (2008). Guidance for Identifying Populations at Risk from Mercury Exposure, The primary targets for toxicity of mercury and mercury compounds are the nervous system, the kidneys and the cardiovascular system. Exposure to very high doses can damage the lungs, causing inflammation, tissue swelling and even death. Chronic (longer-term) exposure can cause neurobehavioral effects, mood changes, and tremors and has also been associated with hypertension and autonomic system dysfunction.
12. U.S. Department of Energy. (2012). Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products. Retrieved March 10, 2012 from http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_LED_Lifecycle_Report.pdf

Most lamp manufacturers have begun to reduce the amount of mercury (see Figure 1) in CFLs. Safer production techniques combined with increasingly stringent hazardous substance requirements can effectively reduce per lamp mercury levels.[13 14]

This is consistent with the Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury, adopted by the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes (October 2011), which state, “Mercury content limits should be established for mercury-added products until such time as they can be banned or phased out because they result in less mercury used in the production stage, which, in turn, results in less mercury being emitted throughout the entire product life-cycle.”[15] Therefore, the most cost-effective approach is to globally implement a gradual reduction for mercury in CFLs, following international best practice and towards implementation of a global restriction of hazardous substances.[16]

2.2 European Union RoHS Directive

The EU’s Restriction of Hazardous Substances Directive (RoHS)[17] is considered to be one approach towards setting benchmarks for international best practice standards for regulating the use and levels of hazardous substances in the electrical and electronics sector. This Directive sets hazardous substance limits for all lamp types used for general and special lighting purposes. The RoHS Directive took effect on 1 July 2006. It was updated in September 2010 (effective January 2012), when more stringent mercury content limits for CFLs were added.[18] The requirements become law in all EU member states.

RoHS restricts the use of six hazardous substances (see Figure 2) in the manufacture of various types of electronic and electrical equipment. The RoHS Directive has effectively banned the introduction of new electrical and electronic equipment containing lead, cadmium, mercury, hexavalent chromium and both polybrominated biphenyl and polybrominated diphenyl ether flame retardants into the EU since 1 July 2006.[19]

Figure 2: Restricted substances referred to EU RoHS Directive and maximum concentration values tolerated by weight in homogeneous materials[20]

Substance	Tolerated mcv of substance by weight in homogeneous materials
Lead	0.10%
Mercury	0.10%
Hexavalent Chromium	0.10%
Polybrominated biphenyls (PBB)	0.10%
Polybrominated diphenyl ethers (PBDE)	0.10%
Cadmium	0.01%

RoHS limits the mercury content in CFLs to the extent technically feasible without impeding their energy efficiency or life expectancy. Manufacturers and importers need to ensure that all their products and components comply with the current requirements of RoHS, which went into effect on January 1, 2012. The maximum allowable limits for mercury and other hazardous substances in CFLs and other lamp types have been set. The annex of the Directive, establishing limits, is reviewed and updated every four years to account for technical progress.[21] This gradual approach takes into account any technological advances and new information.

A recent review of exemptions for certain applications containing lead, mercury or cadmium, found that the elimination or substitution of the use of those substances had become scientifically or technically possible. The end dates or numerical limits for those exemptions were consequently revised.

13. E3 Equipment Energy Efficiency. (2012). A Policy Makers Guide to Mercury in Compact Fluorescent Lamps. Retrieved March 29, 2012, from: http://www.energyrating.gov.au/products-themes/lighting/compact-fluorescent-lamps/documents-and-publications/?viewPublicationID=2441
14. Betne, R., Rajankar, P. and Tripathy, R. (2011). Toxics that glow: Mercury in compact fluorescent lamps in India. New Delhi, India: Toxics Link
15. Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury adopted by the Conference of the Parties at the tenth meeting in 2011. Retrieved February 1, 2012, from: http://www.basel.int/Portals/4/Basel%20Convention/docs/techmatters/mercury/guidelines/UNEP-CHW-10-6-Add_2_rev_1.pdf
16. European Parliament and of the Council. (2010, September 25). Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, amended by Decision 2010/571/EU of 24 September 2010;. Official Journal of the European Union, 2010/571/EU, Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2002L0095:20100925:EN:PDF
17. European Parliament and of the Council. (2002, February 13). Directive 2002/95/EC of The European Parliament and of The Council of 27 January 2003 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment. Official Journal of the European Union, L37/19-L37/23. Retrieved from: http://www.rohs.eu/english/legislation/docs/launchers/launch-2002-95-EC.html
18. European Parliament and of the Council. (2010, September 25). Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, amended by Decision 2010/571/EU of 24 September 2010;. Official Journal of the European Union, 2010/571/EU, Retrieved from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2002L0095:20100925:EN:PDF
19. European Parliament and of the Council. (2002, February 13). Directive 2002/95/EC of The European Parliament and of The Council of 27 January 2003 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment. Official Journal of the European Union, L37/19-L37/23. Retrieved from: http://www.rohs.eu/english/legislation/docs/launchers/launch-2002-95-EC.html
20. For the purposes of Article 5(1)(a) of Directive 2002/95/EC, a maximum concentration value of 0,1 % by weight in homogeneous materials for lead, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominateddiphenyl ethers (PBDE) and of 0,01 % by weight in homogeneous materials for cadmium shall be tolerated.
21. European Parliament and Council. (2010, September 25). Directive 2002/95/EC of the European Parliament and the Council of 27 January 2003 of the restriction of the use of certain hazardous substances in electrical and electronic equipment, Amended 25.09.2010, Retrieved from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2002L0095:20100925:EN:PDF

After an in-depth review and discussion of current data, the EU Commission adopted new, more stringent mercury-content limits in 2010. Below is a summary of the new limits on single-capped compact fluorescent lamps (including CFLs used for general and special applications), effective January 1, 2012.[22]

Figure 3: Maximum mercury level in the EU for single capped CFLs and dates of applicability

Lamp wattage	Maximum mercury level in single capped CFLs and dates of applicability
< 30 W	5 mg (Expires on 31 December 2011); 3,5 mg (After 31 December 2011 until 31 December 2012) 2,5 mg (After 31 December 2012)
≥ 30 W and < 50 W	5 mg (Expires on 31 December 2011); 3,5 mg (After 31 December 2011)
≥ 50 W and < 150 W	5 mg
≥ 150 W	15 mg

2.3 Other Relevant Laws and Voluntary Initiatives Addressing Hazardous Substances

Following the introduction of the EU RoHS regulation and its impact on the global supply chain, several countries, states and local governments have introduced legislation to set minimum concentration values for lead, mercury and other hazardous substances.

China

"The Administrative Measure on the Control of Pollution Caused by Electronic Information Products Ministry of Commerce, People's Republic of China, Administrative Measure on the Control of Pollution Caused by Electronic Information Products is a Chinese government regulation to control certain materials, including lead and mercury[23]. The manufacturer or importer of electronic products shall mark the products as to whether or not they contain the regulated substances. The Electronic Information Products label is used to mark parts and assemblies that contain acceptable amounts of substances identified by the regulations, and that are environmentally safe. Units that do contain hazardous substances are marked with the Environment Friendly Use Period value.

Currently there is one industry standard for the maximum mercury levels for CFLs sold on the domestic market, which is 5 mg for all CFLs (except the tricolour fluorescent lamps with the life time longer than 20000hrs, for which maximum level is 8 mg).[24] There is also a special certification system that encourages the purchase of the low-mercury containing CFLs (1.5 mg for <30 W and 2.5 mg for >30 W) and micro-mercury CFLs (1.0 mg for <30 W and 1.5 mg for >30 W).[25]

Colombia

According to RESOLUCIÓN No. 180540 issued by Ministry of Mines and Energy, from 1 January 2013 the permissible amount of mercury in CFLs is set at maximum level of 5mg.[26]

Russia

In 2011, the Russian Government adopted Decree No. 602 "On Approval of the Requirements to Lighting Devices and Electric Lamps Used in Alternating Current Circuit for Illumination" in which Annex 1 provides a specification for maximum levels of mercury and lead in compact fluorescent lamps. The requirements are similar to the revised EU RoHS levels. It sets 2.5 mg for lamps <30 W, 3.5 mg for lamps 30 W to 50 W, 5.0 mg for lamps of 50 W to 150 W and 15 mg for >150 W. The maximum quantity of lead cannot exceed 0.2% of the total weight of a CFL.[27]

South Korea

The Act for Resource Recycling of Electrical and Electronic Equipment and Vehicles[28] came into force in April 2007. This regulation has aspects of EU RoHS and WEEE Directive.

22. European Parliament and of the Council. (2011, July 1). Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment. Official Journal of the European Union, L174/88-L174/110. Retrieved from: http://Eur-Lex.Europa.Eu/Lexuriserv/Lexuriserv.Do?Uri=Oj:L:2011:174:0088:0110:En:Pdf.
23. Ministry of Commerce, People's Republic of China. (2012). Administrative Measure on the Control of Pollution Caused by Electronic Information Products. Retrieved March 27, 2012, from: http://english.mofcom.gov.cn/aarticle/policyrelease/domesticpolicy/200605/20060502132549.html.
24. CSSN. (2012). Retrieved March 27, 2012, from: http://www.cssn.net.cn/,
25. China Quality Certification Center. (2012). Certification Rules for Mercury Content for Compact Fluorescent Lamps. Retrieved March 17, 2012, from: http://www.cqc.com.cn/chinese/rootfiles/2012/01/16/1326647038362358-1326647038568331.pdf.
26. Ministerio De Minas Y Energia, Republica de Colombia. (2010). RESOLUCIÓN No. 180540. Retrieved March 27, March 2012, from: http://www.minminas.gov.co/minminas/downloads/archivosSoporteRevistas/7853.pdf
27. Energovopros Russia. (2012). Decree No. 602 "On Approval of the Requirements to Lighting Devices and Electric Lamps Used in Alternating Current Circuit for Illumination. Retrieved March 27, 2012, from: http://www.energovopros.ru/zakonodatelstvo/svet/20478/
28. IPC. (2009). Retrieved on May 21. 2011, from: http://leadfree.ipc.org/RoHS_2-1-5.asp

Turkey

The Turkish Government announced the implementation of e-waste legislation effective June 2009 that is similar to the EU RoHS 2002/95/EC.[29]

U.S.A.

In 2007, the State of California enacted A.B. 1109, which prohibits the sale of general purpose lamps "within California that do not comply with the EU RoHS Directive. This law has an effective date of January 1, 2010. A.B.1109 directs the California standards to be based on the RoHS directive 2002/95/EC[30], as amended.

As of October 4, 2010, NEMA has modified its existing voluntary manufacturer mercury content limit for CFLs. The previous 2007 agreement had set a maximum of 5 mg of mercury for CFLs under 25 W and 6 mg for CFLs from 25 W to 40 W. The updated agreement has lowered mercury content for CFLs under 25 W to 4 mg and a 5 mg limit for CFLs from 25 W to 40 W.[31]

Some states in the U.S.A., notably California[32] and Minnesota, have issued environmental specifications for the lamps offered on state purchase contracts, which set standards for energy efficiency, rated life, and mercury content. These states also require all CFLs offered on their purchase contracts to be ENERGY STAR-qualified. New Jersey issued a state-wide purchase contract for fluorescent lamps that required vendors to disclose each product's mercury content, lamp life, and efficacy; The state then used this information to choose products with the best overall environmental performance. These state purchase contracts do not require verification of mercury content levels, only declarations by manufacturers. In 2012, the State of Oregon adopted maximum mercury standards for CFLs, which allows a maximum of 4.0 mg for CFLs under 25 W and 5.0 mg for CFLs of 25 W to 40W.[33]

The U.S. Environmental Protection Agency and Department of Energy's ENERGY STAR program requires manufacturers applying for its label to agree to the NEMA voluntary mercury limits, by filing a signed commitment letter with the Association. This limit is currently under review, and EPA expects to lower this level in its next version of the ENERGY STAR specification so that the new levels are consistent with RoHS 2013 levels, 2.5mg for lamps up to 24 watts, and 3.5mg for all lamps above 24 watts. The ENERGY STAR labelling programme is voluntary and does not require independent verification of mercury content levels.

2.4 Suggestions for Reducing Mercury Levels

Reduce mercury levels in energy efficient lamps should involve these important considerations:

- Countries should limit the maximum amount of hazardous substances in lamps to reduce the potential for exposure during the manufacture, transportation, storage, use, and end-of-life management of CFLs. This should be done in a gradual manner taking into account national and economic conditions and considering global best practice.

- The European Union RoHS Directive is generally considered to be international best practice in setting hazardous substance requirements. It fixes an aspirational target that establishes progressively lower levels of mercury in CFLs and is regularly reviewed to account for technical progress. This approach minimizes the mercury and lead content of lamps, enabling the non-hazardous materials - notably metals and glass - to also be reused and recycled thereby, reducing the resources needed to produce new lamps.

- Mercury limits in developing countries should be gradually aligned with the current limits adopted in the EU RoHS Directive and other similar standards being adopted elsewhere in the world.

- Efforts should be made to prevent products that fail to meet the current RoHS standards from being sold in developing and emerging nations through the development of a monitoring, verification and enforcement system.

- Countries should follow IEC 62554 "Sample preparation for measurement of mercury level in fluorescent lamps" and IEC 62321 "Electrotechnical products - Determination of levels of six regulated substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ethers)" test methods for the measurement of mercury.

- There is a need to raise awareness among end users about high-quality, low mercury lighting products to guide their purchasing decisions and public procurement.

- Public information campaigns should address concerns about mercury in CFLs, and, should provide information about how to properly handle lamps (see Section 6).

- Establish an appropriate market surveillance process in countries to assure that the intended mercury reduction targets will be met by manufacturers and importers.

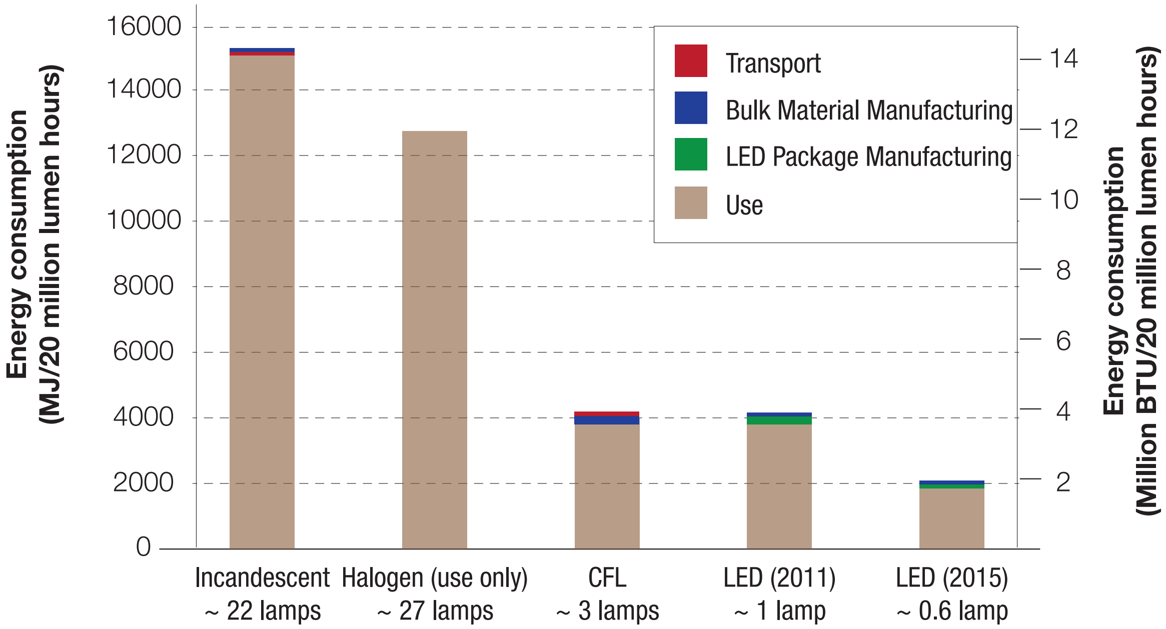
29. RoHS Guide. (2012). Other RoHS Green Initiatives Worldwide. Retrieved May 21, 2011, from: http://www.rohsguide.com/rohs-future.htm
30. Californian Department of Toxic Substances Control. (2012). Restrictions on the use of Certain Hazardous Substances (RoHS) in Electronic Devices. Retrieved May 20, 2011, from: http://www.dtsc.ca.gov/HazardousWaste/RoHS.cfm
31. NEMA. (2012). Voluntary Commitment on Mercury in Compact Fluorescent Lamps. Retrieved May 20, 2011, from: http://www.nema.org/Policy/Environmental-Stewardship/Lamps/Pages/CFL-Mercury.aspx
32. California Department of General Services. (2012). State of California, Department of General Services, Bid Specification: Lamps. Retrieved March 27, 2012, from; http://www.documents.dgs.ca.gov/pd/epp/BuildingandMaintenance/Lamps/DGS6240-0587R2.pdf
33. State of Oregon. (2012). Senate Amendments to Senate Bill 1512. Retrieved March 18, 2012, from: http://www.leg.state.or.us/12reg/measpdf/sb1500.dir/sb1512.1sa.pdf

3. Usage

3.1 Environmental Impact of Lamps during the Usage Phase

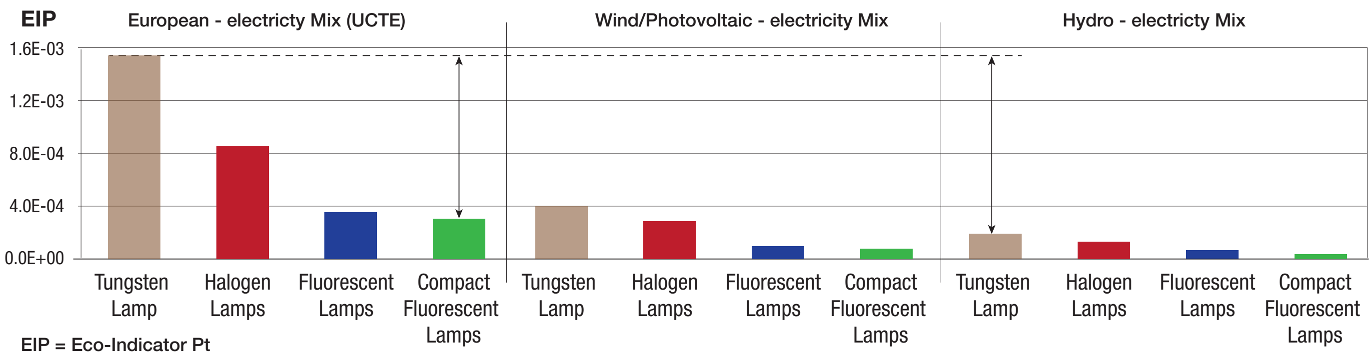
A recent metastudy reveals that approximately 90% of the total impact of a lamp on the environment occurs in the usage phase due to electricity consumption.[34] As Figure 4 below illustrates, the average life-cycle consumption of LED lamps and CFLs represent only 25% of the energy consumption of incandescent lamps of similar light output.

Figure 4: Life-cycle energy of incandescent lamps, CFLs, and LED lamps[35]



Coal-fired electricity generating stations are one of the main sources of GHGs. A large portion of electricity in the developing world is produced from coal. A coal-fired power station burns approximately 500 kg of coal to power a 100 W incandescent lamp during an average 1000 hour life. An efficient LED lamp would require 70 kg of coal and a CFL would require 100 kg to generate the quantity of electricity needed to illuminate the lamp over their much longer average life spans. Thus a simple switch from incandescent lamps to LED lamps or CFLs will result in substantial reductions of CO2 emissions. Even for those countries that have 100% renewable sources of electricity, the environmental impact is still in favour of energy efficient lamps.[36]

Figure 5: Environmental performance for the functional unit of one hour of lighting under consideration of renewable and non-renewable electricity mixes[37]



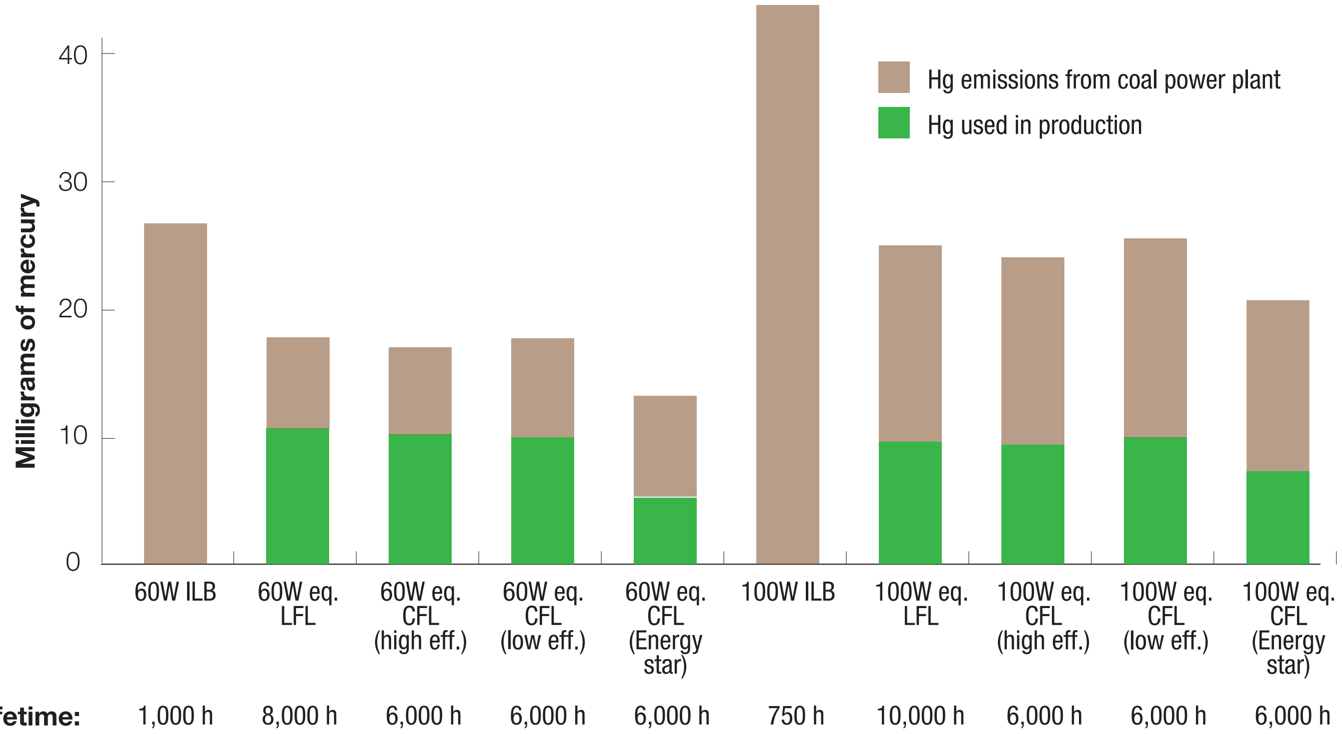
Some end users may voice concerns about environmental impact of CFLs. CFLs do not release mercury during the usage phase, unless the lamp is broken during installation, storage or transportation. Considering the amount of mercury released during electricity generation (especially when coal is the primary power source) and since CFLs use considerably less electricity than incandescent lamps for the same light output, using CFLs will reduce the overall amount of mercury released into the environment.

A recent study shows that fluorescent lamps can reduce by 75% the mercury emitted to the environment, through electricity generation, compared to incandescent lamps, when the lamp mercury is fully recycled. Even without lamp recycling, the combined mercury

34. U.S. Department of Energy. (2012). Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products. Retrieved March 10, 2012 from: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_LED_Lifecycle_Report.pdf
35. U.S. Department of Energy. (2012). Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products. Retrieved March 10, 2012 from: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_LED_Lifecycle_Report.pdf
36. Welz T, Hischier R., M.Hilty L. (2011 April). Environmental impacts of lighting technologies — Life cycle assessment and sensitivity analysis. Environ Impact Asses Rev, 31(3), doi:10.1016/j.eiar.2010.08.004334-343.
37. Ibid

emissions from fluorescent lamps and from power plants over the lamps' lifetimes are significantly less than the emissions associated with incandescent lamps of similar light output.[38 39 40]

Figure 6: Comparison of total mercury emissions from common incandescent and fluorescent lamps[41]



To fully benefit from the transition to energy efficient lamps, to avoid future environmental and health risks and to comply with the upcoming Global Treaty on Mercury[42], countries should establish collection and recycling systems for CFLs and other mercury-added lamps.

3.2 Health and Safety Issues Associated with Mercury

3.2.1 Breakage

Analyses of various CFLs health risks conclude that with adequate ventilation and proper clean up, a broken CFL is very unlikely to lead to mercury exposure that creates any significant threat. The risks are associated with poor clean up and lack of ventilation. The most effective strategy to allay concerns associated with the use of CFLs is to provide accurate factual information describing the potential risks and put them into perspective, and also to provide clear, useful advice about how to prevent and address breakages. All fluorescent lamps contain small amounts of mercury that are essential for them to operate efficiently.

The mercury in an intact CFL poses no risk to consumers. A hazard may arise when the bulb is broken and mercury is released. Critical variables that influence the risk from a broken CFL include: the amount of mercury the bulb contains; the chemical and physical form(s) of that mercury; the fraction of mercury that escapes on breakage; the absorbency of the surface onto which mercury is released; how long mercury remains in or around the breakage site; environmental factors such as temperature, room volume, rate and timing of ventilation; and, most importantly, clean-up actions taken by the consumer. A broken CFL can release mercury vapour, which is of most concern within enclosed spaces without ventilation.

CFLs used in countries with maximum level regulation today typically contain less than 5.0 mg mercury. Older lamps and those made and sold in developing countries may contain significantly more.[43] In contrast, some household thermometers can contain 500 to 3,000 mg of mercury, and some older barometers and thermostats contain more than one gram of mercury.[44] CFLs account for some of the smallest mercury spills likely to occur in most households.

Many experiments have been carried out to measure the release of mercury from broken CFLs, and to monitor air levels and the impac

38. Hu Y, Cheng H. (2012). Mercury risk from fluorescent lamps in China: Current status and future perspective, Environ Int., doi:10.1016/j.envint.2012.01.006.
39. ENERGY STAR. (2012), Frequently Asked Questions Information on Compact Fluorescent Light Bulbs (CFLs) and Mercury. Retrieved March 27, 2012, from: http://www.energystar.gov/ia/partners/promotions/change_light/downloads/Fact_Sheet_Mercury.pdf
40. Natural Resources Defense Council. (2012). The Facts about Light Bulbs and Mercury. Retrieved March 27, 2012, from: http://www.nrdc.org/legislation/files/lightbulbmercury.pdf
41. Based on relevant Chinese standard (AQSIQ, 2002, 3003, 2009, 2010; SEPA, 1997a, 1997b) and the Energy Star criteria (USEPA, 2010) over 6000 h of operation. The energy - savings of fluorescent lamps translate to avoided mercury emissions from power plants, which far outweigh the mercury emissions from their disposal.
42. UNEP. (2012). Intergovernmental Negotiating Committee. Retrieved March 27, 2012, from: http://www.unep.org/hazardoussubstances/Mercury/Negotiations/INC3/tabid/3469/Default.aspx
43. Betne, R., Rajankar, P. and Tripathy, R. (2011), Toxics that glow: Mercury in compact fluorescent lamps in India. New Delhi, India: Toxics Link.
44. Agency for Toxic Substances & Disease Registry. (2012). Children's Exposure to Elemental Mercury: A National Review of Exposure Events. Mercury Work. Retrieved March 27, 2012, from: http://www.atsdr.cdc.gov/mercury/docs/MercuryRTCFinal2013345.pdf

on exposure.[45] [46] [47] [48] [49] [50] [51] [52] [53] These studies provide a general picture of what can happen when a CFL breaks: an initial, rapid release of mercury vapour occurs over the first few minutes, producing a short-term "peak" level of airborne mercury which declines rapidly over the first hour. Next, a longer-lasting phase occurs in which mercury left in lamp debris slowly evaporates. During subsequent weeks or months, occasional short-term peaks of mercury in air may be created by vacuuming, sweeping, or by people walking on or otherwise disturbing the affected area.[54]

Most of the epidemiological evidence on health effects of exposure to mercury vapour comes from studies on workers exposed occupationally. There have been no studies on women and children exposed to elemental mercury spills in the home from CFLs. In the absence of evidence of health risks from a broken CFL on these most sensitive populations, precautionary measures are strongly encouraged. They should include instructions on how to carefully handle CFL to prevent breakage and in case of breakage what clean up procedures should be followed. Young children and pregnant women should not be involved in cleaning up broken CFLs.

3.2.2 Preventing Breakage

The most important strategy is to prevent CFL breakage in the first place. CFLs should be handled carefully when installing or removing them and allowed to cool before touching the glass. During installation, force should be applied to the ceramic or plastic base, not to the glass tube. Just enough force should be used to install them snugly and they should not be over tighten. They should be handled cautiously to avoid be dropped and a drop-cloth may be placed under luminaires when changing lamps to cushion them if dropped and to contain fragments and facilitate rapid debris removal if breakage occurs. CFLs should not be used in lamp fixtures that are unstable, likely to be knocked over, or in play areas or other locations where they may be bumped, jostled or struck by flying objects. CFLs that include a plastic outer envelope to protect the lamp can be used in such higher-risk areas. Spent CFLs should not be discarded in wastebaskets, where they can easily be crushed by trash added on top of them. Inquiries should be made locally for how and where used CFLs can be safely disposed.[55]

3.2.3 Best Practice Clean-up Procedures

Clean-up instructions should be easily accessible to all consumers. When a CFL is broken, the debris and mercury needs to be cleaned up, otherwise it remains in a room for an extended period of time. The EU Ecodesign regulation requires manufacturers to provide information on their websites about how consumers should clean up debris in case of CFL breakage.[56] They must include a link to the online information on the packaging of each lamp.

The information in Annex A draws upon the clean-up guidance offered by Australia, Canada, EU, U.S.A., the U.S. State of Maine and the Mercury Policy Project.[57] [58] [59] [60] [61] [62] Providing clean-up advice also reduces perceived dangers, because it empowers consumers to manage the risks effectively, and gives them control over the risk situation.[63] Regardless of the magnitude of the risk, consumers fear risks more, and may be more upset at being exposed to risks, when they feel information on the risk has been withheld from them or perceive that they cannot control the risk.[64] Good risk communication - explaining the risks and how to manage them - is fundamental to long-term consumer acceptance of CFLs (see Section 6).

3.3 Ultraviolet (UV) and Electromagnetic Fields (EMF)

The light emitted by CFLs differs from that of incandescent lamps in that CFLs emit more UV radiation. National authorities in Australia, Canada, the EU and the U.S.A. have reviewed consumer health concerns associated with CFL use and some investigations are still ongoing[65]. The EU's Scientific Committee on Emerging and Newly Identified Health Risks examined possible health risks of light emitted by CFLs, concluding that prolonged (> 8 hours) exposure to an unshielded CFL at very close distance (< 5 cm) could exceed occupa-

45. Aucott, M., McLinden, M. and Winka, M. (2004). Release of Mercury from Broken Fluorescent Bulbs. Environmental Assessment and Risk Analysis Element, New Jersey Department of Environmental Protection. Research Project Summary. Retrieved from: http://www.state.nj.us/dep/dsr/research/mercury-bulbs.pdf
46. Lindberg, S. E., K. Roy K., and J. Owens J. (1999). Oak Ridge National Laboratory (ORNL), Sampling Operations Summary and Preliminary Data Report for PaMSWaD-I, Brevard County Landfill. Oak Ridge, TN: ORNL
47. Johnson, N.C., et al. (2008). Mercury vapour release from broken compact fluorescent lamps and in situ capture by new nanomaterial sorbents contained breakages. Environmental Science and Technology, 42:5772-78.
48. Department of Environmental Protection, US. (2012). Remediation of Indoor Airborne Mercury Released from Broken Fluorescent Lamps. Retrieved March 27, 2012, from: http://www.dep.state.fl.us/waste/quick_topics/publications/shw/mercury/Mercury_CFL_Dynamics-final.pdf
49. Stahler, D., Ladner, S., and Jackson, H. (2008). Maine Compact Fluorescent Lamp Study. Augusta US: State of Maine, Department of Environmental Protection.
50. Nance P., Patterson J., Willis A., Foronda N. Dourson. (2012 April). Human health risks from mercury exposure from broken compact fluorescent lamps (CFLs). Journal Regulatory Toxicology and Pharmacology. 62(3):542-552.
51. European Comission. (2012). Scientific Committee on Health and Environmental Risks (SCHER) Opinion on Mercury in Certain Energy-Saving Light Bulbs. Retrieved March 29, 2012, from: http://ec.europa.eu/health/scientific_committees/environmental_risks/docs/scher_o_124.pdf
52. Stahler, D., Ladner, S., and Jackson, H. (2008). Maine Compact Fluorescent Lamp Study. Augusta US: Maine, Department of Environmental Protection.
53. Groth, E. (2008 February). Shedding Light on Mercury Risks from CFL Breakage. Montpelier, VT: Mercury Policy Project.
54. E3 Equipment Energy Efficiency. (2012). A Policy Makers Guide to Mercury in Compact Fluorescent Lamps. Retrieved March 29, 2012, from: http://www.energyrating.gov.au/products-themes/lighting/compact-fluorescent-lamps/documents-and-publications/?viewPublicationID=2441
55. U.S. Environmental Protection Agency. (2012). Cleaning Up a Broken CFL What to do if a CFL Breaks in Your home. Retrieved March 28, 2012, from: http://www.epa.gov/cfl/cflcleanup.html
56. European Commission. (2012). How to dispose of energy-saving bulbs. Retrieved March 28, 2012, from: http://ec.europa.eu/energy/lumen/overview/howtodispose/index_en.htm
57. US Environmental Protection Agency. (2012). Cleaning Up a Broken CFL What to do if a CFL Breaks in Your home. Retrieved March 28, 2012, from: http://www.epa.gov/cfl/cflcleanup.html
58. Groth, E. (2008 February). Shedding Light on Mercury Risks from CFL Breakage. Montpelier, VT: Mercury Policy Project.
59. European Lamp Companies Federation. (2011). The European Lamp Industry's Strategy for Domestic Lighting Frequently asked questions & answers on energy efficient lamps. Retrieved March 28, 2012, from: http://www.elcfed.org/documents/080613_ELC%20FAQ%20domestic%20lighting_external.pdf
60. Health Canada. (2012). The Safety of Compact Fluorescent Lamps. Retrieved March 28, 2012, from: http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/prod/cfl-afc-eng.php
61. Department of Climate Change and Energy Efficiency, Australian Government. (2012). Fluorescent lamps, mercury and end-of-life management – Fact sheet. Retrieved March 28, 2012, from: http://www.climatechange.gov.au/what-you-need-to-know/lighting/resources/fs.aspx#how
62. Calwell, V. (2011), Broken CFL clean-up guidance and other related research. Prepared for the US EPA Energy Star Program.
63. Covello, V. & Sandman, P.M. (2001). Risk communication: Evolution and revolution. Johns Hopkins University Press, 164-178.
64. Ibid
65. EU. (2012). Frequently asked questions about the regulation on ecodesign requirements for non-directional household lamps. Retrieved 10 November, 2011 from: http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/09/113 and http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_019.pdf

tional limits for UV exposure. However, this risk scenario seemed very unlikely under normal conditions of use.[66]. The EU Committee also concluded that in patients with light-sensitivity, symptoms could be aggravated by exposure to UV and blue light from CFLs. The emissions are substantially reduced by lamp designs that feature a cover. Some countries have also adopted UV emission limits forCFLs to address this concern. The same Committee review found no evidence that the flicker associated with light from CFLs posed any health risk to consumers[67]. The Committee notes that the use of double-envelope CFLs would largely or entirely mitigate both the risk of approaching workplace limits on UV emissions in extreme conditions and the risk of aggravating the symptoms of light-sensitive individuals.

For people with the skin sensitivities to UV, those who have lupus or another auto-immune disease that sensitizes them to UV, Health Canada recommends the following precautionary steps:

- Buy CFLs that are marked low UV
- Buy CFLs that have a glass cover, which further filters UV radiation
- Use additional glass, plastic or fabric materials in luminaires to act as UV filters
- Increase the user's distance from the CFL to reduce the level of UV exposure[68]

The integrated transformer in the base of a CFL emits electromagnetic fields (EMFs). EMFs from CFLs are well within the range of those produced by household wiring and many other common appliances. Extensive research has not demonstrated any adverse health effects caused by exposure to EMF. Nevertheless, national agencies and international organizations such as the International Commission on Non-Ionizing Radiation Protection have established safety limits for EMF exposure. These limits have been incorporated into EU legislation and endorsed by the World Health Organization and the International Radiation Protection Agency and include substantial safety margins.[69] [70] [71] [72] Compliance with these existing safety standards minimizes EMF from CFLs.

3.4 Suggestions for Usage

Ensuring good quality lamps in the market and verifying their compliance with maximum mercury limits is essential to minimize health and safety risks associated with the use of efficient lamps. Section 4 contains additional information on monitoring, verification and enforcement activities in the lighting sector.

- The most important advice that officials can give to consumers is to prevent breakage in the first place. Providing clean-up advice also reduces perceived risks, because it empowers consumers to manage the risks effectively, and gives them control over the risk situation[73]. Public participation activities, publications and educational programmes can be organized to explain how to prevent mercury exposure and other lighting health related issues.

- Risks need to be put in perspective. While the possibility may exist of adverse effects as a result of inhalation exposure to elemental mercury vapour in the case of breakage, based on currently available information, experts advise that those risks are much smaller than the demonstrable benefits, both for consumers and for the broader environment, primarily because of the reduction of emissions from electric power generation from fossil fuels.

- With adequate ventilation and proper clean up, a broken CFL is unlikely to create any significant risks. Risks are associated with poor clean-up and lack of ventilation. Consumers should be provided with instructions on how to cope with a broken CFL, and ensuring that the information is received and understood.

- When promoting CFLs, ensure adequate compliance with the country's existing health and safety related legislation and standards, such as mercury content limits for lamps.

4. End-of-Life

Various programmes for the environmentally sound management of mercury-added lamps have been implemented in many countries. Although this is a relatively recent area of focus for regulators, new information is being developed to ensure successful programmes. The Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury ("the Basel Guidelines") is an important agreement that was adopted in 2011 and provides guidance for many programmes.[74]

66. European Comission. (2012), Scientific Committee on Health and Environmental Risks (SCHER) Light Sensitivity. Retrieved 15 November, 2011, from: http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_019.pdf
67. Ibid
68. Health Canada. (2012). The Safety of Compact Fluorescent Lamps. Retrieved March 28, 2012, from: http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/prod/cfl-afc-eng.php
69. International Commission on Non-Ionizing Radiation Protection. (2012). Retrieved March 17, 2012, from: http://www.icnirp.org
70. The Council of European Union. (1999, July). Council Recommendation 1999/519/EC on the limitation of exposure of the general public. Official Journal of the European Communities, L199/59-L199/70. Retrieved from: http://ec.europa.eu/enterprise/sectors/electrical/files/lv/rec519_en.pdf ; and, European Commission. (2012). Healthy environments Policy. Retrieved March 28, 2012, from: http://ec.europa.eu/health/healthy_environments/policy/index_en.htm
71. The World Health Organization (WHO). (2012). Electromagnetic fields. Retrieved 15 October,2011, from: www.who.int/peh-emf
72. The International Commission on Radiological Protection. (2012). Retrieved March 17, 2012, from: http://www.irpa.net
73. Covello, V. & Sandman, P.M. (2001). Risk communication: Evolution and revolution. Johns Hopkins University Press, 164-178.
74. Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury adopted by the Conference of the Parties at the tenth meeting in 2011. Retrieved February 1, 2012, from: http://www.basel.int/Portals/4/Basel%20Convention/docs/techmatters/mercury/guidelines/UNEP-CHW-10-6-Add_2_rev_1.pdf

4.1 The Importance of Collection and Recycling Programmes

Improper handling, collection, storage, transportation or disposal of CFL waste can lead to releases of mercury.

Once mercury is released into the environment, it can persist in the atmosphere (as mercury vapour), in soil (as ionic mercury) and water (as methyl mercury). Some mercury may enter the food chain via bioaccumulation and biomagnification. At multiple points during handling within the waste disposal stream, mercury from cracked or broken CFLs can create potential health concerns and environmental releases if the lamps are mishandled and concentrated in large quantities. Waste consisting of elemental mercury or waste containing or contaminated with mercury should be treated to recover the mercury or to immobilize it in an environmentally sound manner.

Collection and recycling programmes for CFLs are also important because they:

- Promote the recovery of other materials found in end-of-life mercury-added lamps such as glass, ferrous and non-ferrous metals and phosphors that contain mercury. Some of these materials may be sold to lamp and glass businesses. Reuse of waste glass may offer secondary commercial opportunities in developing countries that decide to implement collection and recycling systems. Mixed glass is used, either directly or after appropriate pre-treatment, for glass products with lower purity requirements, or as an aggregate material in industrial processes.[75]

- Efficient CFLs use rare earth oxides in their phosphors. Hence, collection and recycling programmes may be able to offer waste back to industry, which is experiencing strong demand for rare earth materials. For example, collection and recycling service organizations in Europe have been approached by "upcyclers" to supply them with CFL waste.

- Spent LED lamps also contain electronic waste and other components which need to be collected and disposed in an environmentally sound manner.

4.2 Extended Producer Responsibility

"Extended producer responsibility" is defined as "an environmental policy approach in which a producer's responsibility, physical and/or financial, for a product is extended to the post-consumer stage of a product's life-cycle".[76] "Producer" is defined as one of the businesses putting products on the market (industry lamp manufacturers, traders, wholesalers and retailers). Take-back collection programmes may be part of extended producer responsibility schemes that offer various benefits:

- Relieve the local government of the financial, and in some cases, operational burden of the disposal of the waste/products/material
- Encourage companies to design products for reuse, recyclability, and materials reduction;
- Promote innovation in recycling technology[77]

Detailed descriptions of extended producer responsibility schemes are available in several OECD publications[78]. Extended producer responsibility depends on shared responsibilities among stakeholders, so that all parties in the chain are involved in and support the process. Stakeholders should participate in setting goals and objectives for programmes. Success of an extended producer responsibility programme is more likely if the public is informed about the programme's functional details and the roles and responsibilities of other parties. Businesses in the value chain can participate in establishing distribution and collection/recycling systems, supporting and refining those schemes, helping to meet cost objectives and promoting public participation.

Governments generally take the lead in establishing extended producer responsibility programmes through developing needed regulatory frameworks, treatment standards and market surveillance programmes; collecting data on programme performance; establishing lighting performance standards for longevity and toxicity; certifying and maintaining a list of qualified lamp recyclers; and encouraging participation by relevant parties and the public. Third parties often manage the collection systems and outsource the recycling/recovery operations for spent lamps.

The extended producer responsibility concept was introduced into legislation in the European Union through the RoHS Directive and the Waste Electrical and Electronic Equipment Directive (WEEE). The WEEE Directive, among others, led to the establishment of collection schemes for CFLs in each European Member State. Under these programmes, third-party operators are contracted to organize and finance collection and recycling of lamps at the end of their useful life.[79]

75. European Lamp Companies Federation. (2011). Environmental aspects of lamps (second version). Retrieved March 29, 2012, from: http://www.elcfed.org/documents/090811_ELC%20brochure%20on%20environmental%20aspects%20of%20lamps_updated_FINAL.pdf
76. OECD. (2001). Extended Producer Responsibility: A Guidance Manual for Governments. Paris, France: OECD.
77. Ibid
78. Ibid
79. European Commission. (2012). The Producer Responsibility Principle of the WEEE Directive. Retrieved March 28, 2012, from: http://ec.europa.eu/environment/waste/weee/pdf/final_rep_okopol.pdf

4.3 Preventing and Minimizing Mercury-Added Lighting Waste

In addition to following the Basel Convention Guidelines, countries should consult and adhere to their specific national and local authority requirements.[80] The procedures for the handling, separation, collection, packaging, labelling, transportation and storage pending disposal of CFL waste are similar to those for other hazardous wastes. However, the establishment of a safe and closed system for utilization of mercury is desirable. Mercury contamination of waste streams should be prevented by setting maximum limits of mercury contents in products and procurement of low-mercury CFLs. Waste containing mercury should be separated and collected, and mercury should then be recovered from the waste and used for production (instead of using primary mercury) or disposed in an environmentally sound manner.

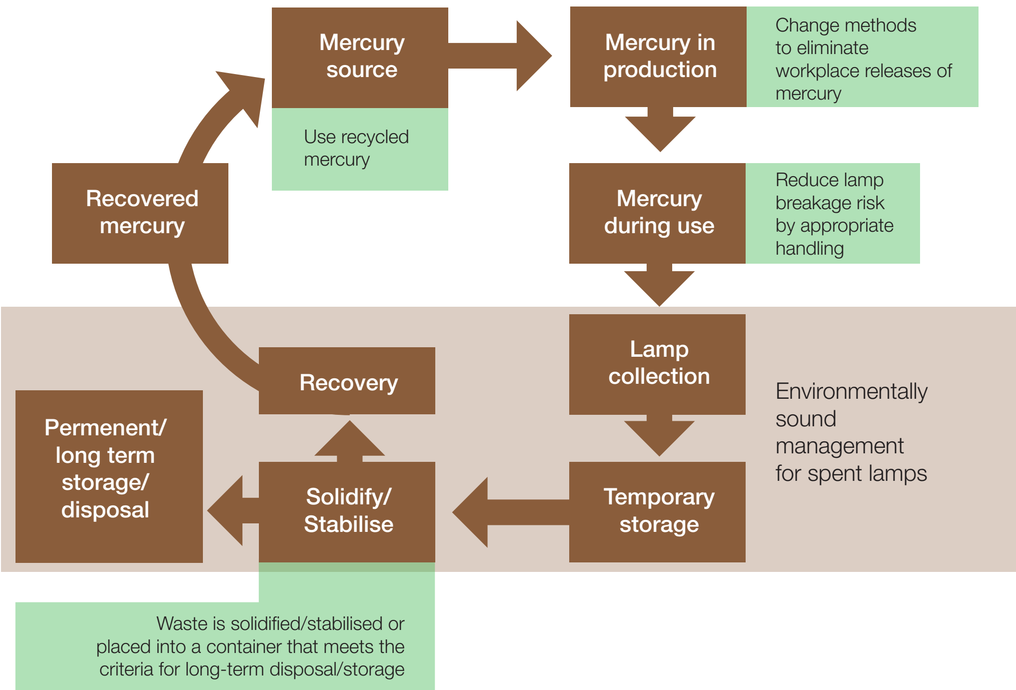
4.3.1 Collection and Management Procedures

The Basel Guidelines recommend the following procedures when implementing collection programmes for spent CFLs[81]:

- Advertise the programme, depot locations and collection time periods to all potential holders of such waste
- Allow enough time for the collection programmes to complete the collection of all such waste
- Include in the programme the collection of all such waste
- Make available acceptable containers and safe-transport materials to owners of any such waste that needs to be repackaged or made safe for transport
- Establish simple, low-cost mechanisms for collection
- Ensure the safety both of those delivering such waste to depots and of workers at the depots
- Ensure that the operators of depots are using an accepted disposal method
- Ensure that the programme and facilities meet all applicable legislative requirements
- Ensure separation of such waste from other waste streams.

Waste containing mercury should be discarded in a specially designed container at a collection station or depot to avoid mixing it with other wastes. Waste containing mercury should be collected by those authorised by local governments or appropriate authorities. To minimize release to the environment at every stage, CFLs should be collected intact to avoid breakage, carefully stored and transported for environmentally sound management as outlined in Figure 7 below.

Figure 7: Life-cycle management of mercury-added lamps[82]



4.3.2 Collection of Waste That Contains Mercury

The Basel Guidelines suggest three options for collecting waste containing mercury, such as CFLs:

- Waste collection stations or drop-off depots
- Collection at public places or shops
- Collection at households by collectors

80. Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury adopted by the Conference of the Parties at the tenth meeting in 2011. Retrieved February 1, 2012, from: http://www.basel.int/Portals/4/Basel%20Convention/docs/techmatters/mercury/guidelines/UNEP-CHW-10-6-Add_2_rev_1.pdf
81. Ibid
82. Ibid. (Adapted)

Waste collection stations or drop-off depots: Only waste containing mercury should be discarded in a specially designed container at a waste collection station or depot to avoid mixing waste containing mercury with other waste. It should be collected exclusively by those authorised by local governments or appropriate authorities/entities.

Boxes or containers for CFLs should be made available for public use at existing waste collection stations. Designated containers should all be the same colour and/or bear the same logo to facilitate public education and increased participation.
Breakage of CFLs should be avoided through appropriate box design and by providing written information on collection procedures. Collection containers should minimize the "free fall" of the lamp by installing soft, cascading baffles or flaps. Alternatively, a small open box could "invite" users to carefully place their spent lamps there without breaking them. Another option to minimize breakage is that the consumer hands the CFLs to competent and trained staff of a collection station who place the lamps in a box. If CFLs break, the area should immediately be ventilated and staff should follow clean up procedures.

Collection at public places or shops: CFLs may be collected together with other mercury containing waste via specially designed collection vehicles or at shops or public places such as town halls or other public buildings, utility offices or retail outlets, provided that appropriate collection containers are available. The fact that lamps should be separately collected should be also posted conspicuously at the retailer outlets. Only containers specifically designed for this purpose and shown to be capable of containing mercury vapour from broken lamps should be used in public collection locations[83]. Consumers should be able to take spent CFLs to those places free of charge. Authorised collectors, such as municipal collectors or private sector collectors (e.g. collectors trusted by product producers), should gather the waste in the waste collection boxes or containers.

Boxes or containers for waste containing mercury should be monitored to avoid any other waste being deposited in them. The boxes or containers should also be labelled and placed where they can be monitored in a well ventilated area, for example, outside the building in a covered and secure space.

Table 1: Drop-off centre option[84]

Collection option	Description
Retail outlets	Individual, general (e.g. supermarkets) or specialist (e.g. lighting shops, building suppliers) retailers. Points of sale of CFLs are considered logical drop off points, provided they are properly staffed. Advantages: Accessible. Retailers are interested and affected parties and perceived to have responsibility with regard to CFLs. More specifically, this is seen as a logical extension of concept of extended producer responsibility. Can integrate with select items from other mercury containing wastes.
Shopping mall	A single collection point positioned at a shopping mall. Advantages: As above for retailers. Disadvantages: Risks associated with safety. Shopping mall drop off points would only be acceptable if staffed.
24-hour operation centres	A 24-hour drop-off centre, often also a point of sale. As before only acceptable if staffed. Advantages: Accessible, 24-hour operation. Easy to integrate with other mercury containing wastes.
Buy-back centre	Centres that take back or purchase recyclable material as broker between public or salvager and material recycler. Advantages: Familiarity with waste, but possibly not with hazardous wastes. Often centrally located.
Utility facilities	Utility walk-in or customer centres function as drop-off centres for CFLs. Advantages: Assumed familiarity with CFLs and perceived responsibility for CFLs. Potentially good publicity. Proper operation is likely. Will not easily integrate other mercury containing waste types.
Municipal facilities	Municipal facilities include refuse sites and other civic amenities. Advantages: Usually under proper control. Even if not associated with municipal depots, they are usually staffed and controlled.
Mobile units	A secure, specially designed mobile container placed in a strategic location. Public brings CFLs, and other mercury containing wastes, to the unit where it is appropriately sorted and handled. Advantages: Secure and well staffed. Relocate regularly to address accumulated wastes. Limits requirement for permitting hazardous waste storage facilities.

Collection at households by collectors: To ensure efficient collection of waste containing mercury by local collectors, an initiative or legal mechanism will be required. For example, governments, producers of mercury-added products or other agencies will need to provide arrangements for the collection of waste containing mercury by local collectors.

83. Glenz, T. G., Brosseau, L.M., Hoffbeck, R.W. (2009). Preventing Mercury Vapor Release from Broken Fluorescent Lamps during Shipping. J. Air and Waste Management Association, 59, 266-272.
84. Southern African NGO Network. (2012). Recovery of Compact Fluorescent Lamps from the general household waste stream. Retrieved March 28, 2012, from: http://www.ngopulse.org/sites/default/files/Recovery%20of%20Compact%20Fluorescent%20Lamps%20from%20the.pdf

Table 2: Separate collection option[85]

Collection option	Description
Salvagers	Sidewalk collection of select material with recycling value by informal sector. Disadvantages: The health risk of repeat exposure to individuals.
Separate bag, collection with general waste	Separate colour-coded bags collected by standard waste collection service and either diverted to hazardous landfill/treatment facility or disposed at general landfill for recovery by landfill salvagers. Disadvantages: Logistics of diversion to hazardous landfill prohibitive. Recovery by salvagers at landfill presents same health and safety risks/challenges as above.
Dedicated CFL and household waste collection	CFL collected in coloured bags or specially provided bins by a dedicated service. Volumes expected to be small hence collection intervals extended. Disadvantages: Collection schedules potentially challenging and logistics costs very high.

4.3.3 Take-Back Collection Programme

Generally, take-back collection programmes focus on consumer products which are widely used, such as lamps[86]. Take-back programmes can refer to a variety of systems established to divert products from the waste stream for purposes of recycling, reusing, refurbishing or in some cases recovery. The programmes can be voluntary initiatives delivered by the private sector (e.g. manufacturers and in some cases retailers) which provide the opportunity for consumers to return used CFLs at the point of purchase or some other specified facility. Some take-back programmes offer financial incentives to consumers, some are mandated or operated by governments, and others can also partly finance disposal or recycling activities[87].

The selection of a collection scheme depends very much on national and culture context. For example, South African e-waste Association conducted a special study to select a suitable CFL recovery solution for the Western Cape among low, medium and high income groups. It discovered that for all income categories groups specially demarcated and suitably safe bins at central locations is an acceptable recovery option for spent CFLs. For most, points of sale or retailers would constitute a central location, but in the low income areas 'central' refers to 'within walking distance'. Mobile units would therefore represent a potentially plausible solution in lower income areas[88]. Similar studies may be necessary to conduct in countries where waste separation and recycling are unfamiliar and not generally practiced concepts.

4.3.4 Packaging, Labelling and Transportation

For transporting CFLs from generators' premises or public collection points to waste treatment facilities, the waste should be properly packaged and labelled. Packaging and labelling for transport is often controlled by national hazardous waste or dangerous goods transportation legislation, which should be consulted first. During transportation, such waste should be identified, packaged and transported in accordance with the United Nations Recommendations on the Transport of Dangerous Goods: Model Regulations (Orange Book)[89]. Persons transporting such waste should be qualified and certified as carriers of hazardous materials and wastes. Guidance on the safe transportation of hazardous materials can be obtained from the International Air Transport Association, International Maritime Organization, and United Nations Economic Commission for Europe and the International Civil Aviation Organization.[90] [91] [92] [93]

International standards have been developed for the proper labelling and identification of wastes. The following reference materials are helpful:

- UNECE (2003): Globally Harmonized System of Classification and Labelling of Chemicals.
- OECD (2001b): Harmonized Integrated Classification System for Human Health and Environmental Hazards of Chemical Substances and Mixtures.

85. Ibid
86. Honda, S. (2005). Study on the Environmentally Sound Management of Hazardous Wastes and Other Wastes in the Asia, Tsinghua University, Beijing, P.R.China, Postdoctoral Dissertation.
87. A study conducted by Sound Management of Mercury Products Project (DINAMA/UNEP/UNIDO/Basel Convention) in Uruguay shows that in case a financial incentive is used for a take-back program, the spent lamp should only have a discount value for a new one, but it should not have a exchangeable value (i.e: to allow to buy other things in a supermarket), because in such case the informal household waste collectors could start storing the lamps in non proper condition (at their homes). (Descripción de Posibles Alternativas Tecnológicas y Costos Asociados al Tratamiento de Lámparas Fluorescentes Descartadas, 2012).
88. Southern African NGO Network. (2012). Recovery of Compact Fluorescent Lamps from the general household waste stream. Retrieved March 28, 2012, from: http://www.ngopulse.org/sites/default/files/Recovery%20of%20Compact%20Fluorescent%20Lamps%20from%20the.pdf
89. UNECE. (2012). UN Recommendations on the Transport of Dangerous Goods (Model Regulations). Retrieved March 18, 2012, from: http://www.unece.org/trans/danger/publi/unrec/rev15/15files_e.html
90. IATA. (2012). Dangerous Goods Regulations Manual. Retrieved March 18, 2012, from: http://www.iata.org/ps/publications/dgr/pages/index.aspx
91. IMO. (2012). International Maritime Dangerous Goods Code. Retrieved March 18, 2012, from: http://www.imo.org/Safety/mainframe.asp?topic_id=158
92. UNECE. (2012). UN Recommendations on the Transport of Dangerous Goods (Model Regulations). Retrieved March 18, 2012, from:, http://www.unece.org/trans/danger/publi/unrec/rev15/15files_e.html
93. ICAO. (2012). Annex 18 - The Safe Transport of Dangerous Goods by Air. Retrieved March 18, 2012, from:, http://www.icao.int/safety/DangerousGoods/Pages/annex-18.aspx

4.3.5 Storage and Processing

It is important to properly store wastes consisting of elemental mercury and waste containing or contaminated with mercury after collection but before disposal. The technical requirements regarding storage of hazardous waste should be complied with, including national standards and regulations as well as international regulations. Information about storage and processing methods and guidelines can be found in Annex B.

Case Study – Multiple Countries – Minimizing Mercury-Added Lighting Waste

Australia[94]

Electronic waste has been on the agenda of the Australian Federal Government since the mid-1990s. The Australian and New Zealand Environment and Conservation Council (now replaced by the Environment Protection and Heritage Council) first identified e-waste as a concern. The Council, comprised of state, territory, and Australian Government environment ministers, has also examined end-of-life management for CFLs and mercury-added lamps. In July 2010, a voluntary, national scheme was initiated to increase mercury-added lamp recycling.

Waste disposal and handling is primarily a state and local government responsibility in Australia. The initial focus is on those sectors that account for the largest consumption of mercury containing lamps, the commercial and public lighting sectors. The scheme is a collaboration between industry and government, administered by Lighting Council Australia and sponsored by the Council. An alternative to landfill disposal is taking CFLs to specialty recyclers who are able to safely recover not only the mercury, but also the glass, phosphor and aluminium contained in the lamps. Recovered mercury is commonly sold to the dental industry, where it is used in amalgam for fillings.

China[95]

In October 2008, The Chinese State Council approved a "regulation on the management of electronic waste." Intended to promote the continued use of resources, this regulation requires the recycling and monitoring of the end-of-life treatment of electronics. Under this regulation, recycling will be conducted only by operators licensed by the relevant local authority department. A special fund for Waste Electrical and Electronic Appliance Treatment will be set up by these departments. Manufacturers will have to adopt product designs that feature nonhazardous treatment of resources; select non- or minimally hazardous and toxic materials or materials that are easily recycled and reused; and provide information on the product composition, recycling and treatment instructions associated with the product and materials. China's now has plans for 100 cities which have populations of more than one million people to have established collection and recycling centres and the separation of municipal and e-waste into different waste streams.

European Union

Several European countries implemented laws prohibiting the disposal of electronic waste (e-waste) in landfills in the 1990s. This action created an e-waste processing industry in Europe and began legal efforts for member nations to harmonize actions regarding e-waste management. Subsequently WEEE identified categories of electrical and electronic equipment and set collection, recycling and recovery targets for electrical and electronic equipment as part of a legislative initiative to solve the issue of increasing amounts of e-waste containing toxic materials such as mercury and lead.

The WEEE Directive aims to make equipment manufacturers financially or physically responsible for their products at the end-of-life under extended producer responsibility. Users of electrical and electronic equipment from private households should have the possibility of returning WEEE at least free of charge and manufacturers must dispose of it in an environmentally friendly manner, by disposal, reuse, or refurbishment. The WEEE Directive was made into national law by all member countries of the European Union, thus creating national compliance schemes.[96] These national schemes are not identical and vary and are adapted from country to country, but all must comply with the overall directives contained in WEEE and RoHS[97].

Since August 2005, EU electronics manufacturers have been financially responsible for compliance with the WEEE Directive. Under the Directive, each country recycles at least four kg of electronic waste per capita annually. The Directive is also expected to "decrease e-waste and e-waste exports."[98] The EU Environment Ministers are in the process of revising the WEEE Directive aiming at establishing collection targets of 45% for 2016 and 65% target by 2020.[99]

In Austria, for example, to ensure that consumers are encouraged to comply with WEEE directives on recycling, two fees totalling one euro are imposed simultaneously at point of sale. This deposit is returned to the consumer when the lamp is returned, and includes the recycling fee for the lamp. Both are indicated in a line item on the sales receipt. This programme has resulted in a more than a 50% return rate. Current recycling rates are estimated to be in the range of 80% of all retired mercury-added lamps.

94. Department of Sustainability, Environment, Water, Population and Communities, Australian Government. (2012). Safe disposal of mercury-containing lamps in Australia. Retrieved March 18, 2012, from:, Available at: http://www.environment.gov.au/settlements/waste/lamp-mercury.html
95. Ewaste Guide. (2012). China approves e-waste regulation—systems proposed, penalties established. Retrieved March 18, 2012, from: http://ewasteguide.info/china-approves-e-was
96. The new WEEE was adopted by the Council on June 7, 2012. Retrieved July 10, 2012 from: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/jha/130724.pdf
97. OSRAM AG. (2012). Local Recycling Partners. Retrieved March 18, 2012, from: http://www.osram.com/osram_com/sustainability/products/recycling/local-recycling-partners/index.jsp
98. European Commission. (2012). The Producer Responsibility Principle of the WEEE Directive. Retrieved March 18, 2012, from: http://ec.europa.eu/environment/waste/weee/pdf/final_rep_okopol.pdf
99. European Parliament. (2012). European Parliament legislative resolution of 19 January 2012 on the Council position at first reading with a view to the adoption of a directive of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE) (Recast) (07906/2/2011 – C7-0250/2011 – 2008/0241(COD)). Retrieved March 28, 2012, from: http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2012-0009+0+DOC+XML+V0//EN#BKMD-9

India

Commissioned by the Ministry of Environment and Forests, ELCOMA, and other civil society organisations, the Energy and Resource Institute has worked with interested parties in India to develop a national functional framework for managing spent CFLs and other fluorescent lamps.[100] Stages in development of the system incorporated:

- Inventory production and consumption of mercury-added lamps at national and state levels
- Evaluation of collection, disposal, and management options as they relate to current frameworks in legal, regulatory, and institutional structures at both national and selected areas
- Formulation of potential financial mechanisms related to the entire supply chain (collection, transportation and disposal) considering international best-practices and local conditions
- Survey and analyses of financial models for application at local, regional and national levels
- Feedback and opinions obtained from the public about the pilot programmes.

Initially, the Institute identified that over 90% of households either threw lamps in the trash or expected waste handlers to address the problem. About half of all those surveyed knew special handling was needed, with similar numbers indicating willingness to participate in programmes for spent lamp collection.

The most successful outcomes were from the Producer Responsibility System or "top prospect" program. Producers funded an initiative to establish a system with interested partners in government and the public to establish producer responsibility organizations. Technologies and incentives for enhancing collection activities were identified along with efforts to establish markets for the mercury-added lamp components. State level agencies ensured that service providers would respond to partners' needs - including development of enhanced collection strategies, marketing systems for materials and education of the public to improve diversion rates.

Japan[101]

Three laws in Japan reduce both the landfill and e-waste problems. The Law for the Promotion of Effective Utilization of Resources encourages manufacturers to help voluntarily with the recycling of goods and reducing waste generation. The Law for the Recycling of Specified Kinds of Home Appliances imposes more obligations on the recycling efforts of both consumers and manufacturers of used home appliances. The Soil Contamination Countermeasures Act of Japan, enacted in February 2003, formally recognized mercury as a specified toxic substance and raised awareness of the requirement to recover mercury contained in fluorescent lamps, which account for approximately 25% to 50% of the total mercury flow in Japan.[102]

Japanese officials estimate that the maximum total annual mercury use in all products in Japan is 20 tons per year, with approximately 0.6 tons per year being recycled. The leading mercury-containing product was mercury-added lamps, which accounted for approximately 5 tons per year with only 5% being collected. Local governments manage the majority of these lamps.

South Africa[103]

Before the introduction of the National Environmental Waste Act of 2008, South African waste management legislation was fragmented, lacked focus and was considered ineffective. There was no general practice of separate lamp collection and recycling.

The National Environmental Waste Act introduced extended producer responsibility for the management of hazardous waste, shifting responsibility for waste from government to industry. Further to this Act, the Department of Environmental Affairs invited the lighting industry, through the Illumination Engineering Society of South Africa, to submit an Industry Waste Management Plan for Lamps, as it also did with all other industries involved in waste management. Parallel to the Waste Act, the Consumer Protection Act of 2008 requires suppliers, producers, importers or distributors to accept and take responsibility for the disposal of any goods, such as CFLs, and requires collection facilities to be made available to consumers.

Since March 2009, the main lamp producers in South Africa and electricity producer, Eskom, initiated an extended producer responsibility project group. The Waste Plan deals with the legal obligations arising under both the Waste and the Consumer Protection Act

South Korea

The South Korean government has adopted extended producer responsibility approaches for fifteen products including CFLs and other mercury-added lamps[104]. The national system includes both a deposit/refund system and mandatory recycling regulations for some products.

Taiwan[105]

Taiwan has adopted a "zero landfill - total recycling" approach which requires the purchase of city-approved bags for waste pick-up by municipal solid waste trucks. Taiwanese lamp retailers face fines unless they accept lamps back for recycling. In 2007, Taiwan reported achieving an 80% recycling rate for mercury-added lamps.

100. Personal communication with TERI. PPT presentation provided by Sandeep Garg,Ph.D, Energy Economist, Bureau of Energy Efficiency, India Ministry of Power. August 29,2011.
101. Asari, M., Fukui. K, Sakai S. (2008, April 1). Life-cycle flow of mercury and recycling scenario of fluorescent lamps. Japan Original Research Article Science of The Total Environment, 393 (1), 1-10. Retrieved May 1, 2011 from: http://www.sciencedirect.com/science/article/B6V78-4RR20X5-1/2/3a65f4754a6743a013fc56bacbdea71e.
102. The mercury flow originating from these products was estimated to be about 10-20 tonnes annually, about 5 tonnes of which was attributable to fluorescent lamps, the major mercury-containing product in Japan.
103. Personal communication with Grant Thornton Belgium.
104. Ministry of Environment, South Korea. (2012). ECOREA Environmental Review 2007, Korea. Retrieved March 28, 2012, from: http://eng.me.go.kr/file.do?method=fileDownloader&attachSeq=1587.
105. Silveira, G. and Chang, S. (2011). Fluorescent lamp recycling initiatives in the United States and a recycling proposal based on extended producer responsibility and product stewardship concepts Waste Management and Research. 29(6), 656-668.

5. Financial Mechanisms and Responsibilities for Funding Collection Programmes

In all extended producer responsibility mercury-added lamp collection programmes, consumers will likely ultimately bear the costs. Issues that decision makers face designing collection schemes include when, to what extent and in what manner do consumers pay. Regulators should analyse the market and decide which stakeholders will support the program. A number of regulatory initiatives that stipulate the collection and recycling of all mercury-added lamps in line with extended producer responsibility norms, require producers to set up the system that will facilitate the collection and recycling for the lighting products. Major lamp manufacturers and national regulators have successfully established take-back infrastructures for mercury-added lamps in some countries.

In a non-regulated system, the costs for collection and recycling are not assigned. To ensure that spent lamps are sustainably collected and recycled, regulations should account for economies of scale, minimizing the costs to the end user. Information to purchasers and transparency of system finance costs on collection and recycling is also essential for the effective development of these systems. Consumers who are aware that a product needs to be recycled will tend to change their behaviour resulting in increased rates of collection of mercury-added lamps. Collecting mercury-added lamps together with other mercury containing waste via specially designed collection depots can also make the system more-cost effective.

Principal financing mechanisms include:

- Full cost internalization
- Visible and invisible advance disposal fee systems
- Deposit-refund systems
- Last-owner-pays systems
- Regional systems

5.1 Full Cost Internalization

Full cost internalization is the financing mechanism that best reflects individual producer responsibility, creating an incentive for competition and design improvement. Costs are passed on to end users but a company that can reduce its internal costs, through process redesign for example, can gain a market advantage. For CFLs, the primary costs are related to setting up the infrastructure, logistics and storage, whereas the cost for the treatment itself is relatively minor. Individual producer responsibility has not been implemented yet due to the significant higher cost structure for small producers and the lack of effective market surveillance systems.

5.2 Visible and Invisible Advance Disposal Fee

Industry-managed fees are called “eco-fees.” In a visible fee system, the consumer is aware that a specific amount of the purchase price of a product supports an end-of-life management system. Some programmes completely internalise the costs of end-of-life management within the price of the product, making it invisible to end users. The advance fees can be collected either directly from the consumer at the point of sale or can be collected from producers based upon their total sales. The advantage of a visible fee is that throughout the value chain no profits are calculated over the fee (by the value chain players) and that the use of the fee for environmentally sound management can be audited (no hidden tax for governments).

5.3 Deposit-Refund

In a traditional deposit-refund system, consumers pay a deposit at the time of purchase. They receive the same amount as a refund when they return the used product to the collection system. Most deposit-refund systems achieve very high collection rate because of the financial incentive to return. The high collection rate, in turn, encourages producers to maximise reuse opportunities, to improve the recyclability of the materials and to make the recycling as economically efficient as possible. Challenges with a deposit-refund system for CFLs would be the long delay (in years) before consumers received their refunds and, the complexity of setting up the system.

5.4 Last Owner Pays

This collective scheme determines flat fees to be charged to the last owner, the consumer. In this type of system, the price is set as close to the actual recycling cost as possible. When the infrastructure for end-of-life management exists, this payment system eliminates the problem of costs associated with pre-programme and “orphaned” products. However, these systems have had problems of consumers avoiding paying the fee by disposing of CFLs in the municipal waste stream and illegal dumping, including the bulk export of discarded products as recyclable materials.

5.5 Regional Collection and Recycling

The establishment of regional collection and recycling systems can be the optimal solution in cases where national approaches are not financially viable to support the recycling of lamps in one single country. Even though the Basel Convention and many national laws establish strict guidelines for the movement of hazardous wastes to other countries, exceptions can be made if certain conditions are met by the proposed programme. A country or group of countries planning to collaborate in the establishment of a regional recycling programme should consult with the Basel Convention Secretariat and its Regional Centers to obtain information.

6. Suggestions

Potential concerns about mercury-added lamps have resulted in viable methodologies and good practices for environmentally sound management of spent lamps. Collection and recycling systems coupled with technologies that capture and securely contain mercury can be effective. Further processing to recover mercury and recycle other lamp components is manageable and affordable if an appropriate system is designed and properly implemented.

Regulators can explore and adopt approaches that encourage the collection and recycling of mercury-added lamps. These approaches should be adapted to national conditions. If effectively designed and managed, they can also create jobs in collection and recycling.

To succeed, environmentally sound management programmes require sustainable funding, adequate legislation, the implementation of a comprehensive collection scheme, and community participation. Communication and ongoing awareness campaigns are required to increase and then maintain compliance.

Conclusions

During the transition to CFLs and LED lamps, interested parties may voice concerns about the potential impact of these products on health and the environment. CFLs do not release mercury unless the lamp is broken during installation, storage or transportation. Mercury releases from broken CFLs can be minimized by providing the public with information on how to prevent breakage and properly clean up and dispose of broken CFLs. The amount of mercury entering the environment from CFLs can be further minimized when the mercury is recovered from spent lamps.

The transition to efficient lamps significantly reduces the overall global emissions of mercury and GHGs. A recent scientific evaluation conducted by a committee of the EU concluded that the overall mercury balance is in favour of CFLs[106]. The significant environmental benefits of efficient lamps should be considered when making lighting policy decisions.

Raising awareness among consumers about high-quality, low mercury lighting products will help guide their purchasing decisions. Ensuring good quality lamps in the market and verifying their compliance with maximum mercury limits will minimize health and safety risks. When introducing new lighting-related laws, regulators should ensure adequate compliance with existing health and safety laws.

Countries are encouraged to adopt standards to gradually reduce and limit the amount of hazardous substances such as mercury, without compromising light output or life expectancy of lamps. The EU RoHS Directive is considered as international best practice in setting hazardous substance requirements, reducing the potential for exposure to six hazardous substances during the manufacture, transportation, storage, use, and end-of-life management of lamps.

Policy makers should consider regulations that limit the content of mercury and other hazardous substances in lamps. Limits should be set in line with the international best practice standards, aiming for progressively lower levels of mercury in CFLs. Limits should be reviewed regularly and adjusted to account for technical progress.

Approaches for the environmentally sound management of spent lamps should be coupled with technologies that capture and securely contain mercury vapour and residues. Further processing to recover mercury and recycle other lamp components is not only manageable, but affordable under the appropriate system. Regulators can explore and adopt approaches that encourage the collection and recycling of mercury-added lamps. These approaches should be adapted to national conditions. If effectively designed and managed, they can also create jobs in collection and recycling.

By following the Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury, mercury emissions from spent lamps can be virtually eliminated. Extended producer responsibility systems where all stakeholders share in the responsibility have proven to be most cost-effective. These systems can be funded in various ways, depending on country conditions and resources.

Environmentally sound management of lamps should be an essential aspect of any national efficient lighting strategy. To succeed, programmes require adequate legislative frameworks, sustainable funding, a comprehensive, and a supervised design approach combined with broad-based community participation and support. Communication and ongoing awareness campaigns are also essential to an integrated policy approach.

106. European Comission. (2012), Scientific Committee on Health and Environmental Risks (SCHER) Opinion on Mercury in Certain Energy-Saving Light Bulbs. Retrieved March 29, 2012, from http://ec.europa.eu/health/scientific_committees/environmental_risks/docs/scher_o_124.pdf

Annex A: Clean-up Procedures

The guidance from all expert sources is similar and has been summarized below.

Before clean up:

- Do not panic.
- Have people and pets leave the room.
- Avoid stepping on any broken glass.
- Immediately air out the room by opening a window or door to the outdoor environment. Leave the room for at least 15 minutes.[107] This will ensure that mercury vapour levels are reduced before one starts cleaning.
- Close doors to other rooms. If necessary to improve air flow out the window, leave an indoor door open slightly.
- Shut off any fans or central forced air heating/air conditioning systems.[108]
- Collect materials needed to clean up broken lamp:
  - Stiff paper or cardboard
  - Sticky tape (such as adhesive or duct tape)
  - Damp paper towels or disposable wet wipes (for hard surfaces)
  - Glass jar with a metal lid (such as canning jar) or sealable plastic bag(s)

During clean up:

- Wear disposable rubber gloves.[109]
- Do not use a vacuum cleaner, broom or dustpan to clean up; vacuuming can rapidly vaporize mercury and disperse it in the air.
- Use disposable clean-up material and follow the directions below. Contaminating your clean-up tools can spread mercury to other parts of the home.[110]
- Be thorough in collecting broken glass and visible powder.
- Place clean up materials in a sealable container, such as a glass jar with a screw-on lid.

Clean up procedure for hard surfaces

- Carefully scoop up glass fragments and powder using stiff paper or cardboard and place debris and paper/cardboard in a glass jar with a metal lid. If a glass jar is not available, use a sealable plastic bag. (NOTE: Since a plastic bag will not prevent the mercury vapour from escaping, remove the plastic bag(s) from the home after clean up.)
- Use sticky tape to pick up any remaining small glass fragments and powder. Place the used tape in the glass jar or plastic bag.
- Wipe the area clean with damp paper towels or disposable wet cloths. Place the towels in the glass jar or plastic bag.

Clean up procedure for carpeting or rugs

- Carefully scoop up glass fragments and powder using stiff paper or cardboard and place debris and paper/cardboard in a glass jar with a metal lid. If a glass jar is not available, use a sealable plastic bag. (NOTE: Since a plastic bag will not prevent the mercury vapour from escaping, remove the plastic bag(s) from the home after clean up.)
- Use sticky tape to pick up any remaining small glass fragments and powder. Place the used tape in the glass jar or plastic bag.

After clean up:

- Avoid leaving any lamp fragments or cleanup materials indoors.
- Promptly place all lamp debris and clean up materials outdoors in a sealed container or protected area until materials can be disposed of properly. This is the most effective way of reducing potential contamination of the indoor environment.
- Wash your hands with soap and water after disposing of the jars or plastic bags containing lamp debris and clean up material.
- Continue to air out the room where the lamp was broken and leave the heating/air conditioning system shut off for several hours.
- Check with your local, state or provincial government about disposal requirements in your area. Some areas require fluorescent lamps (broken or unbroken) be taken to a local recycling centre.

The sources of the above advice are all from developed countries, so while this advice has generic elements that are undoubtedly useful in a wide range of cultures and countries at varied stages of economic development, advice may need to be fine-tuned by national governments to make it more applicable to local conditions.

107. Please note EPA recommends only 5-10 minutes while European Lamp Federation recommends 20-30 minutes of room ventilation.
108. Mercury Policy Project also recommends using plastic bags and masking tape to seal off floor vents in the room with the broken lamp to prevent mercury vapour from moving through the heating cooling system to other parts of the building.
109. Mercury Policy Project also recommends using tweezers.
110. Australia and EPA recommends that If vacuuming is needed to ensure removal of all broken glass, the following tips need to be followed: Keep a window or door to the outdoors open; Vacuum the area where the bulb was broken using the vacuum hose, if available; and, Remove the vacuum bag (or empty and wipe the canister) and seal the bag/vacuum debris, and any materials used to clean the vacuum, in a plastic bag.

Annex B: Storage and Recycling of Mercury-Added Lamps (including CFLs)

The guidelines presented below are adapted from the Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury.[111]

Storage

Storage by waste generators pending collection means that waste containing mercury, including CFLs, is stored temporarily at the waste generator's premises before the waste is collected for disposal. Waste containing mercury should be stored safely and kept apart from other waste until it is brought to waste collection facility or picked up by collection programmes or contractors. Waste should be stored by generators for a limited time, as allowed by national standards, and sent off-site for appropriate disposal as soon as is practical.

Household waste containing CFLs should be stored temporarily after appropriately packaging the CFLs. Any CFLs that are broken in the course of handling should be cleaned-up and all clean-up materials stored outdoors until collection for further management.

Large-scale users such as governments, businesses and schools should have a plan to store large amounts of wastes containing mercury. Where original boxes or packages for the CFLs are not available, containers that are specially designed to store wastes containing mercury (such as fluorescent lamp containers) should be purchased.

It is important to properly store wastes consisting of elemental mercury and waste containing or contaminated with mercury after collection but before disposal. The technical requirements for storage of hazardous waste should be complied with, including national standards and national and international regulations. The risk of contamination to other materials should be avoided. In terms of sites and design, storage facilities should not be built in sensitive locations such as floodplains, wetlands, groundwater, earthquake zones, Karst terrain, unstable terrain or areas with unfavourable weather conditions and incompatible land use, in order to avoid any significant risks of mercury release and possible exposure to humans and the environment.

The mercury waste storage area should be designed to ensure that there is no unnecessary chemical or physical reaction to mercury. The floors of storage facilities should be covered with mercury-resistant materials. Storage facilities should have fire alarm systems and fire suppression systems and have negative pressure environments to avoid mercury emissions to the outside of the building. The temperature in storage areas should be maintained as low as feasibly possible, preferably at a constant temperature of 21°C. The storage area for wastes consisting of elemental mercury and wastes containing or contaminated with mercury should be clearly marked with warning signs. [112] [113] [114]

In terms of operation, storage facilities should be kept locked to avoid theft or unauthorized access. Access to waste consisting of elemental mercury and waste containing or contaminated with mercury should be restricted to those with adequate training for the purpose including in recognition, mercury-specific hazards and handling. It is recommended that storage buildings for all types of waste consisting of elemental mercury and waste containing or contaminated with mercury should not be used to store other liquid waste and material. A full inventory of the waste kept in the storage site should be created and updated as waste is added or disposed of. Regular inspection of storage areas should be undertaken, focusing particularly on damage, spills and deterioration. Clean-up and decontamination should be carried out speedily, but not without alerting the authorities concerned. [115]

In terms of safety for facilities, site-specific procedures should be developed to implement the safety requirements identified for storage of waste consisting of elemental mercury and wastes containing or contaminated with mercury. A workable emergency plan, preferably with multiple procedures, should be in place and implemented immediately in case of accidental spillage and other emergencies. The protection of human life and the environment is paramount. In the event of an emergency, there should be a responsible person who can authorize modifications to the safety procedures when necessary to allow emergency response personnel to act. Adequate security and access to the area should be ensured.

Recycling and Processing

Lamp collection and recycling systems are generally designed and operated by qualified and government appointed third parties. Suppliers of lamps form partnerships with certified or approved specialist disposal companies, as legally defined under national requirements. Through utilization of lamp processing equipment, the main objective of these systems is to prevent loss of mercury vapour and mercury-containing phosphor powder to the environment while recovering materials for primary recycling.
Mercury-added lamp waste management systems generally involve the following steps: crushing or shredding the lamps into small pieces; separating the crushed or shredded materials into different components for subsequent processing; mercury-recovery; and waste treatment and disposal processes for materials that remain, either before or after mercury recovery.
Mercury-added lamp recycling produces the following material streams: glass, ferrous and non-ferrous metals, and phosphor powders that contain mercury. Although these materials can be reused, most of them have little or no value and consequently, the recycler must recover processing costs from the generators. The efficient use of the recovered material requires ongoing cooperation between

111. Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury adopted by the Conference of the Parties at the tenth meeting in 2011. Retrieved February 1, 2012, from: http://www.basel.int/Portals/4/Basel%20Convention/docs/techmatters/mercury/guidelines/UNEP-CHW-10-6-Add_2_rev_1.pdf
112. Ibid.
113. U.S. EPA. (2012). Sensitive Environments and the Siting of Hazardous Waste Management Facilities. Retrieved March 1, 2012, from: http://www.epa.gov/osw/hazard/tsd/permit/site/sites.pdf
114. BASEL. (2012). Updated General Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of, Containing or Contaminated with Persistent Organic Pollutants (POPs). Retrieved March 30, 2012, from:, http://www.basel.int/Portals/4/Basel%20Convention/docs/pub/techguid/tg-POPs.pdf
115. U.S. EPA. (2012). Sensitive Environments and the Siting of Hazardous Waste Management Facilities. Retrieved March 1, 2012, from: http://www.epa.gov/osw/hazard/tsd/permit/site/sites.pdf

stakeholders, including lamp manufacturers and the recycling industry. Improvements in product design can further reducing or eliminate environmentally sensitive substances, reduce the variety of materials used and improve ease of disassembly.

Lamp glass from crushed mercury-added lamps can retain mercury, and for some end uses, should be treated thermally, or in other ways to remove mercury, before sending it for reuse or disposal.[116] If the glass is re-melted, the melting unit should have air pollution controls specifically designed to capture released mercury (such as activated carbon injection).

Phosphor powder is becoming a more valuable commodity as the value for rare earth phosphors increases. Limited available resources, trade issues and increasing costs are entering into greater demand for recycled rare earth phosphors.

Basic Elements of Lamp Recycling and Environmentally Sound Management Systems

Various methods for recycling of gas-discharge lamps are described in detail in the Basel Guidelines. They include the following:

- The shredder method, used for all types of discharge lamps, including energy-efficient lamps.
- The end cut method, for linear fluorescent lamps.
- The crush and sieve method, used for all types of fluorescent lamps.
- The centrifugal separation method, used for CFLs.
- The high intensity discharge lamp processor, used for high-mercury content lamps to help improve recovery and reduce cross-contamination of equipment.

Product-specific stripping methods yield maximum recycling rates. For example, the end cut method for linear fluorescent lamps recycles roughly 90% unmixed soda-lime glass, which can be fed directly back into the glass melting process and reused for lamp production. Crush and separation with air removal of phosphor has been identified as superior to acid wash systems. To prevent danger to workers and the environment, all lamp treatment processes need to be conducted in negative pressure systems which continually draw outside air into the machinery to ensure that no mercury (either in vapour form or as suspended phosphor powder) gets into the work area. In addition, special waste air purification systems to remove particulates and vapour from the exhausted air need to be in-place and operating properly.

Recovery and Solidification/Stabilization Processes

Systems recovering mercury for recycling employ a variety of techniques. The materials of concern include the mercury vapour, phosphor powder, arc tubes and other mercury-bearing waste. These can be treated by either roasting or retorting[117] to vaporize the mercury, which can then be recovered with vapour collection systems. Facilities for this step include rotary kiln and multiple hearth processes. These units emit mercury and organic substances also driven off by heat; emissions are present in both flue gas and fly ash, and exhaust gas treatment devices are therefore required. Mercury can also be recovered from exhaust gases when wastes are incinerated; this may be essential to minimize mercury pollution, although it is generally not a cost-effect method for recovering reusable mercury.[118] [119] [120] [121]

Recovery Operations

To minimize mercury emissions from the mercury recovery process, a facility should employ a closed system. The entire process should take place under reduced pressure to prevent leakage of mercury vapour into the processing area[122].

The small amount of exhausted air that is used in the process passes through a series of particulate filters and a carbon bed which absorbs the mercury prior to release to the environment. Examples for mercury recovery include waste from mercury-added equipment that easily releases mercury into the environment when broken, such as lamps containing mercury. In the U.S.A., a specific standard for waste subject to mercury recovery has been set; the waste that has total mercury content greater than or equal to 260 mg/kg is subject to mercury recovery based on the Land Disposal Restrictions.[123]
The Technical Guidelines on the Environmentally Sound Recycling/Reclamation of Metals and Metal Compounds (R4) of the Basel Convention focus mainly on the environmentally sound recycling and reclamation of metals and metal compounds including mercury that are listed in Annex I to the Basel Convention as categories of wastes to be controlled. It is possible to recycle waste consisting of elemental mercury and waste containing or contaminated with mercury, in special facilities which have advanced mercury-specific recycling technology. It should be noted that appropriate procedures should be employed in such recycling to prevent any releases of mercury into the environment. In addition, recycled mercury may be sold on the international commodities market, where it can be re-used. The recovery of metal will usually be determined by the degree of allowable use and a commercial evaluation as to whether it can be profitably recovered.

116. Jang, M., Hong, S. M., Park, J. K. (2005). Characterization and Recovery of Mercury from Spent Fluorescent Lamps, Waste Management, 25, 5-14.
117. A closed laboratory vessel with an outlet tube, used for distillation, sublimation, or decomposition by heat.
118. European Parliament and Council. (2001). Corrigendum to Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the Incineration of Waste. Official Journal of the European Communities, L145/52-L145/52. Retrieved from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:145:0052:0052:EN:PDF
119. UNEP Chemicals. (2012). Global Mercury Assessment. Geneva, Switzerland: UNEP Chemicals
120. European Commission. (2012). Integrated Pollution Prevention and Control Reference Document on the Best Available Techniques for Waste Incineration. Retrieved March 10, 2012, from: http://eippcb.jrc.es/reference/wi.html
121. UNEP. (2012). Study on mercury sources and emissions and analysis of cost and effectiveness of control measures. Retrieved March 28, 2012, from: http://www.unep.org/hazardoussubstances/Mercury/Negotiations/INC2/INC2 MeetingDocuments/tabid/3484/language/en-US/Default.aspx
122. Anel, B., Reyes-Osorno, B., Tansel, I.N. (1998). Comparative Analysis of Fluorescent Lamp Recycling and Disposal Options. Journal of Solid Waste Technology and Management, 25, 82-88.
123. U.S. Government Printing Office. (2012). U.S. Code of Federal Regulations: 40 CFR 268.40. Retrieved March 19, 2012, from: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol26/pdf/CFR-2010-title40-vol26-sec268-40.pdf

Pre-treatment

Before undergoing thermal treatment, wastes containing mercury or contaminated with mercury are treated to increase the efficiency of the thermal treatment; the pre-treatment processes include removal of materials other than those containing mercury by crushing and air separation, dewatering of sludge and removal of impurities. Examples of waste-specific pre-treatment operations are summarized in Table 1.

Table 3. Examples of Pre-Treatment Operations by Waste Type[124]

Waste Type	Pre-treatment
Fluorescent Lamps	**Mechanical Crushing** Waste mercury-containing lamps should be processed in a machine capable of crushing and separating the lamps into three categories: glass, phosphor powder and metals and plastics. By injecting the lamps into a sealed crushing and sieving chamber, vapour can be controlled at the point of breakage. Upon completion, the chamber automatically separates end products to eliminate the possibility of cross-contamination. End- caps and glass should be removed and sent for reuse in manufacturing. However, the metal pins associated with the end caps should be removed and treated separately as there may be considerable mercury content. Co-mingling the metals with powder results in amalgamation of mercury that can leave the metals fractions in a less desirable condition for recyclers. Mercury-phosphor powder may be stabilized or further processed to separate the mercury from the phosphor. Lamp glass from crushed mercury-added lamps can retain mercury. Therefore, additional treatments, including thermal application, may be needed to remove mercury before sending it for recovery or final. If this glass is sent for re-melting as part of its recovery process, the melting unit should have air pollution controls specifically directed at capturing released mercury (such as activated carbon injection). A high-performance exhaust air system should prevent the emission of any mercury vapours or dust during the entire process. The phosphor and any mercury should be removed from the chopped lamps. The separated phosphor, including the mercury and fine particles of glass should be processed to remove the mercury.
	Air Separation Aluminium end caps of fluorescent lamps (straight, circular and compact tubes) are cut by hydrogen burners. Air blowing flows into the cut fluorescent lamps from the bottom to remove mercury-phosphor powder adsorbed on glass. Mercury-phosphor powder is collected at a precipitator and glass parts are crushed and washed with acid, through which mercury-phosphor powder adsorbed on glass is completely removed. In addition, end-caps are crushed and magnetically separated to aluminium, iron and plastics for recycling.

Distillation of Mercury (Purification)

After treatment, collected mercury is subsequently purified by successive distillation.[125] High purity mercury is produced by distillation in many steps, permitting a high purity grade to be achieved in each distillation step.

Rare Earth Oxides for Phosphors

Rare earth oxides are an important material for the energy efficient lighting market. The narrow diameter tubes in CFLs require rare earth phosphors to operate efficiently and to emit high colour rendering white light. The price of rare earth phosphors fluctuates and is trending significantly higher in recent years as demand outstrips supply of highly refined rare earth oxides. Roughly 9000 MT of rare earth oxides as phosphors (6.97% of all rare earth oxides) are used annually. According to the U.S. Geological Survey, none of these rare earth oxides are being recycled at this point, but some companies are planning to introduce recycling processes.[126]

In 2008, phosphors accounted for 100% of the consumption of europium oxide (441 t), 89 % of the consumption of terbium oxide (414 t), 54 % of the consumption of yttrium oxide (6,230 t), 21% of the consumption of gadolinium oxide (162 t), 2.4% of the consumption of cerium oxide (990 t), and 2.0% of the consumption of lanthanum oxide (765 t).[127]

124. Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury adopted by the Conference of the Parties at the tenth meeting in 2011. Retrieved February 1, 2012, from: http://www.basel.int/Portals/4/Basel%20Convention/docs/techmatters/mercury/guidelines/UNEP-CHW-10-6-Add_2_rev_1.pdf
125.U.S. EPA. (2000). Section 2 - Treatment and Disposal Options, Proceedings and Summary Report -Workshop on Mercury in Products, Processes, Waste and the Environment: Eliminating, Reducing and Managing Risks from Non-Combustion Sources. Retrieved July, 2011, from: http://nepis.epa.gov/Exe/ZyNET.exe/30004HCY.TXT?ZyActionD=ZyDocument&Client=EPA&Index=2000+Thru+2005&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C00thru05%5CTxt%5C00000002%5C30004HCY.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=p%7Cf&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL
126. U.S. Geological Survey. (2012). Rare Earth Elements - End Use and Recyclability Scientific Investigations Report 2011 - 5094. Retrieved March 19, 2012, from: http://pubs.usgs.gov/sir/2011/5094/pdf/sir2011-5094.pdf
127. For more information please refer to a recent study on “Rare Earths and Their Recycling” developed for The Greens/EFA Group in the European Parliament available at http://reinhardbuetikofer.eu/wp-content/uploads/2011/01/Rare-earths-study_Oeko-Institut_Jan-2011.pdf

Section 6
Communications and Engagement

Table of Contents

Introduction

Energy efficiency is one of the most important issues on a country's agenda. The gap between electricity supply and demand in many developing and emerging countries is increasing rapidly, Demand is not being met and reliability is threatened due to the high cost of new power generation and increasing fuel prices. Promoting energy efficient lighting can greatly reduce peak energy loads and better utilize existing capacities without having to build new, expensive generation facilities. The rationale behind a communications campaign varies between countries where climate change considerations directly or indirectly are key drivers and other countries where energy supplies are crucial.

Awareness-raising communications campaigns support National Efficient Lighting Strategies and promote lighting energy efficiency policies and programmes. Changes in end user behaviour can lead to energy savings as high as 20%. Changes in energy conservation, lifestyle, awareness, low-cost actions, and small investments all contribute to overall savings.[1] When properly conducted, public awareness and educational campaigns help energy efficient lighting programs gain momentum in the marketplace. They reinforce the long-term effects of other related energy efficiency measures. In addition to providing end users with knowledge about specific energy efficiency issues and their environmental and financial impact, they can help to promote general acceptance and create a positive public environment for energy efficiency.

Improvement of energy efficiency and related market transformation require informed consumers and awareness among all segments of society as well as customized information, education and training for selected stakeholders.[2] To ensure the success of awareness, promotion, and education programmes, it is necessary to assess the aims of a communications initiative and intended audience message from the start. This helps to establish clear goals and objectives, determines the resources (time, personnel, and funding) that the programme requires. Each campaign must take into account the cultural and social attitudes of the region as they apply to energy efficiency. Additionally, to ensure their effectiveness, campaigns should be designed based on research results, such as market surveys, and should involve a large number of stakeholders.

Public awareness and public benefit campaigns are primarily designed and implemented by government agencies, utilities or NGOs. Private companies are also involved in energy efficiency awareness campaigns. For example, in Europe, the Energy Services Directive mandates energy companies to provide energy efficiency services to their clients. In countries with capacity problems, investments in improving energy efficiency are usually a more cost-effective solution than are investments in new generation capacity. In progressive energy markets, the provision of energy services, including energy efficiency campaigning, helps to build positive company image.
It is also important to consult with industry stakeholders when designing a programme to ensure that the key messages are compatible and will be well-received. This means that potential problems are identified and can be managed effectively. It also builds relationships, which can help during the implementation phase.

To be effective, a public information campaign must be adapted to its specific audience, deliver a credible and understandable message, and create a social context that leads to the desired outcome. Effective promotion of energy efficient products relies heavily on an appropriate education and awareness strategy. Promotional activities raise awareness among potential purchasers, as well as sellers and service providers, and work best when they demonstrate the full range of benefits attributable to the energy efficient lighting products, not just their energy saving benefits. Key messages may include: a cleaner and safer place for future generations; improved security of energy supply; reduced energy dependence; monetary savings; creation of green jobs; and, the reduction of greenhouse gases (GHG) and air pollutant emissions from fossil fuel combustion.[3]

1. Campaign Design

The success of any communication and awareness-raising campaign depends, in large part, on its design, specifically with regard to implementation and evaluation. The design phase of an efficient lighting campaign should involve the following elements:

- Setting the objectives
- Determining the time and duration of the campaign
- Understanding the audience
- Identifying communication tools
- Crafting the messages
- Determining implementation and monitoring parameters
- Campaign evaluation

All of the elements above are interrelated and dependent on the others. For example, the campaign objectives determine the audience, timing and duration which in turn, influence the selection of communication tools and messages and the allocation of resources.

Figure 1: Communication and awareness raising campaign design strategy[4]

1. Dahlbom, Bo, Greer Heather, Egmond Cees and Jonkers Ruud (2009): REF Kok et. al, 2007
2. Mikkonen, I., Gynther, L., Hamekosi, K., Mustonen, S., Silvonen, S. (August 2010) Innovative Communication Campaign Packages on Energy Efficiency, Motiva Services Oy, pp. 6
3. Dahlbom Bo, Greer Heather, Egmond Cees and Jonkers Ruud (2009): REF Kok et. al, 2007
4. Based on Business Solutions Europa & Entropia Consultoro (2011)

2. Setting the Objectives

The first step in designing an efficient lighting communications campaign involves establishing a set of objectives and goals. They should be specific, measurable, attainable, relevant and time-bound. They will determine the choice of communication tools and messages as well as evaluation parameters.

Examples of objectives of an efficient lighting communication campaign

- Increase consumer confidence in the viability of energy efficient lamps
- Increase the rate of purchase of energy-efficient lamps
- Increase understanding within the governmental agencies responsible for efficient lighting about the importance and benefits of phasing out incandescent lamps
- Introduce a labelling scheme to consumers and retailers
- Inform end users about the introduction of MEPS for lighting products
- Inform end users about replacement alternatives for incandescent lamps
- Increase consumer awareness and willingness to recycle energy-efficient lamps
- Increase the rate of collection of spent lamps
- Support retailer sales efforts, and/or capacity-building efforts
- Create networks along the lighting supply chain to sustain energy efficient lighting initiatives

Campaign objectives should be established in line with policy goals. The initiative can originate from a government which defines the role of behavioural change in reaching its goals and established priorities. Alternatively, the initiative may come from national energy agencies or other stakeholders who propose programmes based on their view of the policy goals. Campaigns should address energy behaviour which has the greatest impact and is easiest to change. Campaign goals should be challenging but achievable, targeted and measurable. Potential problems which may arise from the need to address multiple target groups and technologies can be avoided by dividing larger campaigns into clearly distinguished sub-campaigns. Campaign goals should be measurable to facilitate campaign financing when other types of energy efficiency instruments and measures vie for the same source of funding.

Energy efficient lighting campaigns aim to change habitual energy or investment behaviours of end users. The determinants of desired behavioural change are various motivational, enabling or reinforcing factors. Examples of motivational factors are awareness, knowledge, social norm, attitude, self-efficacy and intention and some socio-economic variables, such as income. An example of motivational initiatives would be a campaign that clearly addresses the general lack of knowledge on lighting energy efficiency among the population, businesses and public authorities.

Enabling factors are external to the end user and include financial, technical or organizational resources or new skills that need to be developed. The distribution of free energy efficient lamps is one way that countries have acted to address enabling factors. The reinforcing factors include feedback and support such as advice. For instance, when citizens reacted positively to the very urgent energy saving message for an impending energy crisis in Chile, the subsequent campaign wave had an informal tone and people were acknowledged and lauded for their action.[5]

These determining factors need to be recognised, analysed and integrated into the campaign plan in such a way that they induce the desired behavioural change. Assessing the factors is closely related to market segmentation because the three factors need to be related to certain behaviour of certain target groups.

3. Campaign Duration

The start date and campaign duration need to be determined from the outset. To identify the stages and length of the campaign, it is essential to take into account the phases which will accompany the legislative, regulatory and technical changes within a country or community. Public awareness campaigns should be designed in parallel with these activities. For example, the inefficient lamp phase-out initiative can be timed to start during the seasonal power demand peak in order to demonstrate the potential for energy efficient lighting to reduce peak residential electrical lighting loads.

The timing and duration of a campaign should relate to the budgetary process. If limited budgets are an issue, then a campaign should target groups whose behaviour is the easiest to change and will take the least amount of time. Target audiences can also be grouped at various levels and a communication campaign can start with a key audience and then expand to others, as time and budgets allow. More information on allocating resources and potential financing mechanisms can be found in Section 3.

5. Mikkonen, I., Gynther, L., Hamekosi, K., Mustonen, S., Silvonen, S. (August 2010) Innovative Communication Campaign Packages on Energy Efficiency, Motiva Services Oy, pp. 12

4. Understanding the Audience

To design a targeted communication campaign, it is necessary to develop a thorough understanding of the audience. The target group not only guides the messaging but the outreach strategies, including the tools and communication channels utilized. This is particularly relevant where campaigns are designed to promote technologies that involve multiple stakeholders, such as is the case with energy efficient lighting. In such instances, blanket communication campaigns that target a general audience can prove to be expensive and ineffective. Some campaigns focus on "early adopters," those end users who are eager to try out a new technology as soon as it introduced. Other campaigns may target peer influencers who can quickly spread a message through their direct networks. Campaign designers may arrange a sequence of messages to appeal to various audience segments.

Understanding the audience involves two main aspects:

- Stakeholder analysis
- Audience selection and prioritisation

4.1 Stakeholder Analysis

Stakeholder analysis identifies the key players in the lighting supply chain and assesses their knowledge, interest, position, alliances, and degree of importance in relation to the targeted phase-out programme. The analysis can also identify whether some stakeholders are more receptive than others to certain messages, or if there is existing relevant material that can be augmented. Such an analysis allows campaign designers to interact more effectively with key stakeholders in order craft more targeted messages; select the appropriate communication tools; establish realistic and attainable performance indicators to measure results; and mobilise appropriate resources to implement customised activities.

4.2 Audience Segmentation and Prioritisation

After performing a stakeholder analysis, it is necessary to prioritise the campaign audiences and conduct market segmentation. Market segmentation is an important pre-requisite for establishing programme goals and analysing the determinants of behaviour. Segmentation forms an important basis for the success of a campaign, since finding homogenous subsets helps to formulate and implement programme goals and to reach the desired target groups. Segmenting markets also helps to structure and control campaign budgets.

For an efficient lighting communications campaign, the primary audience may include supply-side stakeholders such as manufacturers, trade associations, distributors, retailers, or sales cooperatives. The secondary audience might consist largely of end user consumers. A target audience of consumers can encompass certain demographic variables such as age group, gender, or psychographic variables, such as lifestyle features and attitudes. Without knowing and understanding the target audience, social advertising and the promotion of a particular value and information can become difficult and waste resources and funding.

An example of a well-focused target group is school children. This defined audience of future consumers has been specifically addressed in many campaigns. For example, in Hungary an "Energy Champions Competition"[6] was designed for pupils who were instructed to conduct lighting energy audits in their own homes to calculate the possible savings with the optimal use of CFLs. Schools were given comprehensive information packages including a calculation guide, which assisted pupils in compiling the results. The pupils who submitted the best papers received bicycles and packages of CFLs as prizes.

Although the results of stakeholder analyses vary according to the country and/or region in which the programme is implemented, the main stakeholders in any efficient lighting communications campaign can be generally categorised as follows:

- Institutional and government
- Business
- Consumers
- Media and others

6. Efficient Lighting Initiative. (2006) Hungary Residential CFL Campaign. Retrieved March 23, 2012, from: http://www.efficientlighting.net/FormerELI/hungary/overview_resid.htm

Table 1: Communication campaign stakeholders and involvement

Stakeholders	Primary interests and areas of involvement
Institutional and governmental • Governments – federal, state/provincial and local • Utilities • Standards organizations • Customs authorities • Testing laboratories • Trade unions	**Primary interests:** • Reducing electricity consumption and greenhouse gas (GHG) emissions by establishing or expanding a sustainable market for energy efficient lighting products • Ensuring efficiency standards and product quality in market • Stimulating the development of new products and effective distribution **Involvement:** • Support regulatory and legislative initiatives and policy implementation through available funding opportunities • Provide experienced support in identifying success factors for achieving efficient lighting implementation and market transformation • Evaluate and monitor processes against established targets
Business • Manufacturers • Lighting industry associations • Wholesalers and retailers • Specifiers • Building owners and managers	**Primary interests:** • Promoting innovative, energy efficient new technologies • Business prospects • Corporate responsibility • Reducing electrical consumption **Involvement**: • Facilitate direct and indirect end-user communication • Key actors in assisting the implementation of sustainable lighting policies and transforming markets to efficient lighting • Provide best practice lighting solutions at local, regional or international level • Provide guidance regarding technical feasibility and realistic time schedules • Play a key role supporting energy efficient lighting programmes and the adoption of high quality products and solutions
End Users • Customers • Civil society • Consumer and community associations	**Primary interests:** • Acquire additional information to promote informed decisions about the monetary or environmental savings associated with a switch to efficient lamps **Involvement:** • Acceptance and utilisation of energy efficient products based on first-hand experience and affordability • Provide information about buying habits — what types of products are purchased and for what purpose • Stimulate preference for energy efficient lighting and sustain the change in consumption patterns
Media and others • Media • Research and training institutes	**Primary interests:** • Develop knowledge base about energy efficient lighting among professionals and the general public **Involvement**: • Simplify and disseminate information related to energy efficient lighting to the general public • Monitor , compare and identify local, regional, and international best practices and policies • Assist governments in implementing sustainable lighting policies • Publish formal and informal educational and training materials

Case Study: European Union – Integrated Communications Campaign Targeting Multiple Stakeholders

The communications campaign for the inefficient lamp phase-out initiative in Europe targeted all audiences. In 2009, the European Parliament and Council of the European Union (EU) adopted a phase-out decision aimed at restricting inefficient incandescent lamps in Europe by 2012 and low efficiency halogen lamps by 2016[7]. The switch will reduce energy consumption for domestic lighting by 30% in Europe and fight climate change by preventing 23 million tons of CO_2 emissions per year.
The move was backed by European lamp manufacturers who agreed to provide consumers with the widest range of energy efficient lighting solutions to achieve the targeted switch. The lighting industry also committed to contributing to an information campaign on the phase-out and answering all questions consumers may have in cooperation with environmental groups and consumer organisations.

7. "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."

The initiative was supported by an integrated communications campaign which sought to inform the public that energy efficient lamps could reduce energy consumption by as much as 80% and would last up to 15 times longer than their less energy efficient equivalents. An important message was that the lamps provided good quality light and were available in a wide range of shapes and sizes for use in most any illumination application.

The inefficient lamp phase-out initiative was supported with many different media components supported by each of the lighting stakeholders. The European Lamp Companies Federation provided an initial press release, factsheets for consumer organizations, retailers and professionals and a comprehensive pamphlet that extolled the benefits of energy efficient lighting and provided key facts about savings, replacement options, and where to purchase and dispose of spent lamps. They also developed a website that highlighted changes to the product labelling, a guide to the product types, FAQs, useful links, technical background and a press corner.[8] Manufacturers supported the initiative with industry presentations and printed and online material that provided a detailed phase-out schedule as well as alternative product choices.

Source: OSRAM

Source: Philips Lighting

5. Communicating to Governments and Institutions

5.1 Convincing Decision Makers

It is important to start communicating early with stakeholders about the need for efficient lighting programmes and convincing government decision makers about the overall benefits for the economy, environment and society at large. A concerted effort may be required to engage politicians to whom the benefits of an integrated policy approach may be less familiar or not well understood. It is advisable to identify and enlist a ‘champion’ – an individual who understands the potential benefits and impact of and energy efficient lighting programme and who can convince other decision makers.

Central or local administrations should also be engaged in order to ensure the acceptance and success of an inefficient lamp phase-out strategy. They often have the most insight into their local situations and implementation challenges and can provide valuable and practical information. It is also very important to communicate with non-governmental stakeholders, such as utilities and civil society groups, to generate broad support.

5.1.1 Government Stakeholders

- The Ministry or Department of Energy is the main government institution that is key to a successful transition to efficient lighting. The energy ministry may work in collaboration with the economic development ministry, so it is important to provide them with the phase-out arguments that address the economic benefits (see Section 1). These assertions demonstrate how a phase-out can help meet the national energy objectives of a country; improve the security of supplies; and, reduce energy dependency from imports. The en.lighten initiative Country Lighting Assessments can also be utilized to provide specific country information and forecasts.

- The Ministry of Environment is the main agency to work with in setting policies aimed at reducing CO_2 emissions and other pollutants into the atmosphere. In addition, it is a key institution to get involved with sustainable end-of-life treatment of spent lamps. To engage this ministry, arguments should be presented about how a phase-out programme will assist in meeting climate change goals and promote sustainable development strategy. The en.lighten CLAs provide estimates of CO_2 savings.

- The Ministry of Health will need to be well-informed about the impact of lighting technology on health and safety. It can also be the lead agency for the comprehensive collection and recycling schemes established in a country, which will help reduce the release of mercury into the environment and thus, reduce the risk to the population.

8. European Commission. (2009) Retrieved February 15, 2012, Retrieved from: http://ec.europa.eu/energy/lumen/index_en.htm

- The Ministries of Finance and Trade or Industry will need to be involved in order to determine the best strategies to finance the phase-out programmes. For example, they should be consulted in order to decide whether implementing fiscal policies for a phase-out is possible and whether or not introducing MEPS will have an effect on national lamp production. Arguments about the reduction of national trade imbalances through reduced energy imports should also be addressed during the discussions with these ministries. Customs bureaus will need information and training to enforce new requirements.

- Local and regional authorities interact directly with consumers and are more likely to be affected by public concerns if the phase-out benefits are not well communicated. This may be the case for issues such as: the costs and financing of phase-out plans; health related issues; or, collection and recycling practices. Therefore, it is important to engage these authorities early on the process and provide them with valid arguments and facts on the benefits of efficient lighting, as well as the proper handling of products.

- Members of parliament and political leaders are responsible for decision-making and the legislation regarding the phase-out of inefficient incandescent lamps. They should receive key information on the goals and benefits of the phase-out in order to exercise their position as the first point of contact with citizens (consumers) and their involvement in the economic system.

5.1.2 Other Key Decision Makers

- Electric utilities (including generation, distribution and energy services) face increasing demand, escalating energy prices, high infrastructure improvement costs and the challenge of maintaining a reliable grid. In most developing countries, the capital required for new infrastructure may be difficult to access. The phase-out of inefficient lighting is a cost-effective means for utilities to reduce these pressures, meet growing energy demand, and save resources which could be channelled into the development of new infrastructure. The en.lighten Country Lighting Assessments (CLAs) could serve as a useful basis for presenting savings projections.

- Customs authorities must be involved in any efficient lighting programme in order to control the product quality of imported lamps. They ensure the compliance of lighting products with existing legislation and help eliminate illegal trafficking.

- Testing authorities and laboratories must be involved in monitoring, verification and enforcement (MVE) activities and also in the standards setting process. Standardization bodies develop basic standards for efficient lighting products and assist with the application of existing principles and test procedures. Their involvement is essential, as they expand knowledge and improve the efficient lighting landscape for end users. Harmonized test standards allow laboratories to promote services to manufacturers, distributors and law enforcement officials.

- Lighting associations link standardization bodies, distributors, designers and specifiers and serve to educate end users and promote the benefits of lighting. Their involvement assists the standardization process and adds value to the supply chain.

- Trade unions should also be involved, particularly in those countries that must adapt processes and products to energy efficient lighting production and distribution. They must be informed about the significant benefits of a phase-out programme and its impact on employment issues, re-training programmes and the relocation or transformation of industrial plants.

5.2 Internal Communication Tools for Government

Communication tools for approaching government decision makers differ from the strategies employed for end users. Information approaches should persuade officials to formulate policy that promotes and maintains efficient lighting best practices.

5.2.1 Ministerial Memoranda

Ministerial memoranda are official records of the advice provided to elected authorities. In general, ministerial memoranda need to be provided from the lead agency to policy makers, as well as to other governmental ministries, agencies, institutions, and stakeholders, where required. These can form the basis for discussions and identify the responsible parties within each agency that can lead activities and contribute to the overall programme implementation.

The example of a ministerial memorandum for a hypothetical country ('Fredonia') can be found in Annex A and used as a template by government officials responsible for coordinating or drafting energy efficient lighting policy as a briefing note. A description of the impact of efficient lighting as part of the global context is presented in the 'Background'. This section is followed by an assessment of the energy efficient lighting potential in the country from the en.lighten Country Lighting Assessments. The final part of the memorandum briefly explains what the en.lighten initiative is about and outlines an integrated policy approach to phase-out inefficient lamps.

5.2.2 Meetings

Legislative committee meetings involve members of legislators who receive briefings on the pros and cons of proposed legislative measures or involve the discussion of proposed legislation with other officials and stakeholders including the private sector, civil society, etc. Committee meetings are therefore, at the centre of the legislative process. It is here that an amendment to efficient lighting legislation may be proposed, clauses added or deleted to improve it and an attempt made to build a consensus for proposals containing practical and coherent policy analysis and recommendations.[9] However, in some countries, leaders may decree phase-outs, with assistance from technical advisors.

9. About Senate Committees. (2011). Retrieved January 15, 2012. Retrieved from: http://www.parl.gc.ca/sencommitteebusiness/AboutCommittees.aspx?parl=41&ses=1&Language=E

Intergovernmental coordination meetings can be organized by lead agencies and attended by relevant government agencies, legislators, and executive branch officials to help them understand each other and to discuss the benefits of a transition to efficient lighting. A national report on the benefits and impacts of a phase-out programme can be commissioned and presented in the meeting. The meeting would serve to increase awareness and knowledge among the various departments involved and promote consensus. These gatherings should be publicly announced in advance to ensure a transparent process.

Meetings with local authorities are key to finding out more about the local context and concerns and eventually providing feedback for policies and communication campaign design. Meetings also enable local authorities to better understand the terms and conditions of lighting phase-out programmes. This enables them to communicate the benefits and challenges to citizens. Meetings should be organized and prioritized according to stakeholder analyses and impact assessments. These meetings should also be publicly announced in advance to ensure transparency and encourage participation.

6. Communicating to Businesses

To address professionals, effective communications channels can include: practical tools such as online information and printed materials such as in the European Union example; new media; targeted training programmes; events and trade shows; and design competitions.

6.1 New Media

The internet is an important tool for business and should be a central part of any communications effort. The internet allows campaign designers and implementers to control and direct the message as well as the presentation. It also allows for fast and simple updating and a huge reach among audiences. In addition to delivering the energy efficient lighting message through text and tools, such as online calculators, the internet can also be used to present video and audio materials. Webinars are an effective way to reach and educate an audience cost-effectively and the recorded sessions can be posted online afterwards.

The internet is considered a passive medium, so end users need to be encouraged to visit a site. Therefore, it is very important that a campaign is presented in an integrated manner in order to promote an internet presence. Printed material can be used to direct an audience to a web site. Printed publications, such as brochures and flyers, can be produced with control of the messaging and its context, and distributed directly to an audience to attract attention and guide them to a web site.

Social media sites also provide a good base for marketing activities. In the past, meetings and events were the preferred way for building business relationships. These networking strategies are still important but now those activities have also moved online within social media communities. For example, "LinkedIn" provides all the benefits of offline networking and it delivers a platform to research, identify, engage and maintain contacts and groups in one place. Using professional social media sites such as LinkedIn correctly and effectively may be a key marketing strategy to incorporate into regular communications efforts.

6.2 Retailer Training

Retailer education is very important to help overcome the lack of public awareness and misinformation about energy efficient lighting, which can result in retailer reluctance to commit shelf space to energy efficient lamps.[10] Indeed, if retailers are knowledgeable, they can play a key role both in terms of making the product available to consumers and in providing space for in-store displays and shelf space for informative packaging.

It is important to reassure retailers that a product is going to perform as stated. They also need to be informed about what constitutes a high quality product, especially with new and unfamiliar technologies. Training should be technically-oriented and explain economic benefits, wattage conversions, and power quality issues. They should also learn how to set up effective and visible point-of-purchase displays and be taught how a promotion may unfold (e.g. the administrative process for using rebate coupons). They should also be advised about inventory maintenance and the necessity to plan stock purchases taking into consideration opportunities such as celebrations, lighting seasons and other times of year when many people purchase lamps.

Training can be carried out by manufacturer representatives and may be assisted by utility or stakeholder field staff, especially if the efficient lighting products are imported and there is a lack of local manufacturer staff to deliver the training. To be effective, training activities should be accompanied by in-store product demonstrations and frequent field visits. Retailers may also deliver training online by hosting webinars and posting short, informative videos.

Case Study: California, U.S.A. – Residential Lighting and Appliance Program

The annual Residential Lighting and Appliance Program involved California utilities in a massive state-wide effort to build retailer infrastructure for marketing CFLs. This included the professional training of sales representatives and regular visits by field staff to each store to display merchandise attractively; tabulate inventory levels; and, maintain point-of-purchase displays, together with cooperative advertising programmes, to leverage investments by manufacturers and retailers in product promotions. At the end of the project, over 800 sales staff in over 170 participating national retail stores was trained with a 25% increase in proficiency test scores regarding ENERGY STAR lighting.[11]

10. Sandahl, L.J., Gilbride, T.L., Ledbetter, M.R., Steward, H.E. and Calwell, C. (2006). Compact Fluorescent Lighting in America: Lessons Learned on the Way to Market. Eco Consulting. Prepared for the U.S. Department of Energy. Retrieved on February 15, 2012. Retrieved from: http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/cfl_lessons_learned_web.pdf
11. Fulbright, V., Jacob, A. and Caldwell, C. (2003). Compact Fluorescent Light Programs Shine through the West Coast Power Crisis. ER-03-11. Ecos Consulting. Prepared for Platts Research and Consulting, Boulder, Colorado.

Case Study: Czech Republic - Retailer Support

As part of the communication campaign and training of retailers carried out during the Efficient Lighting Initiative in the Czech Republic, an informational brochure on CFLs was produced and distributed to shop assistants at almost 3,000 retail outlets. The brochure served as a comprehensive guide to CFL features and benefits and addressed selection criteria, answered consumer FAQs, and covered basic information on lighting in general. The brochure featured caricatures that also appeared in animated videos that were shown on public broadcasts.

6.3 Trade Shows

Trade shows and expositions are very effective tools for promoting phase-out programmes or new efficient lighting technologies and are especially useful in reaching distributors, technical audiences and professionals. Trade shows can have national, regional, and international outreach and generally involve industry, government, utilities, consumer association, end users and others involved in the lighting supply chain. They encourage the dissemination of information between various stakeholders, depending on the type of event, and they offer an excellent opportunity to give visibility to other initiatives and communication tools such as advertising and educational and training programmes.

Case Study: Peru - Efficient Lighting Initiative

To complement energy efficient lighting initiatives in Peru, participation in industry trade shows was seen as an effective means to target lighting professionals and commercial end users. The Efficient Lighting Initiative was represented at various shows including events that attracted students and professionals from important universities and the private sector. In addition to a presence on the show floor with a booth explaining energy efficient lighting, a keynote lecture was given on the "New Criteria for Lighting Design."

Retailers and other professional end users were addressed through Peru's key industry hardware show. Participation included an exhibit module in which informative material was distributed as well as two lectures delivered to end users, hardware store owners and employees, hardware suppliers and specialist contractors on efficient lighting and the importance of product quality. The programme logo was featured and explained so that viewers would understand its meaning and appropriate use.

6.4 Design Competitions

Design competitions can promote energy efficient lighting and stimulate the design of a wider range of luminaires that are compatible with the characteristics of efficient lamps. In South Africa, a competition to design fixtures for CFLs was introduced that featured two categories, one for students and one for professional designers[12]. This engaged two important sectors – the designers of today and the designers of tomorrow. Manufacturers and component suppliers can co-sponsor opportunities such as this so as to bring awareness to the widespread use of efficient lamps.

Case Study: USA – Lighting for Tomorrow Competition

The "Lighting for Tomorrow" competition is an annual event that seeks to recognize the best in decorative energy efficient lighting fixtures. Since its inception in 2002, the goal of Lighting for Tomorrow has been to increase the availability of energy efficient residential lighting fixtures. It also assists in increasing the marketing, promotion and sales of the winning entries. Recently, the competition expanded to include LED lighting fixtures and LED lamps.

The 2011, Lighting for Tomorrow competition presented awards for solid state lighting fixtures, LED lamps, and lighting controls. To see a list of winning designs, please click here. In 2012, LED retrofit kits were added to recognize the growing demand for energy efficient lighting products for use in renovation and upgrade applications.

7. Communicating to the Public

The selection of the detailed communication channels must start with a clear vision of target audience: individuals, groups, market segments, or the general public. Individual attitudes, values and actions also influence in the degree and the extent to which a message penetrates the awareness of the target. Therefore, communication should be developed to shape thoughts, change an attitude, or induce action. In order to provoke behavioural response, the communication channels need to be matched with the determinants of behaviour. For consumers, for example, practical tools may include the use of focus groups or surveys with questionnaires which can help to identify the most important influential factors.

After the background research is done, the best channels to reach the target groups can be identified. Subsequently, the communications material and channels should be tailored. The messages should seek a cognitive, affective or behavioural response. The following should be taken into account in determining media channels:

12. Efficient Lighting Initiative Online. (2002). Retrieved on March15, 2012. Retrieved from: http://www.efficientlighting.net/FormerELI/south_africa/hightlights.htm

- Budget in relation to the size and number of target groups
- Media profiles and images
- Media coverage and access
- Cultural factors
- Long-term viewing and repeated visits

The size of the communications budget is a significant practical factor which has an impact also on the choice of target groups. If the target groups are small and the objective is to reach as many of them as possible, then sizeable budgets are necessary. This may lead to having to compromise the level of tailoring the campaign and budgetary concerns thus, cost-effectiveness is usually a real concern. It can be enhanced by a good analysis of the changeability of behaviour and, for example, by prioritizing target groups whose behaviour is the easiest to change. Target groups can also be segmented at different levels and the campaign can start with key groups thereafter expanding to others.

Media can be divided into various profiles based on the audience and nature of the tool. For example, large target groups can be reached using media which is all-encompassing and generally considered reliable whereas other methods can have a high impact on some smaller groups. Countries may range from those that are highly "digitalised" and have made significant advances in energy efficiency to countries where not everyone has access to electricity or TV. Radios and cellular telephones can be used as communications alternatives in many countries. Therefore, strategies in choosing communication channels must be carefully devised.

The message should be adapted to local culture. For example, when designing their efficiency campaign, the U.K. Energy Saving Trust was compelled to question the use of term "energy saving" in their campaign because it is an intangible idea and implies sacrifice, undermining the positive charge of "energy.[13]" Therefore, it was decided that the issue of "not wasting energy" should be utilized instead of discussing the notion of saving energy. In Cuba, the energy efficiency campaign name "Energy Revolution" referred to the compelling need to change energy behaviour.[14] Furthermore, culturally, the word "revolution" has a positive notion related to it within large part of the Cuban population.

Energy efficiency campaigns are usually implemented jointly by several different institutions and actors. For example, energy agencies may co-operate with local government authorities, various associations, civil society, and the energy and construction industry. Broad co-operation has positive and negative aspects. Action can be divided between many parties and information can be disseminated widely. However, a designee must be responsible for the whole organisation and management of the programme, which can be complex and time consuming.

To be effective and achieve lasting impact a communications campaign for energy efficient lighting must be properly designed with respect to the selection of existing or new communications tools used to reach consumers. Individual communication tools can be utilized effectively to communicate the various aspects of energy efficient lighting programmes. However, integrated communication campaigns using multiple media and complementary messaging to address target groups are usually more successful.

7.1 Labelling

Product labelling is one of the most direct and effective means of communication to consumers. Implemented properly, it is also one of the most cost-effective energy efficient policy measures. According to Nielson Monitor Research, when consumers were asked where they would expect to find information about how efficient lamps performed, 75% advised they would look to the packaging.[15] They also found that a high percentage of consumers would expect to find other key product information such as; light colour and output and product use/limitations on the packaging (for example, suitability for use with a dimmer).[16]

Labels should be designed for the needs, benefit and convenience of consumers. Many labels convey too much technical information that consumers do not use. Labels must be simple and easy to understand, and may be accompanied by supplemental information such as a brochure or user's manual. To use labelling as an important communication tool, governments should aim at harmonising them by promoting consistency of message, content and information placement on the package (see Section 2).

7.2 Advertising

Traditional advertising places paid or public service messages in the media or in public spaces to increase awareness of and support for an energy efficient lighting campaign. The most frequently used channel in advertising is television because it has the greatest reach. Radio, newspaper, magazine and billboard advertising may also have considerable impact and can be utilized to address a mass audience. In many countries, the high costs of advertising may preclude its widespread use, but used tactically it can prove effective, especially in reinforcing messages. Advertising's primary advantage is full control over message and presentation coupled with wide coverage, but again, it can be a complex and expensive medium to utilize. In some countries, advertisers and media may collaborate to offer complimentary or discounted media space for public service announcements.

13. Mikkonen, I., Gynther, L., Hamekosi, K., Mustonen, S., Silvonen, S. (August 2010) Innovative Communication Campaign Packages on Energy Efficiency, Motiva Services Oy, pp. 15
14. Ibid. pp. 16
15. Neilson Monitor Research completed for EECA, August 2008
16. McLagan, A. (2008). Information Barriers to Growth. Energy Efficient Lighting in New Zealand: http://www.eeca.govt.nz/sites/all/files/Energy%20Efficiency%20Lighting%20in%20New%20Zealand%20-%20Information%20Barriers%20to%20Growth.pdf

Case Study: Tonga – "Save Money Now!"

In the first half of 2011, Tonga launched its first energy efficiency public awareness campaign to provide residents with information regarding simple measures they could implement themselves to reduce energy consumption. The first stage of this campaign included a series of radio announcements, in both Tongan and English, and was followed by an awareness-raising campaign published in local newspapers. The next stage involved a television advertising campaign at peak viewing times. The key messages in this campaign include turning off lamps when light is not needed, and, purchasing energy efficient lamps.

Case Study: U.S.A – Department of Energy and ENERGY STAR Lamps

The U.S. Department of Energy (DOE) launched an advertising campaign promoting the use of ENERGY STAR lamps. The advertisements comprised part of a broader set of television and print public service announcements (PSAs) focused on energy efficiency to show solutions for consumers how to save money on their electricity bills easily. The print advertisements included slogans such as "Save energy, save vacation," and, "Save energy, save date night."
The innovative and attention-grabbing television advertisement features a turkey being cooked by inefficient lamps, illustrating that they generate nine times more heat than light.
The advertisements were aired nationwide using advertising space donated by the media.

Advertising for consumers should clearly point them to a place where they can find additional information. This advertising campaign directed consumers to the U.S Department of Energy website, where they could find tools and information such as: energy saving tips, efficient lighting alternatives, videos and presentations.

7.3 Internet and New Media

Today, the internet is a primary source for the promotion and dissemination of information. Effective efficient lighting communication campaigns should include a comprehensive website as part of the informational strategy. Depending on the nature of the target audience and their level of technology ability and access, the site can include a broad range of content, resources, and contacts. In addition to informational websites, the internet provides other popular and effective communication channels such as social networks (such as Facebook and LinkedIn) or video sharing platforms (such as YouTube or vimeo), which are becoming increasingly important, culturally-focused, and able to attract a great variety of online audiences.

As a result of an increasing internet usage, a large number of websites have been created to provide instant and comprehensive information about efficient lighting and related activities both to the general public and to specialised audiences. This ranges from technical information on efficient lamps to tools for calculating actual savings achieved by replacing inefficient incandescent lamps with energy efficient lamps. Web information can also include where to install energy efficient lamps and where to buy models of lamps from a list of certified products available in stores or via online shopping. Pertinent information about current legislation and ongoing projects can also be accessed.

When developing and formatting web sites, attention should be paid to the various communications devices, such as laptops and smart phones, which may be used as primary viewing tools. Additionally, care should be taken to accommodate the diverse needs of the audience and should adhere to guidelines for disabled-access users, for example. To accommodate diverse audiences, many websites are made available in multiple languages.

Case Study: Australia – Change the Globe

The Change the Globe phase-out initiative in Australia featured a strong internet component. A landing page provided general information about the initiative and directed the reader to other specific sections related to:

- Relevant legislation (for example, import controls for lamps)
- Media releases and speeches
- Government actions and guidelines for inefficient incandescent lamp phase-out strategies

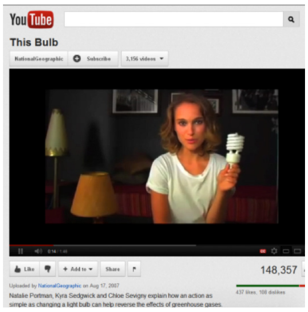
The landing page directed users to the website for the Australian Government Department of Climate Change and Energy Efficiency which provided comprehensive information including details of the phase-out, environmental benefits, available alternatives, product quality, health questions and disposal issues. It also provides links to a wide variety of other sources and provides a useful conversion table to help consumers choose an efficient lamp that will provide as much light as their previous lamps did.

Case Study: United Kingdom – Energy Savings Trust, via a Popular Online Shopping Site

As part of the EU phase-out campaign, a Lighting Education and Buying Guide site was created in the UK. It is hosted on
Amazon.com so that consumers can find information where and when they needed it, while shopping. The site explains the phase-out schedule in great detail, including labelling information, and highlights the various lamp technologies. For each lamp type, it provides advantages, disadvantages and recommended use. It also addresses recycling –what lamps, where to recycle and precautions to be taken. The Frequently Asked Questions (FAQs) section covers all possible consumer-related questions

and provides links to the Energy Savings Trust site as well as to the Lighting Industry Federations, Lighting Association, lamp recycler website and pertinent regulations on non-directional household lamps.

7.4 Social Media



Social media is very popular for communications campaigns. It can include content specifically related to energy efficient lighting that is created and shared by individuals on the web using freely available content from websites. Communications professionals can create and post text, images and video and then share it with the entire internet or just a select group. This type of interactive media promotes engagement, sharing and collaboration among all stakeholders involved in a phase-out initiative. Common examples of social media include YouTube, Facebook and Twitter. YouTube is the preferred site for posting video, along with company websites. An example of a recent YouTube video featured the use of celebrities to promote the switch to CFLs through the National Geographic channel. The "This Bulb" video demonstrates that changing a lamp is a simple act but the consequences are dramatic when many people join together to make a change.

Social media sites can cultivate communities where segmented user groups such as experts, journalists or interest groups interact with each other regarding energy efficient lighting in general, or on a specific aspect of a phase-out programme. New media can be a very useful complement to other communication channels like point-of-sale information and advertising. They are very effective at distributing information quickly and can have a wide reach at a relatively low price compared to other, more traditional advertising methods. Communications managers must also be ready to quickly respond to false claims, misinformation and negative opinions, all of which can spread rapidly on social media sites.

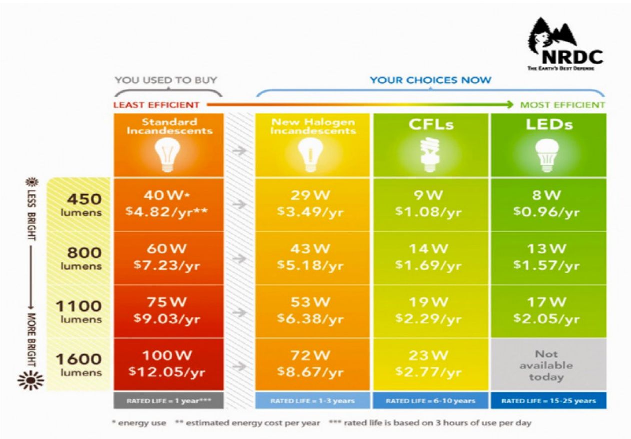
7.5 Printed Material and Direct Mail

Brochures and printed material are practical tools to spread efficient lighting messages. They offer a tangible product that can be sent directly to an audience. Professional communicators can control over the message and its context. They can provide pertinent information about energy efficient lamp selection criteria, answer consumer FAQs, and, deliver basic information on lighting or address more technical issues. Brochures must be written in an easy-to-understand way and distributed properly to reach the target audience. Collateral material can be produced by governments, utilities, energy agencies, manufacturers, retailers and anyone party that has a stake in communicating the energy efficiency message. The pieces can be printed and distributed at trade shows or events, or at the retail level, and can be posted online for download.

Stand alone brochures or simple printed pieces can be designed to be inserted into utility bills. This is an excellent distribution method as they will be received directly by consumer as they review their electricity charges. The impact of an energy efficiency message, in this context, will be well-received, especially if it directs the consumer to additional information, and suggests a simple, specific action that the consumer can accomplish near-term. The logic of each message must be transparent, and the consequences of the action should be spelled out in a positive, encouraging manner.

Case Study: U.S.A. – Consumer Guide to More Efficient and Money-Saving Lamps

The Natural Resources Defense Councildeveloped a lamp buying guide to help consumers determine which energy efficient lamps to purchase.[17] It details the energy efficient alternatives that replace 100, 75, 60 or 40 watt incandescent lamps including: tungsten halogen lamps, CFL and LED lamps. It clearly identifies the light output of each of the lamps and the annual operating cost for each option.[18] The guide highlights the fact that even though more efficient lamps have a higher initial cost than older, inefficient incandescent lamps, they more than pay for themselves over their lifetime.



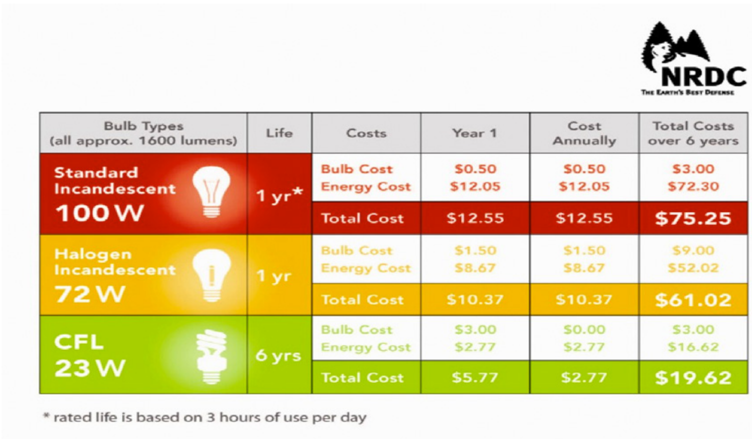
NRDC

YOU USED TO BUY | YOUR CHOICES NOW

LEAST EFFICIENT → MOST EFFICIENT

LESS BRIGHT → MORE BRIGHT	Standard Incandescents	New Halogen Incandescents	CFLs	LEDs
450 lumens	40 W* $4.82/yr**	29 W $3.49/yr	9 W $1.08/yr	8 W $0.96/yr
800 lumens	60 W $7.23/yr	43 W $5.18/yr	14 W $1.69/yr	13 W $1.57/yr
1100 lumens	75 W $9.03/yr	53 W $6.38/yr	19 W $2.29/yr	17 W $2.05/yr
1600 lumens	100 W $12.05/yr	72 W $8.67/yr	23 W $2.77/yr	Not available today
	RATED LIFE = 1 year***	RATED LIFE = 1-3 years	RATED LIFE = 6-10 years	RATED LIFE = 15-25 years

* energy use ** estimated energy cost per year *** rated life is based on 3 hours of use per day



NRDC

Bulb Types (all approx. 1600 lumens)	Life	Costs	Year 1	Cost Annually	Total Costs over 6 years
Standard Incandescent 100 W	1 yr*	Bulb Cost Energy Cost	$0.50 $12.05	$0.50 $12.05	$3.00 $72.30
		Total Cost	$12.55	$12.55	$75.25
Halogen Incandescent 72 W	1 yr	Bulb Cost Energy Cost	$1.50 $8.67	$1.50 $8.67	$9.00 $52.02
		Total Cost	$10.37	$10.37	$61.02
CFL 23 W	6 yrs	Bulb Cost Energy Cost	$3.00 $2.77	$0.00 $2.77	$3.00 $16.62
		Total Cost	$5.77	$2.77	$19.62

* rated life is based on 3 hours of use per day

17. Horowitz, N. (December 12, 2011). Retrieved on February 15, 2012. Retieved from: http://switchboard.nrdc.org/blogs/nhorowitz/new_energy-saving_bulbs_are_co.html
18. The prices for the lamps and electricity rates($0.12 cents/kWh) shown are for the U.S. only. The figures may change for local conditions.

Case Study: Argentina –Utility Insert

As part of the Efficient Lighting Initiative[19], a brochure for homeowners was developed and inserted into electricity bills that were sent to each household. The primary message concerned the financial savings to be realised by using CFLs including:

- The potential savings by replacing incandescent lamps with CFLs
- The cost of the replacement and how it pays for itself over time
- How take advantage of CFL promotions
- Where to buy or receive additional information
- Advice about responsible consumption

7.6 Point-of-Sale Material

Point-of-sale information targets messages at the exact location where the consumer makes their purchase decisions and where the purchase transaction occurs. Other communication tools, such as media advertising, can help to change attitudes and perceptions about energy efficient lighting and may influence decisions but it is only at the retail level that the customers make their ultimate purchasing decisions. CFLs have now become symbols of energy efficiency in many countries and are purchased for the benefits they provide with respect to sensible advantages, such as savings. The higher purchase price and sometimes difficult selection process for energy efficient lamps can adversely influence buyer decisions and should be addressed at the point-of-sale - particularly on the store shelf or on the online catalogue product information page where the purchasing decision is made.

This communications channel should be used for the dissemination of appropriate informational materials for new products or phase-out programmes (e.g. image boards, brochures or stickers) or specific marketing initiatives (e.g. special price offers, promotional coupons, discounts). When developing messaging, it is very important to seek and obtain co-operation with manufacturers and retailers. Additionally, a number of marketing studies indicate that retailer product displays play a very strong role in influencing lamp buyers.[20] Positioning is essential. Eye-level display shelves and end of aisle displays tend to receive more attention from consumers so CFLs and LED lamps are best displayed in these locations.

Case Study: Hungary – Point-of-Purchase Display

To show the savings potential of energy efficient lamps, comparison meters were manufactured for the Efficient Lighting Initiative programme in Hungary to demonstrate the energy savings of a CFL compared to an incandescent lamp. These meters were also made available for other campaign activities such as schools activities and consumer events. Their use was particularly effective as they clearly demonstrated the energy efficiency benefits of efficient versus inefficient lamps. All retailers who participated in the programme were provided with a meter to spread the energy efficiency message through this very effective tool. Other point-of-sale material such as posters, shelf talkers, and danglers were also used to augment the campaign.

7.7 Events

A well-planned event that features an interesting photo opportunity is a great way to encourage regional or community participation and to attract media coverage to spread the efficient lighting message. Organisations can host events to promote energy efficiency and savings. Examples may include:

- Community celebration events such as “Energy Conservation Awareness Day” or “Earth Day” gatherings
- Proclamations, challenges and civic leadership – events within local governments such as distributing energy efficient lamps to employees; or, challenging building tenants to reduce electricity demand by a certain percentage
- Commercial retail and office space energy efficiency adjustments – encouraging commercial businesses to adjust lighting in shopping areas and offices
- Employee education events and promotions – employee events to share efficient lighting ideas. These may involve outside expert speakers to provide an enhanced learning experience
- Encouraging students to learn about energy, its link to the environment, and how they can make a difference by installing efficient lamps in their homes. These lessons can be presented by an invited guest from the lighting or utility industry, and may include a lamp exchange
- Incentive-based contests and giveaways – handing out free CFLs or LED lamps as a reward for completing a questionnaire or quiz. The purpose of the exercise is both to gather information and to help the participants retain the message.

7.8 Road Shows and Community Events

Home shows and community events are excellent ways to directly interact with consumers. Sustainable energy shows or green home shows target those that may already prioritize energy efficiency or attract consumers who would like to learn about energy efficient alternatives. A message that focused on the simple switch that a consumer can make to energy efficient lighting along with a demonstration can be very effective in convincing consumers. Directly interacting with consumers and encouraging them to make environmentally responsible choices in their daily behaviour can makes an immediate impact on a phase-out campaign. Participants should be encouraged to spread the message to their peers: family, friends and neighbours.

19. Efficient Lighting Initiative Online. (2004). Retrieved on January 20, 2012. Retrieved from: http://www.efficientlighting.net/FormerELI/argentina/highlights.htm
20. Calwell, C. Granda, C., Gordon, L. and Ton, M (1999). Lighting the Way to Energy Savings: How Can we Transform Residential Lighting Markets? Volume1: Strategies and Recommendations. Ecos Consulting. Prepared for the Natural Resources Defense Council, San Francisco, California.

Case Study: Philippines – Promotional Events

The Philippine Energy Efficiency Project demonstrated the societal benefits of energy efficiency projects in the commercial, residential and public sectors. From a consumer communications perspective, it sought to promote public awareness of the initiative and to facilitate the adoption of energy efficiency in daily life. To accomplish this, "public learning events" were held across the country which involved public discussions and forums. An "energy consciousness month" was also celebrated to showcase energy efficient lighting technologies and initiatives and to promote energy conservation at home.
These events promoted the prospect of improving economic and social conditions, appealed to citizens' concern about the future and their commitment to the common good. Promotional material was distributed which highlighted these messages and provided valuable energy efficient lighting tips. The events proved to be very successful in generating interest and encouraging participation in the programme.

7.9 Community-Based Initiatives

Community based initiatives utilize trusted sources such as community leaders or volunteers to engage consumers in a dialogue about the importance of making a small change and to provide a tool to enable action.[21] Two such initiatives sought to mobilize consumers to take action by distributing complimentary lamps, rather than just explaining the amount of money and energy that could be saved from replacing incandescent lamps with CFLs. This created a sense of reciprocity whereby homeowners were inspired to change their behaviours from the initial installation to repeated purchases of CFLs.

Case Study: North America - Community-Based Marketing

Green Light New Orleans in the U.S.A. and Project Porchlight[22] in Canada both enlist volunteers to install CFLs. The volunteers must attend an information session where they are briefed on the programmes, including; the purpose and goals, expected conduct, safety and how to engage residents. The volunteers highlight the connection between energy efficiency, monetary savings, and carbon emission reduction with each programme participant to promote awareness and detail the purpose of the installation.

In addition to the CFL installation programme, Green Light has expanded its outreach in an effort to engage all residents. They teach elementary-age youth, partner with local high school clubs and university courses to develop youth leaders through community service, and manage an efficient lamp programme for small businesses and churches.

7.10 Educational Programmes

To widen the reach of a phase-out campaign, especially regarding its non-commercial side, educational and training programmes carried out in schools or in workplaces can be very effective tools to directly reach specific primary audiences (such as school children and employees) and, indirectly, secondary audiences (such as parents, grandparents, and educators). Such programmes can also involve competitions aimed at inspiring the use of efficient lighting and thereby increasing their awareness about efficient lighting market trends. The primary advantage of educational programmes is that the information provided usually enjoys higher credibility than information channelled via advertisement or public relations.

Case Study: Argentina – Teacher Education Campaign

In Argentina, a training programme was developed for teachers to introduce the environmental, social and economic benefits of efficient lighting into primary and secondary schools. Training workshops were held and participants were provided with educational guides for the teachers, together with programme and activity information to be used with their students.

This environmental education programme was sponsored by government departments including the National Ministry of Education, the National Secretariat for Sustainable Development and Environmental Policy and Education and/or Environment Secretaries or General Directorates of cities and provinces. Over 6,000 schoolteachers participated in these workshops, reaching an over 300,000 pupils. Additionally, an educational contest was developed which was open to all school children in the country. It was divided into two categories, one for primary and the other for secondary schools. For the first group, the objective was an artistic work on the benefits of saving energy, emphasizing efficient lighting. The second group was asked to conduct research leading to a report on subjects dealing with energy use, climate change and efficient lighting as it relates to the society, the economy and the environment. Winners were award prizes of a personal computer with printer.

21. One Change. "Our Approach Community-Based Social Marketing. Retreived on March 15, 2012. Retrieved from: http://www.onechange.org/our-approach-community-based-social-marketing
22. Photo reproduced with permission of OneChange.org © 2012

Case Study: United Arab Emirates – "The Heroes"

'The Heroes' is an educational campaign launched at the beginning of 2009 in the United Arab Emirates the purpose of which was to convince consumers to reduce their energy consumption and to promote sustainable lifestyles. The educational campaign was an initiative of the Emirates Wildlife Society in association with the World Wide Fund for Nature and the Environment Agency - Abu Dhabi. More than 150 schools took part in the campaign, resulting in the distribution of 40,000 CFLs, a proliferation of 'information corners' in shops, and initiatives for businesses.[23]

7.11 Public Relations

When launching any efficient lighting communications campaign, it is important to conduct public relations activities simultaneously, if possible. Although advertising is useful for gaining the attention of the consumer, public relations activities allow the communication of more detailed information and add extra importance to the phase-out programme. Like advertising, public relations should be considered as complementary to other communication tools that more directly influence buyer decisions with regard to the purchase and use of efficient lighting.

To increase the credibility and visibility of public relations, well-known personalities and/or high-ranking officials within a country or organisation can be enlisted to support the phase-out programme. Celebrities may serve not only to create and maintain attention but also to achieve high recall rates for communications messages in today's highly cluttered media environments. In some regions of the world, sports figures, such as soccer players, may be enlisted to deliver messages which may generate higher appeal, attention and recall than those executed by unknown spokespeople. Caution should be taken into account when employing celebrities to ensure promise, believability and delivery of an efficiency claim. They must be credible sources and be able to inspire aspiration an action with regard to the environmental or product message that they endorse.

In South Africa, Bonesa and the Nelson Mandela Children's Fund joined forces to promote the use of energy efficient lighting technologies.[24] Proceeds from the sale of each CFL over the duration of the programme were donated to the Fund for use by the fund and the Nelson Mandela Foundation. Although all of their efficient lighting activities were fully supported by relevant advertising and press releases to the national and trade media, one of the most celebrated aspects of the campaign was ex-President Nelson Mandela himself officiating at the official launch of the Efficient Lighting Initiative in South Africa.

Case Study: Morocco – Integrated Campaign - Market Transformation for Energy Efficient Lighting

In 2009, the Moroccan Ministry of Energy, Mines, Water and Environment launched a communications campaign, primarily targeting households, to achieve sustainable energy savings and to support the strategies of the National Plan of Priority Actions[25]. The design of the communications plan was based on the findings of a previous baseline study regarding the perceptions, attitudes, and behaviours of the general public towards energy savings. This communication campaign had three main goals:

- Educate consumers about energy issues (such as increasing energy costs, primary energy dependence, natural resources leakage, and global warming)
- Encourage and support changes in behaviour through the introduction and dissemination of energy efficient products
- Develop the concept of a 'responsible citizen' to demonstrate the personal and social benefits that would result from changes in behaviour with regard to energy usage

The communication campaign consisted of three components including television and radio advertisements, printed materials and other related activities. During the first phase of the communication campaign a general television and radio advertisement was broadcast to highlight the issue of the energy consumption challenges in Morocco and to promote participation in the programme. During the second phase of the campaign, a series of additional related advertisements were aired to inform the public how to use energy more efficiently and thus, contribute to achieving success for the programme. One of the advertisements explained the advantages of using CFLs instead of inefficient incandescent lamps and invited electricity consumers to contact their electricity utility to benefit from the CFL programme.

Together with the television and radio advertisements, the communication campaign included the distribution of printed materials. Additionally, specific awareness-raising activities informed lighting consumers about the benefits of energy efficiency and energy savings. Several handbooks were published and seminars were held on practical and effective methods for energy demand management.

Municipalities also played a major role in ensuring the success of the energy efficiency policy and staff received training to improve their energy efficiency knowledge. The training included energy conservation handbooks and seminars to enable municipal officials to incorporate energy efficiency and savings measures into their municipal management and development plans. An 'Energy Efficiency' trophy was also introduced and awarded each year to encourage competition among municipalities with regard to improving energy efficiency savings.

23. The Heroes of the UAE. Retrieved October 2011. Retrieved from http://www.heroesoftheuae.ae/en
24. Efficient Lighting Initiative Online. (2002). Retrieved on February 15, 2012. Retrieved from: http://www.efficientlighting.net/FormerELI/south_africa/hightlights.htm#2
25. Retrieved on April 12, 2012 from: http://www.thegef.org/gef/sites/thegef.org/files/documents/document/09-07-2011%20Council%20document.pdf

8. Crafting the Messages

8.1 Communicating the Benefits

Achieving energy conservation through efficient lighting makes sense from many perspectives, and its benefits impact all businesses and citizens within a country. The simple transition to energy efficient lighting helps to reduce the strain on a country's electricity system, ensuring a more reliable supply of power for all users. It also reduces the need for investment in generation and transmission resources, as well as the need for expensive imports of electricity from neighbouring countries.
The methods required to communicate the benefits of a phase-out programme should be as simple as possible and relevant to the audience. Messages should make the desired behaviour attractive and easy and demonstrate benefits to end-users. Usually, monetary savings are a strong motivator in all communications campaigns about efficiency, but in some developing countries, messages that tap into a sense of national pride may resonate as strongly.

Beyond primary messages about energy, money savings and convenience (long-life), communications can be most effective if they convey how efficient choices are personally relevant to end users. Messages should tie into the motivation of target audiences and, if possible, make an emotional connection. For consumers, this might include statements such as "energy efficient products are the right choice for your family" or "efficient products improve the comfort of your home and protect the quality of your environment."

Communication campaigns should always accentuate the positive and focus on the range of benefits and outcomes that end users will enjoy as a result of seeking out and selecting efficient lighting products. If end users can feel good about the outcome, they are more motivated to take an interest in seeking out information and to understand why it is meaningful to their purchasing decision. Dry, factual messages will have less impact than positive, beneficial statements. Many early energy-information programmes failed because they simply made information available without a serious effort to use psychologically motivating messages.

Programme implementers should avoid developing complicated or highly technical text, graphs or charts. Messages should be factual enough to be compelling but also user-friendly and simple enough to be memorable. Campaign messages can take various forms, depending on the audience at which they are targeted, but many successful campaigns focus on the following:

- Monetary savings
- National pride
- Energy efficiency and energy savings
- Convenience (long-life)
- A simple switch
- Environmental responsibility
- Political and economic advantages

8.1.1 Monetary Savings

Monetary and energy savings realised by the use of efficient lamps can act as a strong motivator for consumers and serve as the core message of an efficient lighting campaign. Messages can be crafted around the concepts that: efficient lighting helps to reduce energy bills; and, although more expensive to purchase initially, these products last much longer and the monetary savings from reduced energy bills and far fewer replacement lamps will cover the higher initial purchase price. A good example is, "CFLs last up to ten times longer and save up to 75% of the energy of inefficient incandescent lamps."

8.1.2 National Pride

In cases where monetary savings are not the primary motivator, civic and national pride may be a compelling factor. Campaigns should emphasize benefits and utilise key messages that convey a sense of social and civic responsibility inherent in energy efficient behaviour or a sense that consumers are doing their part to preserve the environment. A sample message could be, "Purchasing and installing efficient lamps in my home makes my country a cleaner and safer place for future generations."

8.1.3 Energy Efficiency, Saving Energy and Reducing GHG Emissions

The message that is communicated in this case is that new strategies should be adopted that focus on reducing energy use through efficient lighting that conserves energy, rather than increasing electrical supply to meet increasing demand. Not only does this ease electricity outages by reducing demand, but also cuts smog and air pollution because it decreases the amount of fossil fuels burned to produce electricity. Cutting energy use saves consumers and businesses money. Through planned, cost-effective energy efficiency measures, governments and industry may be able to start phasing out coal-fired plants which will help reduce GHG emissions and provide a more reliable electricity system. For example, decades of experience in North America have proven that it is significantly less expensive to invest in energy efficiency than to build or even maintain polluting sources of electricity supply.

8.1.4 Convenience

End users who are used to frequently replacing spent incandescent lamps often are surprised by the longer average life of efficient lamps. Messages targeted towards the convenience of not having to replace lamps on a regular basis, especially in hard-to-reach locations, can resonate well. Another message that is impactful, especially for elderly and rural populations, is the fact that using energy efficient, long life lamps not only provide better value for their money, but also reduces the need for regular trips to purchase replacement lamps.

8.1.5 A Simple Switch

End users need to be made aware that CFLs and LED lamps are simple and direct replacements for inefficient incandescent lamps. With recent advances, quality lamps are now instant-on and flicker free, fit into standard sockets, and emit the same amount of light. Many efficient lamps are also dimmable, so they can be used virtually anywhere in a residential or office setting. They are also available in a wide range of colour temperatures, shapes, sizes and wattages so there are many choices for end users.

8.1.6 Environmental Responsibility

Environmentally focused messages appeal to a sense of social responsibility and should be crafted to show the relationship between energy consumption and stress on the environment. Efficient lamps require at least two-thirds less electricity than the inefficient incandescent lamps that they replace. Since CFLs last up to ten times longer than regular lamps, they can last for over five years, which keeps at least 10 incandescent lamps out of the landfill. LED lamps can last much longer, up to 25 years if used approximately three to four hours per day. This represents a significant reduction of solid waste. Efficient lamps generate less heat than do inefficient incandescent lamps, so air conditioning load is reduced in hot regions. A national efficient lighting strategy and action plan signifies that a country takes its environmental responsibilities seriously.

8.1.7 Political and Economic Advantages

Countries reap many benefits from the transition to energy efficient lighting including: improved security of energy supply; greater system stability; reduced exposure to price volatility on both the electrical and fossil fuel markets; reduced per capita spending on the energy system; reduced emissions of air pollutants and GHGs; creation of new local and regional green jobs. Governments, industries and individuals are working together worldwide to launch new businesses in lighting technology and product development, manufacturing, distribution, marketing, sales, and installation and maintenance.

Efficient lamps can reduce electricity bills, a valuable opportunity for every residential electrical customer, homeowner, business, industry and institution to save money. Lamp replacement is cost-effective for all sectors and helps to make businesses more competitive. The price of electricity will rise over time, so conserving with efficient lighting can help to control expenses for the essential service of light.

8.2 Addressing Complex Issues

Crisis communication strategies should be developed and put in place from the start of a phase-out programme and may be used to address situations such as; the opening of a new production or recycling facility, or incidents that attract public attention or raise health concerns. Effective risk communication is a two-way process through which end users can express their concerns and know that they will be addressed. A one-way, top-down communications approach may undermine perceptions that the information is trustworthy. Addressing issues immediately reduces perceived risks and empowers consumers to manage the risks effectively, thereby giving them control over the situation. For more information, refer to Section 5.

It is essential to ensure end user participation and maintain public education and awareness efforts throughout a phase-out programme. Communications professionals must be able to address sensitive issues that may arise with the usage of CFLs from individuals or the press, such as those identified below. Information can be disseminated in multiple ways such as through printed material, online and through other traditional media. It is important to involve community civil organizations in information and outreach activities as well. For more technical information about health and safety issues associated with the use of mercury-added lamps (see Section 5).

8.2.1 Mercury in CFLs

Communicating about the mercury content of CFLs is important, as misinformation can create a significant barrier to the success of a phase-out project. Mercury is the only existing element that produces the ultraviolet (UV) radiation needed to make CFLs operate. Only a very small quantity of mercury is required to operate a CFL. On average, a CFL for indoor residential use contains the smallest quantity of mercury of all mercury-containing personal and household products. From a communications perspective, useful comparisons that can be made include the fact that a CFL contains about the amount of mercury to cover the tip of a ballpoint pen; there is up to five times the amount of mercury in a watch battery; between 60 to 200 times the amount of mercury in a single “silver” dental filling, depending on the size of the amalgam; 100 to 200 times the amount in old-style thermometers; and about 500 times the amount in old thermostats used to adjust heat in homes[26]. There is no risk of direct exposure to mercury when the lamp remains intact. However, CFLs should always be handled with care to prevent breakage and disposed of properly.

In areas where CFLs have been introduced as part of phase-out activities, many common questions have arisen and require responses. Frequently asked questions (FAQs) have been posted on the websites of governments, manufacturers, retailers, lighting associations and on many other sites of those involved in a phase-out initiative. Some common FAQs and recommended responses are:

Do LED lamps or CFLs contain mercury?
LED lamps do not contain any mercury. Very few LED lamps—models that are made and sold for special purposes where very high colour rendering is required—use other elements to emit UV radiation that is subsequently converted by phosphors to visible radiation. CFLs contain a small quantity of mercury, a toxic substance, sealed inside the glass tubing. Mercury is an essential part of a CFL; it enables the lamp to emit light efficiently. No mercury is released when the lamps are intact or in use so it is important to handle the lamps carefully and dispose of them properly.

26. Natural Resources Defense Council. (2011) Compact Fluorescent Lights Are Safe for Your Home. Retrieved on February 15, 2012. Retrieved from: http://www.nrdc.org/energy/cfl.pdf

How do CFLs account for less mercury in the environment compared to incandescent lamps?
The burning of fossil fuels to generate electricity is the main source of mercury emissions. CFLs use less electricity than incandescent lamps, so CFLs require less electricity. Using less electricity for the same amount of light reduces electrical consumption and therefore reduces the amount of mercury released by fossil fuel-fired generation facilities. Nonetheless, CFLs should be recycled properly to avoid breakage and mercury release from spent lamps.

How should a broken CFL be cleaned up and disposed of?
The most important strategy is to prevent breakage in the first place; CFLs should be handled carefully. Should a CFL break, a small quantity of mercury is released as mercury vapour (gas). To minimize exposure to the mercury vapour, rooms should be ventilated immediately and best practice cleanup and disposal procedures should be followed (see Section 5).

8.2.2 Addressing Other Concerns

Where does UV come from?
UV is emitted from natural and artificial light sources, including the sun, welding equipment, and incandescent and fluorescent lamps used for specialty applications such as water and air sterilization. CFLs emit UV, but most of the UV emitted is absorbed by phosphors inside the lamp tube and then emitted as visible radiation.

Is the UV from CFLs hazardous to my health?
The amount of UV emitted from CFLs is so small that it is not considered hazardous to an end user's health. The results of studies have showed that, when either CFLs or incandescent lamps are operated at a distance of 30 cm or more from the user, UV emissions do not present a health risk to the general population[27]. Therefore, it is recommended that lamps are placed at least 30 cm from any user.

I have sensitivity to UV. How do CFLs affect this?
Although the amount of UV emitted by CFLs does not pose any issue for the average end user, some people have medical conditions that may make them extremely sensitive to UV. These individuals may be affected by the amount of UV emitted by CFLs. Those who have lupus or another auto-immune disease and certain skin conditions can be sensitive to the UV from CFLs, in the same way that they would be sensitive to sunlight and other lamps that emit UV. Precautionary measures for those with skin sensitivities can be found in Section 5.

What is an EMF and is it dangerous?
Electromagnetic fields (EMFs) surround all electrical equipment from appliances with power cords to outdoor power lines. Like other electric appliances, CFLs create EMFs that are well within the range produced by household wiring and other common appliances. Extensive research has not yet substantiated any adverse health effects caused by exposure to EMF. International scientific opinion has concluded that EMFs from CFLs are not considered to be a health risk[28].

Are headaches caused by CFLs?
When using older generations of fluorescent lighting systems operated on magnetic ballasts, some end users reported experiencing headaches or eye strain. Flicker, or noise, from magnetic ballasts that operated at low frequencies was visible, or audible, to some individuals. Today's CFL products use ballasts that operate at much higher frequencies (greater than 20,000 Hz), so most people cannot detect flicker or noise.

9. Communicating to the Media

Three tools are particularly useful for engaging the media—media advisories, media releases, and backgrounders. Annex B shows an example of a media advisory is used to invite media to an event and is usually no longer than one page. It is designed to provide all of the information the media need to know about an event and includes contact information in case of further enquiries.

A media release, as shown in Annex C, outlines a news story and explains its significance. It usually includes quotes from key people and important background information. A media release should be crafted like an article that appears in the newspaper, with a headline that will attract attention. As with the media advisory, it should include contact information should a journalist require additional details or to schedule an interview with a spokesperson. A backgrounder is a quick reference tool that outlines information about an organisation or issue.

9.1 Addressing the Media

The media are always searching for local stories of interest for their public, be it readers, listeners or viewers. To encourage journalists to cover the story, interviews can be offered with a key spokesperson from a ministry or organisation, ideally a senior official who can talk about energy efficient lighting in the context of a country-specific situation. The media material that is creates can be used to reach out to share the energy efficient lighting story in a particular area.

9.1.1 Print Media and Broadcast Outreach Techniques

- Email or fax the media release to the assignment desk, energy or environmental reporters and/or news desk at the local or national newspaper or magazine outlet
- Follow up with a telephone call to ensure that the information was received and to gauge interest

27. Health Canada. (February 2011). The Safety of Compact Fluorescent Lamps. Retrieved on February 15, 2012. Retrieved from: http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/prod/cfl-afc-eng.php
28. Ibid

- Stage a photo opportunity to create an engaging visual image that will capture the media's attention and provide it to them as part of an outreach strategy

9.1.2 Photo Tips

- Create an interesting backdrop by taking photos on location at an event or having props or signage
- Ensure that the photo is staged in a brightly lit area
- Focus in on VIPs (very important persons) and community leaders but do not have so many people in the image that it appears cluttered
- Provide the names and titles of everyone in the photo
- Obtain a photo release from any individuals who do not serve in an official public role.

10. Campaign Implementation and Monitoring

Programme implementation means following the communications plan while allowing for adjustments based on monitoring results as well as any circumstantial changes. Communications campaign managers must realistically balance goals and resources. Staff should have a mix of different marketing and programme management skills and experience with the target audience.
Campaign implementation consists of executing the activities designed in the planning phase, according to a specific time schedule. Effective implementation requires two types of skills — project management and diagnostic. Project management skills are needed to successfully manage the launch and ongoing operation of the campaign. Diagnostic skills are used to recognise whether or not the campaign fulfils its expectations and goals. If the campaign falls short of its goals, then problems must be addressed in a timely manner.

Monitoring should be planned from the outset of a programme. It is an important tool for providing information to the project management team to allow for marketing control during campaign implementation, and it provides data for the evaluation stage. Monitoring ongoing actions is needed in order to ensure the achievement of the goals. It helps to identify potential problems or conflicts so that corrective actions can take place immediately, in the case of continuous or long-term campaigns. For short-term campaigns that are repeated annually, corrections can be implemented in subsequent campaign cycles.
To assist in monitoring, performance indicators with target levels can be established. Typical performance indicators measure media impact in the form of the number of materials distributed, website visitors, event participants, TV campaign viewers, and numbers of installations. Others may relate to user opinions, satisfaction and participation.

11. Campaign Evaluation

The evaluation process is the most critical phase for the successful implementation of a communication campaign. Evaluations conducted by independent bodies help to ensure an unbiased view. The way in which the evaluation process will be conducted and what criteria will be used needs to be determined from the beginning, during the design phase. A budget for evaluation should be established in the planning phase. An evaluation involves systematic collection and analysis of information to determine the campaign's effectiveness in terms of whether or not, and to what extent, the campaign attained the predefined energy efficiency, programme recognition, or other objectives.

The steps in any communications campaign evaluation process include:

- Deciding on the evaluation objectives (from the outset);
- Establishing how data will be collected (during the campaign);
- Conducting the evaluation and reporting the results;
- Using the results of the campaigns evaluated.

11.1 Evaluation Objectives

Evaluation objectives include; formative, process, impact, and economic evaluation objectives. The formative evaluation is a prerequisite for the others. The effectiveness of the campaign is measured by means of process, outcome and economic evaluations.

Table 2: Efficient lighting communication campaign evaluation objectives[29]

Evaluation objectives	Purpose	Area of feedback
Formative	Assess the strengths and weaknesses of campaign materials in relation to the target audience and chosen media before they have been finalised (before the campaign's implementation)	• Messages (determining what messages work with the target audience) • Material (TV spots, billboards, etc.) • Teamwork (work method and organisation)
Process	Assess the campaign's implementation and how the activities involved are working (during and at the end of the campaign's implementation)	• Planned tasks implemented • Number of stories appearing in the media • Number of stakeholders involved • Quantity of materials distributed • Number and type of people (end users) reached by the campaign • Number of people reached who understood the messages
Impact	Measure effects and changes that result from the campaign and the outcome of the campaign	• Decision to buy an efficient lamp • Energy saved by replacing inefficient lamps
Economic	Measure the campaign's cost effectiveness	• Delivers a cost-effectiveness or cost-benefit analysis

The formative evaluation provides feedback about a campaign's components and evaluation tools. This step usually takes place before the campaign implementation begins, in order to collect information that can help to structure the campaign.

The process evaluation assesses the campaign to improve its design, its delivery, and the usefulness of the quality of services delivered to the consumer.[30] The components of process evaluation include: questionnaires and interviews with stakeholders; site visits; review of programme reports; review of the monitoring results; and assessment of the impact evaluation results. Results from this evaluation help interpret the results of the other evaluations.

The impact evaluation assesses the effectiveness of the campaign, for example, if it was effective in persuading end users to purchase efficient lamps. The evaluation also documents the outcome of the campaign, for example, the total energy saved by the phase-out of inefficient lamps. Examples of impact evaluation following an efficient lighting campaign include: changes in investment and buying decisions; energy savings; and, market transformation. Evaluators' tools include: questionnaires; interviews;opinion polls and consumer panels. All evaluations should include both target groups and non-participant control groups to measure differences—either before and after campaign, or, with and without influence of the campaign. Without a control group, changes cannot be attributed accurately to the campaign.

The economic evaluation assesses the campaign's cost-effectiveness. This evaluation can be carried out through a cost-effectiveness analysis, which relates the cost of the campaign to its performance by measuring outcomes in non-monetary form, or through a cost-benefit analysis, which compares monetary benefits with the costs of the campaign and is a measure of its efficiency. Methods used for gathering quantitative data for conducting evaluations include:

- Direct measurement (end-use load data)
- Billing analysis (energy bills or energy sales data)
- Simple engineering estimate (without on-field inspection)
- Enhanced engineering estimates (with on-field inspection)
- Sales data from manufacturers and retailer/wholesalers participating in the programme

11.2. Conducting the Evaluation and Reporting the Results

Conducting an effective evaluation requires the effective collection and analysis of data. Data should be collected using at least two measurements. The first baseline measurement should be gathered during a pre-campaign period. The second, and any additional, measurement should be taken during the post-campaign period to collect information on impact of the campaign. In addition, data should be collected from at least two groups—people who were exposed to the campaign (experimental group) and people who did not participate in the campaign (control group).

The use of a control group will help determine whether changes in efficient lighting purchasing decisions are due to the campaign itself,

29. CLASP. Adapted from Guidelines on Designing and Implementing Communications Campaigns for Labeling and Standard-setting Programs. Retrieved on December 1, 20111. Retrieved from: http://www.clasponline.org/en/ResourcesTools/Resources/StandardsLabelingResourceLibrary/2005/~/media/Files/SLDocuments/2005_SLGuidebook/English/SLGuidebook_eng_11_Chapter7.pdf
30. Spinney, P., Peters, J.S. and O'Rourke, P. (1992) DSM Process Evaluation: A Guidebook to Current Practice. PR-100647. Palo Alto California: Electric Power Research Institute.

or to other factors unrelated to the campaign. For example, in the case of an inefficient incandescent lamp phase-out campaign, the outcome evaluation may reveal a reduction in incandescent lamp sales. However, this reduction could be caused by the implementation of new legislation (such as the introduction of minimum energy performance standard) and not by the campaign. The use of control groups will show whether both groups have demonstrated the same changes. If the changes are the same for both groups, they were not likely a result of the campaign itself.

The reporting of campaign activities and results can take different forms and be tailored to diverse audiences. For example, institutions may be interested in how to extend or improve results to meet future environmental goals; academia may be receptive to new findings and the implication of studies; and, politicians may wish to emphasize the local perspective to engage news media.

11.3 Using the Results of Evaluated Campaigns

New programmes should build on the results of successful campaigns and avoid the mistakes of past campaigns. Rigorous evaluation is valuable for both current and future campaigns. Evaluation can save time, effort and expense and help improve results in subsequent campaigns. Sharing the results of programme evaluations provides insights and documents benefits that were unexpected by programme designers, and thus can lead to new strategies for future efficient lighting programmes. For example, many lighting programme designers have learned about best practices for conducting communication campaigns for CFL market transformation programmes by attending or reading the papers presented at conferences such as the Energy Efficiency in Domestic Appliances and Lighting (EEDAL) Conference and at summer studies organized by the American Council for an Energy-Efficient Economy (ACEEE) and its European counterpart the European Council for an Energy Efficient Economy (ECEEE).

Table 3: Utility of an evaluation[31]

To current campaign	To future campaigns
Learning whether the proposed materials are suitable for the target audience	Providing useful information in order to minimize the risk of implementing inappropriate future campaigns
Knowing if the campaign is reaching the target audience	Providing information to reach similar target groups
Supervising the implementation of the campaign, and intervening in the operation of the project if needed	Providing information to improve the implementation of future campaigns
Testing the theoretical framework of the campaign	Providing useful theoretical frameworks
Making sure the campaign reaches its objectives	Demonstrating accountability to the funding sources, stake-holders, policy makers, and the public
Finding out whether the campaign has any unexpected benefits or problems	Collecting good ideas and avoiding poor ones
Demonstrating the campaign's cost-effectiveness and efficiency to its financiers or to society	Facilitating future fund raising

The level of evaluation may vary considerably. For some campaigns, lower level of effort may be required due to available resources, project size and the type of activity. It may also be a challenge to estimate energy savings and emission reductions attributable to the campaigns for example, where increased energy prices may have contributed substantially to observed savings. When comprehensive evaluations are undertaken, the results can make a strong case for the funding for future campaigns. In all cases, information for evaluation is relatively straightforward to collect when it is planned from the outset. Competent reporting and candidness in the dissemination of evaluation results enhances the learning process by portraying the strengths and weaknesses of the campaign and will assist in integrating the lessons learned into more effective campaigns in the future.

Conclusions

A well-planned and thoughtfully presented awareness-raising campaign can be one of the most efficient and effective means of disseminating information about efficient lighting alternatives. The success of any communication and awareness raising campaign depends on its design, especially with regard to planning, implementation and evaluation. The design phase of any such campaign should follow a rational approach of answering – in an integrated manner – the 'why, who, when, how, what' aspects of the campaign.

Planning is crucial for implementing a communications campaign. Planners and campaign managers must have a good understanding of the local market needs, driving forces and the prevailing market conditions. Goals and objectives need to be balanced with available resources and attention must be paid to the timing of the activities.

Ideally, campaigns should be based on market segmentation which allows for better focus, use of targeted media and more efficient

31. Trochim, W.M. The Research Methods Knowledge Base, 2nd Edition. Internet WWW page at URL: http://www.socialresearchmethods.net/kb (version current as of October 20, 2006). Retrieved July 23, 2011.

use of resources. Extended campaigns with a repetition of key messages are more effective than singular campaigns. Campaign resources can be augmented and enhanced by cooperation with partners, suppliers, retailers and other stakeholders.

The process of awareness-raising must meet and maintain the mutual needs and interests of the stakeholders. An integrated approach to a communications campaign helps to reach all identified target groups and to account for socio-economic factors, language and access to media. For an efficient lighting communications campaign, the audience might consist of not only the general population or specific demographic groups, such as low-income households, but also include the supply-side stakeholders such as; manufacturers, trade associations, equipment distributors, retailers, or sales cooperatives. Therefore, target group requirements need to be completely understood, communication channels need to be chosen carefully, and messages must be adapted appropriately.

Given the complexity and multitude of lighting energy-use patterns and target groups to be addressed, a focused and tailored approach is needed. The success of a communications campaign depends on the engagement of all those involved in an inefficient lamp phase-out programme. Each stakeholder has a role to play in understanding and delivering the important efficient lighting message which will ultimately lead to a successful national transition to energy efficient lighting.

Annex A: Memorandum

[NAME OF RECIPIENT]
[POSITION OF RECIPIENT]
[ADDRESS OF RECIPIENT]

MEMORANDUM: THE BENEFITS OF A PHASE-OUT PROGRAMME FOR INEFFICIENT LAMPS IN FREDONIA

BACKGROUND

According to the International Energy Agency, lighting accounts for 2,650 TWh/year or 19% of global electricity use. The resulting emissions of 1,889 Mt CO_2 /year are equivalent to 70% of world's passenger vehicle emissions. The phase-out of inefficient incandescent lamps and their replacement with higher efficiency lamps offers one of the most straightforward and cost-effective mechanisms to:

- Reduce dependence on energy imports and contribute to improving security of supply. For example, a compact fluorescent lamp (CFL) uses a quarter of the energy and lasts up to ten times longer than an inefficient incandescent lamp. The introduction of CFLs alone would result in a reduction of energy consumption for lighting of 80%
- Generate energy savings and increase disposable income for lower-income households
- Achieve significant emissions reductions and combat climate change
- Provide societal benefits, especially with regard to increased productivity, employment opportunities and improved living environments

A phase-out of inefficient incandescent lamps can be achieved without reducing the quality of light. A phase-out is rapid, effective and requires relatively small capital expenditure. A phase-out encourages the introduction and adoption of high efficiency products, including CFLs and LED lamps. The financial benefits outweigh the costs even before considering the benefits of reducing GHG emissions and improving a country's environmental profile. Although the initial cost of new, efficient lamps may be higher than the cost of inefficient lamps, the operating and life cycle costs are significantly lower.

AN OPPORTUNITY FOR FREDONIA

In Fredonia, the total annual electricity consumption is 18.5 TWh/year and the emissions from fuel combustion are 51.4Mt of CO /year. Current trends show growing electricity demands due to the electrification of rural areas and overall economic growth;

- A well designed national efficient lighting strategy would generate the following benefits:
  - Annual reduction of 2.8 TWh in lighting electricity consumption, which is equivalent to the electricity generation of 1coal-fired power plant with a capacity of 500 MW, avoiding investments of approximately 500M USD to meet the increasing energy demand
  - Annual reduction of 1.1 Mt of CO_2, equivalent to the CO_2 emissions of 275,000 mid-size cars
- The required investment for the phase-out programme would be approximately 600 million USD. It would generate annual savings of 250 million USD at an average electricity rate per households of 0.09 USD/kWh
- The amortization time for the phase-out programme would be less than two years
- The phase-out of inefficient incandescent lamps would help to reduce electricity grid outages and peak energy demand, increasing business productivity, citizen's satisfaction and overall energy security
- Instead of spending resources on expensive and new power generation, the resources saved could be used to increase electrification or meet other development needs

THE UNEP/GEF en.lighten initiative SUPPORT OF FREDONIA

The economic, environmental and societal benefits of National Efficient Lighting Strategies are demonstrated by several successful practices across the world.

The en.lighten initiative acts a catalyst to transform markets to energy efficient lighting in developing and emerging countries. The en.lighten initiative is managed by the United Nations Environment Programme (UNEP) and is supported in its work on the technical, policy and sustainability aspects of lighting by the Global Environment Facility (GEF), private sector companies and a network of international stakeholders and efficient lighting experts.

To ensure that the transition to efficient lighting is effective and self-sustaining, the en.lighten initiative supports countries in the design and implementation of a cohesive set of national and regional actions to facilitate a sustainable phase-out through:

1. Minimum energy performance standards (MEPS) – establishing basic parameters to ensure the efficiency and quality of products.

2. Supporting policies and mechanisms – helping restrict the supply of inefficient lighting and promoting 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) – discouraging the distribution of non-compliant products through inspections, product testing, laboratory accreditation, fines and/or other relevant means.

4. Environmentally sound management practices – setting maximum hazardous content limits for products to safeguard health and the environment; providing guidelines on the use of lighting products; as well as plans for the collection, environmentally sound disposal and/or recycling of spent lamps.

There are clear financial, economic, development and climate benefits in developing a phase-out strategy for inefficient incandescent lamps. Freedonia should join the en.lighten initiative to receive expert advice and guidance to overcome existing barriers and design a national efficient lighting strategy using best international practices.

[CONTACT]
[SIGNATURE]
[ATTACHMENTS]

Annex B: Media Advisory

[HEADER - centered]

[Sub-header - centered]

[City], [Province/State], [Month], [Day], [Year] – [Description of event and some background information]

What: [Name of Event or Occasion]

When: [Date] [Time]

Where: [Location] [Address]

Who: [Attendees including name, title and organization]
[Speakers, if any, including name, title and organization]

For more information, please contact:

[Contact Name]
[Contact Organization]
[Contact phone number and email address]
[Website]

Annex C: Media Release

Regional Conference Focuses on the Transition to Energy Efficient Lighting in Southeast Asia
Government Officials Discuss the Phase-Out of Incandescent Lamps by 2016 to Save Over $1.6 Billion in Energy Costs

Paris, 9 November 2011 - At the United Nations Environment Programme (UNEP)/GEF en.lighten Workshop in Singapore on 4 November 2011, government representatives from 18 countries in Southeast Asia voiced their support for the phasing out of incandescent lamps. Such a move could save the region an estimated over US1.6 billion a year in energy costs.

The energy efficiency officials and climate change focal points that participated in the regional event included: representatives from the Ministries of Energy, Environment, climate change negotiators, national utilities, manufacturing, international organizations and NGOs. They unanimously agreed that the phase out of incandescent lamps is one of the easiest ways to reduce CO_2 emissions and achieve significant energy and financial savings.

The global transition to efficient lighting will follow an integrated approach which includes minimum energy performance standards; quality control mechanisms; and, policies and procedures which address all aspects of replacement products and practices, including sound disposal and recycling.

UNEP and partner organizations addressed countries in the region and key regional stakeholders and explored opportunities for governments to participate in a UNEP/GEF led globally coordinated effort to transition to efficient lighting as a key efficiency and climate mitigation measure. The emphasis was on the phase-out of inefficient incandescent lamps, the most common type for consumers.

The en.lighten initiative is funded by the Global Environment Facility (GEF), implemented by the United Nations Environment Programme (UNEP) in partnership with leading global lighting manufacturers (Philips and OSRAM) and the National Lighting Test Centre of China (NLTC), to accelerate market transformation of efficient lighting technologies on a global scale.

UNEP has created a Centre of Excellence on Efficient Lighting, consisting of top international experts, to provide guidance and technical support to countries that partner with the en.lighten initiative to develop national efficient lighting strategies and plans.

The en.lighten global partnership aims to restrict the global supply of inefficient lamps and promote market adoption of most efficient alternatives by way of an "integrated approach" including:

- Technical support developed by international lighting experts for countries willing to implement national efficient lighting strategies and join the en.lighten partnership
- Adoption of globally harmonized minimum energy performance standards (MEPS) leading to the phase-out of all incandescent lamps by 2016
- Establishing monitoring, verification and enforcement programs in countries to ensure compliance with global standards and eliminate quality products from the marketplace
- Supporting countries to establish comprehensive waste management efforts including: collection, sustainable disposal and/or recycling of spent lamps
- Country support activities such as communications best practices, policy frameworks and innovative finance mechanisms to encourage and support the transition to efficient lighting

Country Lighting Assessments have been generated for 100 countries around the world to explain the significant savings potential of the transition to more efficient lighting.

In the eleven countries from Southeast Asia analyzed, electricity consumption is over 22 Twh producing about 16 million tons of CO_2 per year. Phasing out inefficient lighting in the region would save around 16.5 Twh of electricity (an average of nearly 75%) and slash 11.8 Mt of CO_2. This is equivalent to removing about 2.9 million vehicles off the road.

Indonesia could save 1 billion USD yearly in reduced electricity bills. Around 8% of electricity consumption in Indonesia originates from incandescent lamps. This would save the equivalent emissions of 2 million mid-sized cars per year.

Many countries in the region have already begun initiatives to transition to efficient lighting, yet an integrated and more coherent approach is needed in order to ensure that efficient and good quality products are available in the region.

The Philippines became one of the first Asian countries to transition to efficient lighting. In 2005, the Philippine Efficient Lighting Market Transformation Project (PELMATP) integrated 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 CO_2).

In 2010, the Malaysian Government committed to reduce carbon intensity by 40% by 2020. The phase-out of incandescent lamps, to be implemented in two stages, is a cornerstone of this policy. The first phase, from January to December 2011, involves halting all production, import and sales of >100 W lamps. The second phase, from January 2012 until the end of 2013, will see an end to the production, import and sales of all other lamps.

In order to ensure sustainable programs and results, the countries in Southeast Asia must quickly adopt strategies to address their own situation and resources. The UNEP/GEF en.lighten initiative offers a comprehensive and rapid support plan, through its Global Partnership Program, for countries to access the regulatory or voluntary-based elements that they may lacking without having to recreate what has already been established by other governments.

EDITORS' NOTES:

- Over 20% of the electricity consumed in Laos originates from incandescent lamps
- Electricity consumed by incandescent lamps in Vietnam amounts to 2.5% of total electricity consumption. Using current economic and energy-efficiency trends, it is projected that global demand for artificial light will be 60% higher by 2030 if no switch occurs.
- Lack of awareness about the energy saving and financial benefits of efficient lamps is a key deterrent for their market penetration in developing countries
- Incandescent lamps have already been phased-out or are scheduled to be phased-out in most OECD countries, Brazil, Mexico, South Africa, Argentina, and Senegal. Malaysia, Philippines and other developing countries
- The International Energy Agency (IEA) estimated in 2007, the total electricity consumption due to lighting at 2650 TWh. This represents almost 19% of global electricity use (15-17% greater than nuclear or hydro power).
- The total global GHG emissions accrued to lighting electricity consumption was estimated in 2005 by the IEA at 1,900 $MtCO_2$ of which grid based lighting systems contribute to 1,528 $MtCO_2$. This is equivalent to approximately 8% of world emissions or 70% of the world passenger vehicle emissions.
- Up to 95% of the energy emitted by incandescent lamps is heat, and their efficiency is inherently low. In comparison, incandescent lamps last around 1,000 hours which is significantly shorter than efficient lamps which can last up to 12,000 hours. Dimmable CFLs are also available.
- Like all fluorescent lamps, CFLs contain mercury, which complicates their disposal. Mercury is a hazardous substance in fluorescent lamps. The en.lighten initiative will support countries in setting up environmentally sound management approaches for spent lamps.
- The average mercury content in a CFL is about 3 mg – roughly the amount it would take to cover the tip of a ball-point pen. By comparison, older thermometers contain 500 mg of mercury – the equivalent of more than 100 CFLs.
- Experts emphasize that mercury is also emitted from coal-fired power stations. Studies indicate that the level of emissions from power stations attributable to inefficient lamps are far higher than those linked with the disposal of CFLs and other efficient lamps.

CONTACT:

Laura Fuller, Communications Officer, UNEP en.lighten initiative at laura.fuller@unep.org or by phone at +33 1 44 37 42 54

ABOUT UNEP:

Created in 1972, UNEP represents the United Nations' environmental conscience. Based in Nairobi, Kenya, its mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations. UNEP's Division of Technology, Industry and Economics - based in Paris - helps governments, local authorities and decision-makers in business and industry to develop and implement policies and practices focusing on sustainable development. The Division leads UNEP's work in the areas of climate change, resource efficiency, harmful substances and hazardous waste.

The United Nations Environment Programme (UNEP)/Global Environment Facility (GEF) en.lighten initiative has been established to accelerate a global market transformation to environmentally sustainable lighting technologies by developing a coordinated global strategy and providing technical support for the phase-out of inefficient lighting. This will lead to a significant reduce of global greenhouse gas (GHG) emissions to mitigate climate change. The en.lighten initiative assists countries in accelerating market transformation with environmentally sustainable, efficient lighting technologies by:

- ***Promoting high performance, energy efficient technologies and highlighting best practice initiatives in developing and emerging countries;***
- ***Developing a global policy strategy to phase-out inefficient and obsolete lighting products resulting in the reduction of GHG emissions from the lighting sector;***
- ***Substituting traditional fuel-based lighting with efficient alternatives, with an emphasis on environmentally sound management practices***

The en.lighten initiative was created in 2009 as a partnership between the United Nations Environment Programme , OSRAM AG and Philips Lighting with the support of the Global Environment Facility. The National Lighting Test Centre of China became a partner in 2011.

www.enlighten-initiative.org

www.unep.org

United Nations Environment Programme
P.O. Box 30552 Nairobi, Kenya
Tel.: +254-(0)20-762 1234
Fax: +254-(0)20-762 3927
E-mail: uneppub@unep.org

UNEP

For more information, contact:

UNEP DTIE
Energy Branch
15 rue de Milan
75441 Paris CEDEX 09
France
Tel: +33 1 4437 1450
Fax: +33 1 4437 1474
E-mail: uneptie@unep.org
www.unep..org/energy

en.lighten initiative
22 rue de Milan
75441 Paris CEDEX 09
France
Tel: +33 1 4437 1997
Fax: +33 1 4437 1474
E-mail: en.lighten@unep.org
www.enlighten-initiaitve.org