UNEP

DEVELOPING MINIMUM ENERGY PERFORMANCE STANDARDS FOR LIGHTING PRODUCTS

GUIDANCE NOTE FOR POLICYMAKERS

JUNE 2015

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ACKNOWLEDGEMENTS

The United Nations Environment Programme (UNEP) and the author would like to thank the following individuals and organisations for their valuable comments and advice: Kathryn M. Conway, Laura Fuller, Marie Leroy, Gustau Mañez i Gomis and Moira Mathers, UNEP; My Ton, CLASP; Ruben Kubiak, DG Energy, European Commission; Martin Bachler, OSRAM; and Irene Klein, Kees van Meerten, Ron van den Braken and Annette Steinbusch, Philips Lighting.

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FOREWORD

Targeted energy efficiency measures can help countries achieve nearly half of the greenhouse gas emissions reductions necessary to put the world on a 2°C pathway by 2020, according to the International Energy Agency[1].

The United Nations Environment Programme (UNEP) estimates that replacing all the inefficient on-grid lighting globally with innovative, energy efficient alternatives would result in more than 1,000 terawatt hours (TWh) of electricity savings annually, which is equivalent to the annual electricity use of India and Mexico combined. This electricity saving is equivalent to more than $120 billion in avoided electricity bills and the reduction of over 530 million tonnes of CO_2 annually.

Many governments, businesses and organisations are already making positive changes by committing to a rapid transition to efficient lighting. Even so, vast opportunities and innovative solutions remain untapped. Countries and regions throughout the world need to adopt regulatory programmes that will remove the least efficient technologies from their marketplace, and stimulate the deployment of cost-effective, energy efficient technology replacements.

Minimum energy performance standards (MEPS) constitute the most cost-effective policy option to transform markets toward more energy efficient products. When effectively applied, in the context of an integrated policy approach, MEPS encourage manufacturers to improve the efficiency of their products or to introduce more efficient replacements.

This guidance note, entitled *Developing Minimum Energy Performance Standards for Lighting Products*, will help policy makers better understand the benefits of MEPS for achieving their energy efficiency goals, while providing practical advice and guidance to enable them to develop and implement effective policies.

This guidance note outlines an approach to integrating MEPS into national policies and strategies, with practical steps, checklists and tips reinforced by case studies that provide valuable learning from those already enforcing efficient lighting MEPS. The resources listed at the end of the document will enable them to explore further policy options for a sustainable market transition to energy efficient lighting.

This guidance is as valid for those countries that have not yet implemented MEPS for energy efficient lighting and appliances, as it is to those that have already started the journey and would like to review and update their regulatory mechanisms to account for more ambitious targets.

We hope that governments will be inspired by the case we present and will make it a reality by developing and implementing lighting MEPS in support of energy efficiency and climate change mitigation.

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1 International Energy Agency. 2013. *Redrawing the Energy-Climate Map.* Available at: http://www.iea.org/publications/freepublications/publication/weo-special-report-2013-redrawing-the-energy-climate-map.html

ABOUT THE UNEP-GEF EN.LIGHTEN INITIATIVE

The United Nations Environment Programme (UNEP)-Global Environment Facility (GEF) en.lighten initiative was established in 2010 to accelerate a global market transformation to environmentally sustainable, energy efficient lighting technologies, as well as to develop strategies to phase out inefficient incandescent lamps to reduce CO_2 emissions and the release of mercury from fossil fuel combustion.

The UNEP-GEF en.lighten initiative serves as a platform to build synergies among international stakeholders; identify global best practices and share this knowledge and information; create policy and regulatory frameworks; address technical and quality issues; and encourage countries to develop National and/or Regional Efficient Lighting Strategies.

The United Nations Secretary General's Sustainable Energy for All (SE4ALL) initiative selected the UNEP-GEF en.lighten initiative to lead its lighting 'Energy Efficiency Accelerator'.

The initiative is a public/private partnership between UNEP, OSRAM and Philips Lighting, with the support of the GEF. The National Lighting Test Centre of China became a partner in 2011, establishing the Global Efficient Lighting Centre, and the Australian Government joined in 2013 to support developing countries in Southeast Asia and the Pacific.

In 2015, based on the lessons learned from the UNEP-GEF en.lighten initiative, UNEP launched the United for Efficiency (U4E) initiative to support countries in their transition to energy efficient appliances and equipment, including room air conditioners, residential refrigerators, electric motors, distribution transformers and information and communication technologies.

UNEP gef en.lighten

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

ABBREVIATIONS AND DEFINITIONS

ACEEE	American Council for an Energy Efficient Economy
CCT	correlated colour temperature
CE	Conformité Européene
CFL	compact fluorescent lamp
CIE	Commission Internationale de l'Eclairage/International Commission on Illumination
CO_2	carbon dioxide
CRI	colour rendering index
EC	European Commission
eceee	European Council for an Energy Efficient Economy
EEA	European Economic Area
EFTA	European Free Trade Association
EISA	Energy Independence and Security Act (2007), US
EU	European Union
GEF	Global Environment Facility
GHG	greenhouse gas
Gt	gigatonnes
Hg	mercury
IEA	International Energy Agency
IEC	International Electrotechnical Commission
LED	light emitting diode
lm	lumen
MEPS	minimum energy performance standard
MW	megawatts
NAMA	Nationally Appropriate Mitigation Action
sr	steradian (SI unit of solid angular measurement)
SSL	solid state lighting
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States of America
W	watt

GLOSSARY

C

compliance: conforming to a rule, such as a law, policy, specification or standard. Also, fulfilment by countries/businesses/individuals of emission reduction and reporting commitments under the UNFCCC and the Kyoto Protocol. (UNEP 2012)

D

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 2009)

E

efficacy: see luminous efficacy.

G

greenhouse gases (GHGs): the atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Less prevalent, but very powerful, GHGs are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). (UNEP 2012)

I

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)

L

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)

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)

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. The luminous flux emitted in unit solid angle (steradian) by a uniform point source having a luminous intensity of 1 candela. (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; symbol: ηv or ϕv. (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)

M

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.

minimum energy performance standard (MEPS): a mandatory minimum performance level that applies to all lamp products sold in a market, whether imported or manufactured domestically. Note: The lamp MEPS can be technology neutral, or, it can apply to specific technologies. Most often the lamp MEPS includes a requirement relating to luminous output per unit input power demand, but it can also include other requirements such as lamp lifetime, colour rendering index, and other characteristics. MEPS are minimum requirements, not lamp product design standards, so manufacturers and importers are encouraged to innovate, and offer lamps that exceed the MEPS requirements, as a way of differentiating their lamps and adding value for the user.

GLOSSARY

O

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

P

p-n junction: a boundary or interface between two types of semiconductor material.

product life; lifetime: see rated lifetime

R

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 characterise and designate it. (IEC)

S

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.

T

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)

EXECUTIVE SUMMARY

This guidance note focuses on the development and implementation of minimum energy performance standards (MEPS) for energy efficient lighting. It is primarily aimed at countries that lack a regulatory framework, or those that have a regulatory framework but lack MEPS for efficient lighting. It aims to be a practical resource for governments on the processes to follow when establishing MEPS in a national market.

MEPS are regulatory tools that increase the energy efficiency of products. For lighting, they contribute to the phasing out of the least efficient lamps in a market by setting the minimum levels of energy efficiency that a lamp in a given class must meet before it can be sold. When effectively applied, MEPS, in conjunction with supporting policies, encourage manufacturers to improve the efficiency of their products or to introduce more efficient replacements. However, before MEPS are adopted, cost/benefit analyses must be performed to ensure that the associated regulatory measures provide a positive economic benefit to consumers. MEPS should be developed in consultation with all of the stakeholders involved in the manufacturing, sale and use of the products to which they apply.

Generally, policymakers have designed the energy efficiency performance MEPS for lamps around one of two different options:

⇨ **TECHNOLOGY-NEUTRAL** approaches that establish MEPS for lamps without specifying the light source technology. For example, the European Union (EU) phase out strategy allows any lamp to be sold if it meets the energy performance and other requirements of the MEPS[2].

⇨ **TECHNOLOGY-SPECIFIC** approaches that establish MEPS for lamps, but that only apply to certain light sources or technologies[3].

Successful market transformation strategies are designed for the long term, to ensure a complete and permanent phase out of inefficient lamps. Although MEPS offer a powerful tool in the transition to energy efficient lighting, they are just one component of an overall strategy required to ensure this complete and permanent phase out of inefficient lamps. The UNEP-GEF en.lighten initiative therefore recommends that MEPS be implemented as part of an integrated policy approach, as detailed in, *Achieving the Global Transition to Energy Efficient Lighting Toolkit*[4].

MEPS are the most sustainable option for achieving high levels of energy efficiency and for phasing out less efficient 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, reviewed and revised. The most important factor for programme success is a functional system of monitoring, verification and enforcement capable of ensuring full compliance of products with any regulatory measures.

It is strongly recommended that a structured, multi-step approach is followed when developing MEPS – with 'initiation steps' which need be conducted only once, and 'product steps' which are repeated for each category of lamp (or other product) to be regulated.

2 European Commission. 2014. *Energy Efficiency Products*. Accessed on February 2014: http://ec.europa.eu/energy/efficiency/ecodesign/eco_design_en.htm
3 Omnidirectional lamps for indoor illumination applications typically use one of the following light sources: incandescent; tungsten halogen incandescent; fluorescent; or, light emitting diodes.
4 United Nations Environment Programme. 2012. *Achieving the Global Transition to Energy Efficient Lighting Toolkit*. Available at: http://www.enlighten-initiative.org/ResourcesTools/EfficientLightingToolkit.aspx

INITIATION STEPS

1. **Establish a legal framework:** Review existing legislation and establish framework legislation to develop a legal basis for, and political commitment to, mandatory efficiency standards and energy labels.

2. **Appoint an administrative agency:** Assess existing institutional capacity for developing, implementing and maintaining a standards and labelling programme. Develop an overall standards and labelling plan and assign one government agency with primary responsibility for driving each element of the programme.

3. **Assemble a stakeholder group:** Identify the key relevant people in your economy who would be interested and invite them to participate in the process.

PRODUCT STEPS

4. **Gather required data:** Establish minimum data needs and develop a plan for collecting the data necessary to conduct analysis to support the programme. This includes information on the market, technology, engineering and usage of the product.

5. **Conduct an economic analysis:** Use cost-effectiveness analysis to determine the appropriate level of ambition for the regulatory measure(s).

6. **Harmonise testing:** To the greatest extent possible, harmonise energy performance test procedures with international protocols (such as International Electrotechnical Commission test standards) to facilitate testing and reduce barriers to trade.

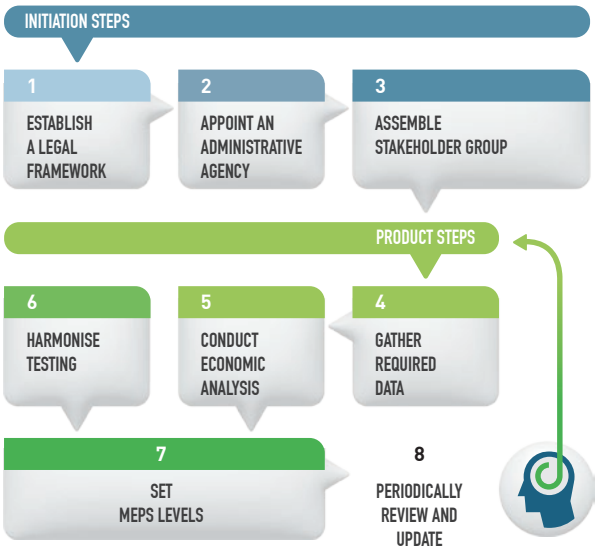
7. **Set MEPS levels:** Determine the technically feasible, economically optimal regulatory level; invite stakeholder comment and refine MEPS if necessary; secure political endorsement; publish regulatory notice; and specify a future date when MEPS will take effect.

8. **Review and update:** Plan to periodically review and update the standards every few years to ensure they remain appropriate and relevant.

If MEPS are to be adopted in a country or regional market, stakeholders should consider whether to harmonise with the existing lamp MEPS on those same products in their region, or with the lamp MEPS of a large trading partner. If one country in a trading region chooses to adopt MEPS that are not compatible with its neighbouring markets, this decision could increase cost and restrict the availability of energy efficient lamps. Manufacturers may need to perform different, or additional lamp tests; create unique labels and catalogue numbers for each market; and track, keep inventory and ship country-specific lamp products.

Harmonisation of MEPS offers many benefits that allow countries and the private sector to avoid the costs of duplicating testing and of non-comparable performance information and requirements. Stakeholders thus benefit from the removal of this administrative trade barrier and are able to leverage the better prices and choice of goods associated with the larger economies to which they are harmonised. Harmonisation of test standards enables multiple national markets to be accessible for the cost of only one test.

The success of any lamp MEPS 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.



Flow diagram illustrating the process of developing lamp minimum energy performance standards

1 INTRODUCTION

Electricity for lighting accounts for almost 20% of electricity consumption and 6% of CO_2 emissions worldwide. If not addressed immediately, global energy consumption for lighting is predicted to grow by 60% by the year 2030, with dramatic consequences for climate change. Minimum energy performance standards (MEPS) offer the fundamental foundation for any Government striving to halt this increase. This guidance note illustrates how to develop MEPS for lamps, based on a country-led national efficient lighting strategy.

MEPS are regulatory tools that increase the average energy efficiency of individual product classes. They contribute to the phasing out of the least efficient lamps in a market by setting the minimum levels of energy efficiency that a lamp in a given class must meet before it can be sold. As such, they provide the most cost-effective policy option for phasing out inefficient lamps and replacing them with more efficient lamps.

This guidance note aims to be a practical resource for governments on the processes to follow when establishing MEPS in a national market. Although the guidance focuses on, and gives examples of, non-directional household lamps and the phase out of incandescent lamps, it should be noted that the principles outlined can be applied broadly to lighting products and equipment, including for example fluorescent lighting, high intensity discharge lighting and solid state lighting. These principles could also be applied by policymakers to household appliances and commercial equipment, as well as other electrical products.

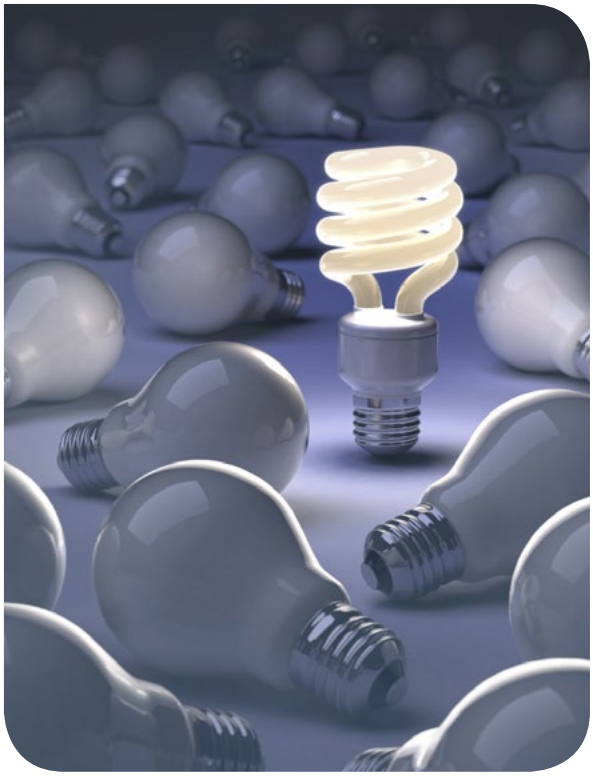
⇨ **CHAPTER 2** introduces the key considerations for MEPS, their advantages and disadvantages and key factors for their successful implementation.

⇨ **CHAPTER 3** presents a step-by-step process for developing MEPS, including the legal framework, the administrative agency, consideration of stakeholders and data requirements. This chapter includes economic assessment, harmonisation with other markets and regular review and updates of MEPS.

⇨ **CHAPTER 4** provides more detail on how harmonising MEPS lowers barriers to trade, gives consumers more choices and potentially lowers the retail price of lamps. It also includes case studies describing two of the most often considered examples of MEPS for single-base, omnidirectional lamps for indoor use.

⇨ **CHAPTER 5** recommends best practices for developing lamp MEPS.

⇨ **CHAPTER 6** provides information on additional resources.



2 KEY CONSIDERATIONS FOR MINIMUM ENERGY PERFORMANCE STANDARDS

When effectively applied, minimum energy performance standards (MEPS), in conjunction with supporting policies, encourage manufacturers to improve the efficiency of their products or to introduce more efficient replacements. This chapter introduces the key considerations for MEPS, their advantages and disadvantages and key factors for their successful implementation.

2.1 INITIAL CONSIDERATIONS

Before MEPS are adopted, cost/benefit analyses must be performed to ensure that the associated regulatory measures provide a positive economic benefit to consumers. MEPS should be developed in consultation with all of the stakeholders involved in the manufacturing, sale and use of the products to which they apply.

Generally, policymakers around the world have designed the energy parameters for MEPS according to one of two options:

⇨ **TECHNOLOGY-NEUTRAL** approaches that establish MEPS for lamps without specifying the light source technology. For example, the European Union (EU) phase out strategy allows any lamp to be sold if it meets the energy performance and other requirements of the MEPS[5].

⇨ **TECHNOLOGY-SPECIFIC** approaches that establish MEPS for lamps, but that only apply to certain light sources or technologies[6].

MEPS should be carefully designed (via a consultative process) and described using standard vocabulary to avoid unintended outcomes, such as disadvantaging innovative efficient lamps, or, unnecessarily exempting inefficient lamp types. Governments should establish a system to regularly monitor the market results when lamp MEPS are implemented[7]. Governments may collaborate with stakeholders to conduct benchmark studies and to create lighting technology roadmaps to better understand market trends and demands. These tools help inform the MEPS development and/or revision process. Government investment in research and development can help support manufacturers during the MEPS process as they develop new products to meet or exceed the MEPS requirements.

2.2 ADVANTAGES AND DISADVANTAGES

MEPS offer many advantages for energy efficient lamp programmes because 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;
- Minimise governmental fiscal and political impact compared to legislative actions, such as subsidies and levies;
- May create a stimulus for manufacturers to invest in research to develop new, more efficient lamps; while removing obsolete lamps from their catalogue offerings;
- Can be adjusted periodically as lamps improve or new lamps become available;
- Can be designed to maximise consumer benefits with very low per unit transaction costs.

5 European Commission. 2014. *Energy Efficiency Products.* Accessed on February 2014: http://ec.europa.eu/energy/efficiency/ecodesign/eco_design_en.htm

6 Omnidirectional lamps for indoor illumination applications typically use one of the following light sources: incandescent; tungsten halogen incandescent; fluorescent; or, light emitting diodes.

7 In the MEPS for omnidirectional lighting in the US, the regulation established a mechanism by which shipments of five exempted lamp types are monitored annually and compared to a published projection of anticipated shipments of those five lamp types. If the actual shipments exceed the projected shipments in any one year by more than 100%, the exemption is dropped and US Department of Energy is required to establish MEPS for that lamp type within one year. To learn more about this regulatory measure, visit: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/63

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. However, there are some constraints associated with establishing MEPS for lamps, including:

- Energy efficient lamps may not be widely available in the market, and the variety of product offerings may be limited;
- Compliant lamps may not meet non-energy performance or quality levels that are equivalent to the less efficient lamps that they are replacing;
- The initial cost of energy efficient lamps may be greater than the less efficient lamps that they are replacing (although costs should be recovered through energy savings over the operating life of the lamp, resulting in overall financial savings);
- Production of lamps by manufacturers will be affected, so advance notice must be given and sufficient preparation time must be built into phase-out schedules.

One, or more, of the above constraints may be magnified in some developing markets. Although desirable, it may not be immediately practical to establish MEPS that are as stringent as the standards of developed nations. Nonetheless, single-base, omnidirectional lamps for indoor illumination are a commonly traded commodity and so it may be possible to align MEPS with trading partners or within geographic regions.

2.3 KEY SUCCESS FACTORS

To be effective, MEPS must be carefully applied. Performance levels and other requirements must be determined by technological developments and market trends for lamps. Where feasible, national MEPS requirement levels should take into account regional conditions and international standards.

Performance levels and programme requirements need stakeholders' input to gain their support and participation. Programmes should involve stakeholders that represent the government, private sector and civil society, including: government standards and test agencies; customs; standardisation institutes; certification and accreditation bodies; test laboratories; manufacturers; suppliers and distributors of lamps; technology research institutes; and consumer organisations.

Once established, MEPS programmes should be monitored, evaluated, updated and revised regularly. The most important factor for programme success is a functioning monitoring, verification and enforcement system capable of ensuring product compliance. A strong market monitoring, verification and enforcement scheme is critical to ensure a level playing field for all manufacturers and importers; it also protects consumers from non-compliant 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 to launch and establish a MEPS programme for lamps.

2.4 INTEGRATED POLICY APPROACH

Many countries undertake massive programmes to procure and distribute millions of energy efficient lamps. However, without supporting policies and legislation to permanently remove inefficient lamps from the marketplace, users may revert to lower price, inefficient lamps if they are still available. Furthermore, the presence of poor quality energy efficient lamps in the market may result in consumers abandoning the efficient lamps after a first try.

Successful market transformation strategies are designed for the long term, to ensure a complete and permanent phase out of inefficient lamps. Although MEPS offer a powerful tool in the transition to energy efficient lighting, they are just one component of the overall strategy required to ensure the complete and permanent phase-out of inefficient lamps. The UNEP-GEF en.lighten initiative therefore recommends that MEPS are implemented as part of an integrated policy approach, as detailed in, *Achieving the Global Transition to Energy Efficient Lighting Toolkit*[8].

The Toolkit presents the importance of a transparent, multi-stakeholder consensus that incorporates the needs and priorities of public and private sectors and civil society. The integrated policy approach has four elements, as shown in Figure 1.

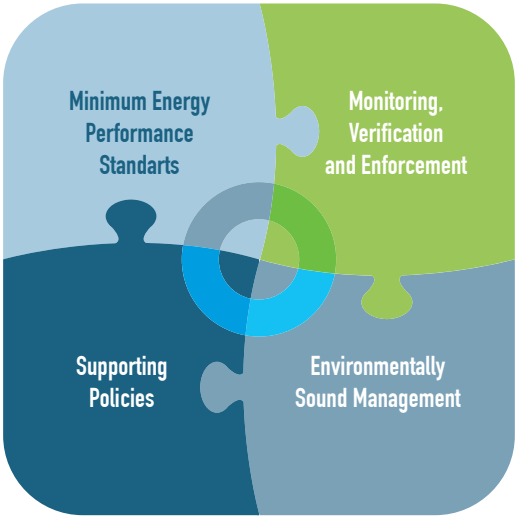


Figure 1
Integrated policy approach for a rapid transition to efficient lighting

MINIMUM ENERGY PERFORMANCE STANDARDS

MEPS are regulatory measures specifying minimum efficacy or efficiency levels acceptable for lamps sold in a particular country [9]. When establishing MEPS:

- Countries are encouraged to review existing standards of major comparable markets to learn from best practices;
- Performance standards should specify the maximum permissible input power demand (watts) limit for a given luminous flux (lumens), or the minimum efficacy (lumens per watt), that a product must meet;
- An implementation period for the standards should be specified and may require greater stringency as more efficient technologies become available;
- Legislation typically includes or refers to product labelling requirements; exploring ways to harmonise labels and their requirements is recommended;
- Additional lighting and product quality guidelines may be stipulated.

SUPPORTING POLICIES

Supporting policies ensure that the intent of MEPS is met by enabling all market players to make an effective transition to higher efficiency technologies and practices[10]. Policies may include:

- **Regulatory and control mechanisms:** Directives; executive orders; laws and implementation regulations that require certain devices; practices or system designs to improve energy efficiency;
- **Economic and market-based instruments:** Market mechanisms that are often initiated and promoted by regulatory incentives, but which can also contain elements of voluntary action or participation;
- **Fiscal instruments and incentives:** Mechanisms that impact retail prices, such as taxes aimed at reducing energy consumption; or financial incentives to overcome initial cost differences;
- **Information and voluntary action:** Communications and outreach that persuades users to change or modify their behaviour by providing relevant information and examples of successful implementation. These actions can include communications campaigns that explain and promote the use of energy efficiency labels for lamps.

8 United Nations Environment Programme. 2012. *Achieving the Global Transition to Energy Efficient Lighting Toolkit.* Available at: http://www.enlighten-initiative.org/ResourcesTools/EfficientLightingToolkit.aspx
9 *ibid.* Section 2, *Selecting and Implementing Energy Efficient Lighting Policies.*
10 *ibid.* Section 3, *Financing the Transition to Energy Efficient Lighting, and, Section 6, Communications and Engagement.*

MONITORING, VERIFICATION AND ENFORCEMENT

The success of an efficient lighting transition strategy depends heavily on a functional system of monitoring, controlling, and testing facilities capable of ensuring enforcement and full compliance with standards[11]. Unless effective and timely market surveillance systems are enforced, substandard lamps will continue to enter national markets in increasing numbers, reducing energy and financial savings.

Compliance activities have multiple purposes: they protect users from lamps that fail to perform as declared; ensure that government regulators fulfil the objectives of their efficient lighting initiatives; and protect suppliers by ensuring that all lamp suppliers are subject to the same market entry conditions. A description of these compliance activities is given below:

- **Monitoring** is a measurement process to verify product efficiency;
- **Verification** is the process through which declarations of compliance are confirmed by lighting suppliers, testing laboratories or third party services;
- **Enforcement** is the system of action taken by programme administrators or other responsible parties against suppliers of non-compliant (including counterfeit) products.

Enhancing the capacity of various countries and the sharing of information and skills between countries and across regions provides an effective means through which to promote best practice, quickly and thoroughly.

ENVIRONMENTALLY SOUND MANAGEMENT

Environmentally sound management encompasses all phases of the life cycle for lamps: materials used in manufacturing; manufacturing processes; packaging; distribution; use; collection and recycling; and treatment of the spent lamps[12]. Maximum amounts of mercury and content standards for other hazardous substance should be established in line with global best practices. Ensuring the availability of quality lighting in the market, and verifying their compliance with maximum hazardous materials limits, is essential to minimising health and safety risks. Examples of environmentally sound management include:

- **Establishing legislation** that sets limits on the hazardous materials used in products, ensuring alignment with international treaties and conventions[13];
- **Developing a legal framework** for environmentally sound end-of-life activities, making this a high national priority and ensuring coordinated law enforcement;
- **Considering the principle of extended producer responsibility** as part of a national environmentally sound management plan;
- **Carefully drafting and implementing policy and legislation** before formal collection channels and recycling facilities are established.

These recommendations reflect global international initiatives addressing hazardous waste, such as the *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal*[14] and the *Minamata Convention on Mercury*[15].

11 *ibid.* Section 4, *Ensuring Product Availability and Conformance.*
12 *ibid.* Section 5, *Safeguarding the Environment and Health.*
13 For example, a country could choose to develop legislation that establishes limits on the amount of mercury allowed in mercury-added lighting products, in line with the requirements of the Minamata Convention: http://www.mercuryconvention.org/Convention/tabid/3426/Default.aspx
14 Basel Convention: http://www.basel.int/
15 *Minamata Convention on Mercury*: http://www.mercuryconvention.org/

3 PROCESS TO DEVELOP MINIMUM ENERGY PERFORMANCE STANDARDS

The consensus to develop minimum energy performance standards (MEPS) follows from the development of a national efficient lighting strategy, a national energy policy, or a similar national effort[16]. This chapter gives an overview of the process developed and pilot-tested by members of the UNEP-GEF en.lighten initiative's *Global Efficient Lighting Partnership*, from 2012 to 2014[17].

MEPS are the most sustainable option for achieving high levels of energy efficiency and for phasing out less efficient 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, reviewed and revised. The most important factor for programme success is a functional system of monitoring, verification and enforcement capable of ensuring full compliance of products with any regulatory measures.

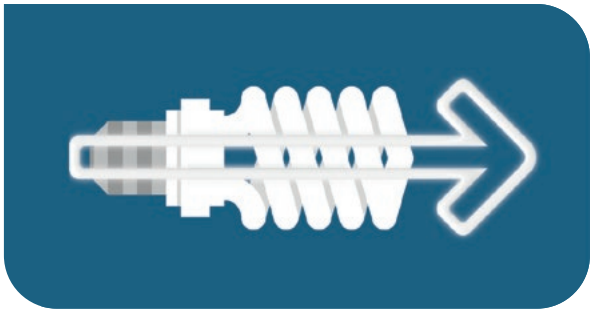
Figure 2 depicts a simplified process flow for the establishment of MEPS. The 'initiation steps' need to be conducted only once, while the 'product steps' are repeated for each category of lamp (or other product) to be regulated. Each of these steps are described briefly below, and in more detail in the subsections of this chapter.

INITIATION STEPS

1. **Establish a legal framework:** Review existing legislation and establish framework legislation to develop a legal basis for, and political commitment to, standards and labels[18].
2. **Appoint an administrative agency:** Assess existing institutional capacity for developing, implementing and maintaining a standards and label-setting programme. Develop an overall standards and labelling plan and assign one government agency with primary responsibility for driving each element of the programme.
3. **Assemble a stakeholder group:** Identify the key relevant people in your economy who would be interested and invite them to participate in the process.

PRODUCT SPECIFIC STEPS

4. **Gather required data:** Establish minimum data needs and develop a plan for collecting the data necessary to conduct analysis to support the programme. This includes information on the market, technology, engineering and usage of the product.
5. **Conduct an economic analysis:** Use cost-effectiveness analysis to determine the appropriate level of ambition for the regulatory measure(s).
6. **Harmonise testing:** To the greatest extent possible, harmonise energy performance test procedures with international protocols (such as International Electrotechnical Commission (IEC) test standards) to facilitate comparability of product testing and reduce barriers to trade.
7. **Set MEPS levels:** Determine the technically feasible, economically optimal regulatory level; invite stakeholder comment and refine MEPS if necessary; secure political endorsement; publish regulatory notice; and specify a future date when MEPS will take effect.
8. **Review and update:** Plan to periodically review and update the standards every few years to ensure they remain appropriate and relevant.



16 See UNEP-GEF en.lighten initiative, *Developing an Efficient Lighting Strategy*: http://www.enlighten-initiative.org/CountryActivities/GlobalEfficientLightingPartnershipProgramme/DevelopingaNationalEfficientLightingStrategy.aspx

17 For detailed descriptions of the MEPS development process in Chile, Jordan, Tunisia, Uruguay and the regional efforts towards MEPS in Central America and West Africa, see: UNEP-GEF en.lighten initiative, *Country Activities*, http://www.enlighten-initiative.org/CountryActivities.aspx

18 Examples of this are the European legal framework established by the *Ecodesign Directive* (2009/125/EC) and *Energy Labelling Directive* (2010/30/EU). For more information see: http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products

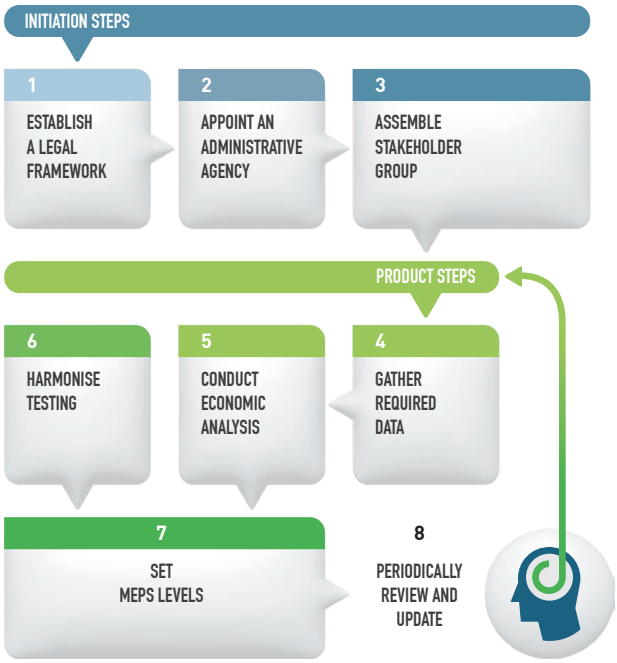


Figure 2
Flow diagram illustrating the process of developing lamp minimum energy performance standards

The following subsections provide more detail on each of the key steps for developing and establishing lamp MEPS.

3.1 ESTABLISH A LEGAL FRAMEWORK

Begin a MEPS programme by examining the existing regulatory framework to determine what authority the government has to establish such a programme. Direct legislative support, or some form of legally mandated authority, for the implementing agency greatly enhances the likelihood that MEPS will be adopted and have a significant, and sustained, impact over time. The stronger the implementing agency's claim to legal jurisdiction, the more likely the programme will survive adversarial challenges. The key stakeholders initiating the process to develop MEPS should examine and discuss the following questions.

- Does any existing legislation regulate the energy performance of products?
- Which, if any, agency is empowered within the government to establish MEPS?
- Is there a standards agency responsible for regulating the quality and performance of products, including products that consume energy (especially electrical appliances)?
- Is any agency empowered to develop energy performance test procedures for energy-consuming products?
- Does the country have membership in the IEC and has the national standards agency looked into harmonisation with international testing standards for lighting products?
- Have any IEC standards been adopted by the country and does the country participate in any IEC technical committees? (Typically, IEC test standards are referenced in lamp MEPS.)
- Does any existing legislation protect consumers against inaccurate, misleading or false product-performance claims?

These issues must be addressed early in the process because legislation forms the basis of an effective mandatory programme. Even when voluntary agreements are reached with industry, these agreements may only be achieved when industry perceives that government negotiators may enforce a mandatory scheme. Mandatory legislation should provide a clear, legal mandate for a government agency to require manufacturers (or retailers) to test products in a uniform way and place labels on all affected products. The passage of legislation also signals strong political support for the programme.

The most widely practiced approach for developing legal authority for MEPS has two main stages: framework legislation; and implementing measures. Framework legislation delegates authority to an agency to implement product standards and/or labels. The legislation may mandate such programmes, prescribe which products are to be addressed (i.e. scope of coverage) and/or it may even prescribe initial regulatory requirements. The second stage involves the application of the authority that was granted under the framework legislation. In the second stage, the designated implementing agency works on establishing, and setting, MEPS for specific product types, such as lighting, or more specifically, for categories of lamp products.

Framework legislation is effective because it obviates the need for the implementing agency to seek approval from the legislative assembly for each new regulatory measure. Framework legislation delegates responsibility for developing product-specific legislative measures to a body with appropriate administrative and technical competence and removes a potentially significant cause of delay for setting and reviewing regulatory measures. Framework legislation often identifies key stakeholders and defines roles, responsibilities and obligations under the law. It also designates a government body as the implementing agency and authorises that agency to issue product-specific MEPS.

Box 1

Framework legislation examples: European Union and United States of America

The framework legislation enacted in the European Union (EU) and United States of America (US) is frequently studied by countries that are considering how to best develop MEPS for their markets. However, countries must always take into consideration different local conditions that may impact the regulations such as voltages and frequencies.

In the EU, the *Ecodesign Directive* (2009/125/EC) grants authority to the Commission to establish product specific MEPS. The original version (2005/32/EC) was updated following a public-participative process and a Member State review. The MEPS issued under the *Ecodesign Directive* are called 'implementing measures' because they implement the objectives of the Directive.

In the US, Congress established a framework structure through the *Energy Policy and Conservation Act* of 1975. Part B of Title III of the Act established the *Energy Conservation Program*, which gives the Department of Energy the *«authority to develop, revise, and implement minimum energy conservation standards for appliances and equipment.»*

Ideally, framework legislation would establish:

- Defined programme objectives;
- Authorised types of intervention (mandatory standards and/or voluntary targets);
- Criteria for determining which lamps are covered;
- Criteria for the level of technical intervention (based on payback periods, life cycle cost, or harmonisation with trading partners);
- The schedule of implementation;
- Procedural rules and deadlines;
- The requirement to evaluate the programme's impact, including effects on manufacturers, consumers and the country.

In practice, the amount of technical detail (such as the categories of lamps, standard minimum energy performance levels, implementation dates, and schedule revision) specified in a law or decree will vary.

3.2 APPOINT AN ADMINISTRATIVE AGENCY

Stakeholders should evaluate the existing resources and institutional capacity within a country or region for developing, implementing and maintaining MEPS. In particular, establishing a robust MEPS programme requires having sufficient financial and personnel resources, as described below.

FINANCIAL RESOURCES

A regular, and consistent, source of funding for an operational budget is required from one or more sources. Typically, annual government budget allocations are the most reliable source of funding for MEPS. Nonetheless, such allocations can be difficult to justify and obtain at the outset of a programme. Some countries supplement governmental resources with fees collected from manufacturers for testing and certification of lamps. Many developing countries rely, at least initially, on donor funding to support the launch and/or implementation of programmes. However, stakeholders should anticipate that donor funds will eventually be discontinued and so governments must transition over the medium to long term to a self-sustaining source of funding.

PERSONNEL RESOURCES

Qualified staff are needed to conduct testing and technical analyses, administer programmes and manage market monitoring, verification and enforcement. Some initial outsourcing of tasks is possible, but sound programme management requires a dedicated staff that can develop niche expertise in lamp and appliance MEPS programme development and implementation.

The institutional review that precedes the establishment of a programme should evaluate whether the agency responsible for enforcement has, or can secure, the appropriate personnel. Consideration should be given, especially for smaller countries with limited resources, to a regional approach where costs and expertise can be shared.

Box 2 Example of appointing an administrative agency: Jordan

In the Hashemite Kingdom of Jordan, the government made a decision to pursue the development of MEPS for lighting.* The ultimate success of that effort was linked to the selection of the Jordanian Ministry of Energy and Mineral Resources as the administrative agency to execute the policy development process. This Ministry worked cooperatively with the other agencies, including the Ministry of the Environment, the Ministry of Planning and International Cooperation and other key stakeholders, to develop Jordan's *National Efficient Lighting Action Plan* and to help ensure it was a successful policy development process.

* http://www.enlighten-initiative.org/countryactivities

3.3 CONSULT WITH KEY STAKEHOLDERS

While the overall net effect of MEPS will be economic gains for society, at the individual stakeholder level, the adoption of MEPS may benefit some stakeholders more than others. For example, in the short term, some manufacturers and importers will be better off while others will be worse off, depending on their ability to: adapt to changing requirements; gain access to, or innovate new products; and persuade customers to purchase and use new lamps. For both manufacturers and consumers, there will be a range of profitability and loss. When policymakers choose to establish a MEPS level, they must research and understand the extent to which some manufacturers and their customers will be impacted, and consider those impacts relative to the overall societal benefits. During a transition to efficient lighting, governments may assist manufacturers and consumers by offering supporting policies, such as financing and communications[19].

Establishing, and consulting with, a stakeholder group of experts who are interested in the regulatory measure is a very important step in the process. These consultations are necessary because the experts will be able to offer information about markets, the lamps, special applications, and other product- and market-specific insights.

Broad representation of interested parties in a stakeholder group will help to ensure that the outcome is more robust and effective when adopted. A list of some interested parties to invite to join a MEPS stakeholder group is shown below.

Box 3 Example of stakeholder group: European Union

In the European *Ecodesign Directive* (2009/125/EC), Article 18 directs the Commission to ensure that any work it does on each implementing measure should include a balanced participation of Member States and interested parties. The Directive provides that these parties should meet in a 'Consultation Forum', which was created by the Commission and meets regularly to review the implementing measures being developed by the Commission. The experts in the forum include: manufacturers and their associations; governments; testing and standardisation experts; environmental organisations; academics and other experts.

* https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products

INSTITUTIONAL AND GOVERNMENTAL

- Governments – federal, provincial and local
- Electric utilities and network operators
- Test standards organisations
- Customs authorities
- Testing laboratories
- Trade unions

19 United Nations Environment Programme. 2012. *Achieving the Global Transition to Energy Efficient Lighting Toolkit.* Available at: http://www.enlighten-initiative.org/ResourcesTools/EfficientLightingToolkit.aspx for Financing, see Section 3, *Financing the Transition to Energy Efficient Lighting*; for Communications, see Section 6, *Communications and Engagement.*

PRIVATE SECTOR

- Manufacturers
- Wholesale distributors
- Retailers
- Electrical contractors
- Specifiers
- Building owners and managers (e.g. of multi-family dwellings)
- Architects and lighting designers
- Industry associations
- Electric utilities and network operators

END USERS

- Consumers
- Civil society
- Consumer and community associations

3.4 GATHER REQUIRED DATA

To establish effective MEPS levels, stakeholders should gather, organise and analyse a large sample of diverse data covering many aspects of a product class (lamps) in a national or regional market. Due to the impact it has on the market, generally more data is required to justify a mandatory lamp MEPS, compared to a voluntary standard or labelling scheme. The challenge of data collection and analysis is one of the reasons countries often consider the possibility of harmonising with, or adopting, MEPS from larger markets or neighbouring countries with which they have strong trade relationships[20].

There are five general areas where data are needed for MEPS: market; engineering; usage; behavioural; and ancillary. Although it would be ideal to have complete data for all of these items, it is often not possible and thus governments must use their best estimates based on what can be collected from the available resources. The five general data categories are described below.

MARKET

General and specific market data is required to assess potential impacts and optimise programme design. The data needed include: equipment annual sales volume; prices; production volumes; and import and export volumes. Information is also needed on equipment distribution channels, including how the lamps are distributed from manufacturers to importers and retail outlets. Data about the retail sector characteristics are also important, including: market shares by retail type and sector (such as electrical specialists or department stores); retail marketing strategies; geographical coverage; and typical profit margins. Information on the manufacturing sector characteristics are also important, including: competition; market shares; brands; parent companies; exports/imports; type of production (if applicable, full production or only final assembly); and technical capabilities.

Box 4 — Example of data gathering: Tunisia

In Tunisia, working with the UNEP-GEF en.lighten initiative, the government launched a national policy development process in 2012 to establish MEPS for omnidirectional lamps.* The Agence Nationale pour la Maîtrise de l'Energie, under the Ministry of Industry, quickly recognised the importance of gathering good data on which to base their policy decisions. Therefore, they engaged a market research expert who contacted manufacturers, importers, retailers, industry associations, the electric utility and other stakeholders on gathering data. This dataset provided the policymakers with critical information about the size of the market, the underlying technology, the more efficient alternatives, the operating hours and many other critical inputs to the analytical process.

* http://www.enlighten-initiative.org/countryactivities GlobalEfficientLighting PartnershipProgramme/Tunisia.aspx

ENGINEERING

Assembling a comprehensive database of technical and energy characteristics for typical (baseline) lamps is required to define the relationship between cost and efficiency for the lamps analysed. These data indicate the changes in cost associated with improvements in efficiency (or changes in technology, such as transitioning from inefficient incandescent lamps to compact fluorescent lamps (CFLs) and light emitting diode (LED) lamps). This relationship is used as an input to the life cycle cost analysis to calculate the cost and benefit for these lamps to consumers and ultimately for the whole market.

20 Previous studies on lighting product energy performance benchmarks include: *Assessment of Opportunities for Global Harmonization of Minimum Energy Performance Standards and Test Standards for Lighting Products* (CLASP, 2011), and *Testing for Quality: Benchmarking Energy-Saving Lamps in Asia* (USAID, 2010)

USAGE

Usage data is required to reflect how lamps are used by the end users, taking into account local conditions, such as the characteristics of the grid, the operating hours, and so on. They often provide information about ownership levels broken down by demographic statistics, such as the number of households, building types, occupancy patterns, rate of lamp replacement, or other relevant factors.

BEHAVIOURAL

Includes data on the uses and service features of the lamps, purchasing decisions, as well as the attitudes toward energy efficiency expressed by the consumers, users, retailers and manufacturers. These data help to ensure the regulator understands important features and applications of the products, to ensure the regulation takes these into account.

ANCILLARY

Includes data and forecasts for energy prices, information on electricity generating sources and fuel mix (at peak and non-peak times), national energy statistics, national statistics on trade and employment, environmental emissions and other factors. These data ensure accurate calculations can be made in projecting the wider environmental and economic benefits, as well as ensuring grid reliability aspects are taken into account.

These data underpin an analysis of the market, and help regulators set 'trial' standard levels and to forecast how these levels could impact the stakeholders in the supply chain, from manufacturer and importer through the supply chain to end users.

3.5 CONDUCT AN ECONOMIC ASSESSMENT

The next step in the lamp MEPS development process is to assess the cost-effectiveness of the various technology options and 'trial' standard levels under consideration. Analysts study the likely energy savings, cost savings and environmental benefits of MEPS. As a way of reducing MEPS development costs, lamp product studies that have been conducted by other markets can be adapted to local conditions, or used as a methodological framework[21].

Representative from the International Institute for Energy Conservation in the Philippines taking part in a lamp sampling exercise as part of a UNEP-GEF en.lighten initiative market surveillance exercise.

The basic steps in assessing the potential costs and benefits are to:

1. **Develop a baseline model:** Develop a baseline model for each candidate category of lamps. This represents the energy performance of a typical lamp model in the market, and is a starting point ('business as usual' model) for the economic analysis;
2. **Select appropriate design options:** Select the energy efficiency improvements that would be applied, or substituted, to improve the performance of the product. For lamps, this could include changing technologies (such as transitioning from inefficient incandescent lamps to CFLs and LED, or improvements within a technology family (such as better quality LED lamps with higher efficacy);
3. **Estimate cost effectiveness:** Refer to market research such as tear-down (reverse engineering) analyses that estimate how much efficiency improvements could change manufacturing costs, and then estimate the supply chain mark ups to quantify how these changes could alter retail prices. Alternatively, analysts can collect data on consumer prices and performance of lamps to obtain an estimate of the a relationship between retail cost and efficiency;
4. **Estimate savings:** Calculate the potential savings from energy efficiency improvements, including estimating the energy savings from the design options considered;
5. **Estimate benefits:** Calculate life cycle costs and payback periods for the different levels of regulatory stringency under consideration.

This is shown graphically in Figure 3.

21 There are several examples of lamp product studies that have been prepared by governments and published on their respective websites for stakeholder review. The following are a few examples of these studies: European ecodesign regulation: http://www.eceee.org/ecodesign/products/domestic_lighting; Australian non-directional lamp regulation: http://www.energyrating.gov.au/products-themes/lighting/lighting-and-phase-out-general-information/
In addition to these, some governments publish online product registries that can be helpful when conducting market analysis and economic assessment. The following are a few examples of these product registries: US Environmental Protection Agency ENERGY STAR database: http://www.energystar.gov/productfinder/product/certified-light-bulbs/results; Australian product registry database: http://reg.energyrating.gov.au/comparator/product_types/40/search/. It should be noted that manufacturer catalogues can be a good source of data for lamp performance analysis. The following are a few examples of these catalogues, however interested parties should make sure to obtain copies of the catalogues from their local markets: Philips: http://www.philips.com/global/country_selector.page; OSRAM: http://www.osram.com/osram_com/

Figure 3
Process flow diagram for conducting an ecomonic assessment

The economic assessment should help to determine the following saving potentials.

TECHNICAL

Maximum technologically achievable energy savings, when costs are not taken into account.

ECONOMIC

Economically optimum energy savings from the end users' perspectives (usually called the 'least life cycle cost').

ACHIEVABLE POTENTIAL

Practical, sustainable energy savings, given market barriers and competing policies.

After cost and energy efficiency data have been collected, baseline energy efficiency information is used to estimate how much energy will be saved if the average energy efficiency of all models is increased by the same amount. End-use energy saving forecasting models (such as, the UNEP-GEF en.lighten initiative *Country Lighting Assessments*) are used to project the national impact of policies. Often, however, detailed end-use data may not be readily available, and thus simplified methods can be used to forecast achievable energy savings from MEPS. It is generally better to rely on simple forecasts, based on limited reliable data, than to prepare detailed models that use unreliable proxy data and estimates. An equipment stock model can organise information on lamp sales, lamp lifetime and operating hours, determining the installed stock from a sufficient time series of data. These models can also forecast trends, using key demand drivers such as population forecasts and income estimates. The output from these models – projected equipment sales estimates – are then used to estimate the impact of the policy measure(s) under consideration.

3.6 HARMONISE TESTING

Testing standards underpin all lamp MEPS and energy labelling programmes because they are the means by which lamp energy performance is measured and compared. Harmonisation of energy performance test procedures facilitates: trade; comparison of performance levels; technology transfer; and encourages replication

of best practices. The most widely used test methods today for measuring the performance of lamps are those of the International Electrotechnical Commission (IEC) and the Commission Internationale de l'Eclairage (CIE). To ensure that they have an opportunity to participate in the development of these test methods, countries are encouraged to join the IEC[22]. The national standardisation bodies should review the lighting test standards promulgated by the IEC, through its Technical Committee (TC) 34, *Lamps and related equipment*.[23]

A test standard adopted for use in a lamp MEPS regulatory programme should meet the following objectives, in terms of:

⇨ **COVERAGE:** The scope of the testing standard must encompass the regulated lamp types.

⇨ **METRICS:** The testing standard must be able to determine input power demand, energy consumption, efficiency or other metric that constitutes the basis of the regulation.

⇨ **ACCURACY:** The test standard must be designed to minimise random, or systemic errors, and to establish maximum margins of error (also, it is best to avoid the use of optional approaches).

⇨ **REPRESENTATION:** The scope of the test standard must provide robust measurement of energy demand, reflective of in situ energy use under environmental and design conditions where the lamp is used in the target application.

⇨ **REPEATABILITY:** The test standard must give the same result each time a lamp is tested in the same laboratory

⇨ **REPRODUCIBILITY:** The test standard must give the same result when a lamp is tested in different laboratories.

⇨ **COST:** It must not be too expensive or time consuming to conduct, and must balance the robustness of the test and cost of testing.

Governments and manufacturers both gain from the harmonisation of testing methods, on both a regional and an international basis. Benefits to governments include a lower development cost for the test method and comparable test results for lamps sold domestically and in neighbouring countries. In addition, harmonisation helps to leverage existing analyses (such as the ability to transpose and adapt analyses and minimum performance levels from other markets). Harmonisation supports governments because it can lead to faster and less expensive testing (for lamp compliance and other purposes) because harmonising test methods can increase access to a larger number of laboratories that are accredited to conduct particular lamp tests.

For manufacturers, having one harmonised test method with specified measurement uncertainties used by markets globally could reduce testing costs associated with demonstrating regulatory and/or lamp labelling compliance. In an ideal world, manufacturers would only need to conduct one set of tests and then the results could be universally accepted by any country as being accurate and representative of the performance of the tested lamps. A harmonised test method enables manufacturers to look ahead to longer-term rewards for innovation of advanced lamp designs that would be more energy efficient and could have lower life cycle costs for

Box 5 — Example of regional harmonisation: Central America

In Central America, working cooperatively with the UNEP-GEF en.lighten initiative, the governments launched a regional initiative to establish MEPS for omnidirectional mains-voltage lamps.* In that process, several different sets of efficiency requirements were considered, but ultimately the countries all decided they would adopt one, harmonised regional level. It was recognised by the policy makers that by having one consistent market, it would increase the economies of scale which would lower prices for consumers and barriers to trade, and facilitate more effective monitoring, verification and enforcement, as all countries have the same requirements. The *Regional Efficient Lighting Strategy for Central America* involves: Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panama.

* http://www.enlighten-initiative.org/countryactivities/GlobalEfficientLightingPartnershipProgramme/CentralAmericaOverview.aspx

22 Membership to the IEC: http://www.iec.ch/about/profile/members.htm
23 Information on IEC TC 34: http://www.iec.ch/dyn/www/f?p=103:7:0::::FSP_ORG_ID:1235

users. Having a consistent test method enables countries to establish a common set of efficiency thresholds that would not only be broad enough to encompass all current market circumstances, but that also could include aspirational efficiency thresholds as indicators for future market developments.

Harmonised testing can also be linked to harmonisation of labelling requirements in a region. This can reduce costs and provide consistent information to customers in a region. This could be especially helpful in regions where distributors, retailers and customers may procure or share products cross-border.

3.7 SET MINIMUM ENERGY PERFORMANCE STANDARD LEVELS

In this step, the MEPS levels are selected by the government and published for stakeholder review prior to being made law. The level of ambition selected by the government is based on the preceding market and technology analysis (see Step 3.4) and the economic assessment (see Step 3.5). The government generally makes a determination that the selected level is technologically feasible, economically justified and will result in significant energy savings in their national market. When selecting the appropriate level, governments may also take into consideration the requirements of neighbouring countries and the opportunity for harmonisation (see Chapter 4).

The level selected is then published as a draft for stakeholder comment, along with the analysis and other evidence underpinning the selected level(s). A comment period is defined and stakeholders are informed via internet, trade press and direct contact (e.g. phone) to inform them about the draft regulation and the invitation to review and comment on the proposed measure. Comments received during the notice period are then reviewed, and a final decision is made by the government on the regulatory measure.

When proposing the regulatory measure, governments should take into consideration the most appropriate mechanism by which to introduce the transition to energy efficient lighting. In Brazil, the country started with an importation and production ban, followed later by a retail ban. Other countries, such as Mexico, simply started with a retail ban, and thus had a more accelerated transition. Furthermore, in addition to the regulatory mechanism, the timing of the regulation is also important to ensure that all stakeholders – including manufacturers, importers, wholesalers, retailers and consumers – have time to be prepared for the law when it takes effect.

The regulation is then published in the country's official journal, whereby it becomes law. The publication includes a date on which the MEPS will take effect, so all stakeholders are given advance notice to make changes to their supply chain. The MEPS may also define a review period when the policy measure will be reassessed to determine whether it is still reasonable and appropriate, as discussed in the next sub-section.

Box 6 Example of public consultation process: Chile

In Chile, as the government moved to establish its national regulatory standard on lighting, it launched a wide stakeholder consultation and review process. The draft legislation was posted for public review, and the communications office of the Ministry of Energy issued press releases to inform stakeholders about the regulation. A comment period was established and clear guidelines were provided for how to submit comments, including a template (*formulario para comentarios*) for submitting comments on the Ministry's website.

http://www.minenergia.cl

3.8 REVIEW AND UPDATE

To ensure the long term viability of MEPS programmes, governments should ensure that they have the resources to monitor the impacts of MEPS in their markets. This work has two objectives: first, to clearly demonstrate to consumers and funding agencies that the expected benefits are being achieved; and, second, to assess whether the levels of ambition are sufficiently stringent, or, if higher efficiency levels are required to achieve the desired savings.

Figure 4 depicts a hypothetical set of omnidirectional lamp data, with input power demand (watts) plotted against luminous efficacy (lumens per watt). Curves representing hypothetical MEPS levels show the impact that lamp MEPS can have. The figure also shows that as new and more energy efficient lamps are introduced, the lamp MEPS can be updated to higher levels of stringency (higher luminous efficacy per watt). Any dots located below the MEPS curves would be removed from the market, making way for more energy efficient, lower life cycle cost lamps.

The regulatory review cycles for lamp MEPS in different countries can range from three to ten years, depending on: the lamp product category; rates of innovation and new product introductions; and the nation's lighting energy efficiency priorities. Establishing a procedure and schedule for revisions of lighting regulations requires input from stakeholders who are engaged in establishing the national MEPS programme. It also requires a discussion of the methods used in setting and adjusting the MEPS, as well as the time frames that can be accommodated by manufacturers and the supply chain. This is necessary because other external pressures may exist in the supply chain, such as other (non-efficiency based) regulatory requirements. The most effective MEPS programmes involve industry input in the establishment and periodic review/increase of minimum levels.

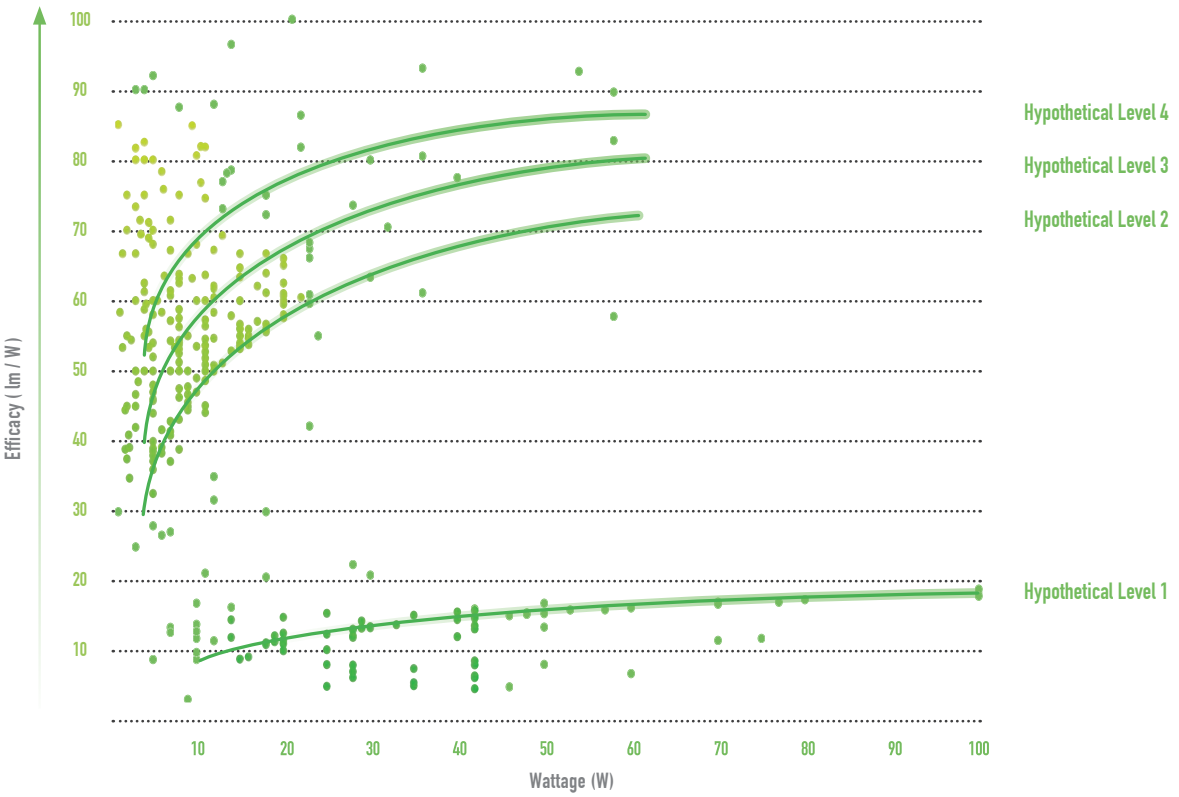


Figure 4
Hypothetical lamp energy performance data and minimum energy performance standard levels

4 HARMONISING MINIMUM ENERGY PERFORMANCE STANDARDS

If minimum energy performance standards (MEPS) are to be adopted in a country or regional market, stakeholders should consider whether to harmonise with the existing MEPS on those same products in their region, or with the lamp MEPS of a large trading partner. This chapter discusses the benefits and constraints of harmonisation and offers examples of lamp regulations in two large economies with which some governments around the world have chosen to harmonise.

4.1 HARMONISATION BENEFITS

Harmonisation of MEPS offers many benefits that allow countries and the private sector to avoid the costs of duplicating testing and non-comparable performance information and requirements. Through harmonisation, consumers of lighting products can benefit from the removal of an administrative trade barrier and are able to enjoy better prices and choice of goods associated with the larger economies with which they are harmonised.

If countries have different requirements, it can be difficult and time consuming for a manufacturer to carry out the necessary tests for each specific country. The non-harmonised approach would require manufacturers: to perform different, or additional lamp tests; create unique labels and catalogue numbers for each market; and track, keep inventory and ship country-specific lamp products.The major goals of harmonisation are to reduce non-tariff trade barriers by: simplifying and harmonising customs procedures among countries; aligning or using the same test procedures, labels, and standards; and implementing mutual recognition agreements.

4.2 HARMONISATION CONSTRAINTS

The benefits of aligning and harmonising MEPS are important, but they may be secondary to the primary benefits of the MEPS themselves. Harmonisation is not a compelling reason to delay development or implementation of lamp MEPS. On the contrary, the process of developing and adopting standards should be shortened if the lamp MEPS level aligns with standards that exist elsewhere, which can help justify the standards levels selected and bring the concomitant benefits to the national market. In some cases, it may be more expedient to take a longer-term approach to alignment by first adopting an earlier, less stringent version of a trade partner's standard, with a commitment or intent to upgrade it to the current level in the near future.

Harmonisation of MEPS requires transparency and willingness to cooperate among trading partners, and indeed can support those markets to have more effective market transformation programmes through that cooperation.

4.3 CASE STUDIES

The following are two case studies of MEPS for certain omnidirectional lamps that have been adopted by Europe and the United States. These are but two examples of large economies with lamp regulations with which some governments around the world have chosen to harmonise.

4.3.1 CASE STUDY: LAMP MINIMUM ENERGY PERFORMANCE STANDARDS IN EUROPE

The European Commission issued its first implementing measure on non-directional household lamps, Commission Regulation (EC) No 244/2009 on 18 March 2009. This regulation gradually prohibited the placing on the market of the least energy efficient lamps for household use. The lamps must comply with energy efficacy, functionality and product information requirements in order to carry a 'CE' (Conformité Européene) mark and thus be allowed for sale in the European market[24]. Therefore, only energy efficient, high-quality products can be used as a replacement for the phased-out inefficient incandescent lamps to ensure consumer acceptance of new lighting technologies.

The European regulations follow a step-by-step approach that phases out inefficient lamps in a series of stages (between 2009 and 2018). This approach was selected because it allowed alternative technologies to evolve and enter the market as the inefficient ones were removed gradually.

The European regulations divided the omnidirectional lamp market into 'non-clear' and 'clear' lamps. It adopted a requirement equivalent to typical compact fluorescent lamp (CFL) performance for the 'non-clear' lamps, and a requirement equivalent to a mains-voltage halogen lamp for 'clear' lamps. The regulation introduces energy efficiency and functionality requirements as well as information requirements that must be provided to the customer. Table 1 presents the energy efficiency (i.e. maximum power for light output) requirements from the regulation.

These equations can be difficult to interpret, so one of the major European lighting companies prepared a table to describe the market impacts. Table 2 is adapted from this reference.[25]

Table 1 European regulation for omnidirectional lamps, EC No. 244/2009

Application date	Maximum rated power (P_{max}) for a given rated luminous flux (ϕ) (W)	
	Clear lamps	Non-clear lamps
STAGES 1 TO 5	$0.8 * (0.88\sqrt{\phi}+0.049\phi)$	$0.24\sqrt{\phi}+0.0103\phi$
STAGE 6	$0.6 * (0.88\sqrt{\phi}+0.049\phi)$	$0.24\sqrt{\phi}+0.0103\phi$

24 Manufacturers may self-declare compliance; however, the products are subject to spot-checks by authorities.
25 OSRAM: http://www.osram.com/osram_com/sustainability/strategic-focus/stakeholder-dialogue/phasing-out-inefficient-lighting/eu%2c-europe%2c-middle-east-and-africa/non-directional-household-lamps/index.jsp

Table 2
Summary of European regulation for omnidirectional lamps, EC No. 244/2009

Stage	Description of Policy's Impact
STAGE 1: 1 September 2009	Clear lamps: Minimum requirement is energy class C for lamps ≥ 950 lm; Incandescent lamps > 100 W are phased out as well as inefficient halogen lamps.
	Non-clear (i.e. 'frosted') lamps: Minimum requirement is energy class A for all lamps, meaning they must now achieve an efficacy of a CFL.
	Minimum performance requirements apply for lamps covered by the regulation (except for LED lamps). Lamps with S14, S15 and S19 bases are exempted from the efficacy requirements until 1 September 2013.
STAGE 2: 1 September 2010	Clear lamps: Minimum requirement is energy class C for lamps ≥ 725 lm; Incandescent lamps ≥ 75 W are phased out.
	Requirements for new lamp information on the packaging are introduced.
STAGE 3: 1 September 2011	Clear lamps: Minimum requirement is energy class C for lamps ≥ 450 lm; Incandescent lamps ≥ 60 W are phased out.
STAGE 4: 1 September 2012	Clear lamps: Minimum requirement is energy class C for lamps ≥ 60 lm; Incandescent lamps ≥ 7 W are phased out.
STAGE 5: 1 September 2013	Increased performance requirements for all lamps covered by the regulation (except for LED lamps); Lamps with S14, S15 or S19 bases are not exempted anymore and thus have to fulfil the efficacy requirements.
STAGE 6: 1 September 2018[26]	Clear lamps: Minimum efficacy requirement increased from energy class C to B. The increased requirements do not apply to halogen lamps with G9 or R7s bases.

The 'CE' mark placed on the product is the self-certification mark declaring compliance with the requirements of the *Ecodesign Directive* and all other applicable European regulations (e.g. regulation of hazardous substances). Market surveillance authorities reserve the right not only to review the compliance reports, but also to sample and conduct testing of products placed on the market to verify compliance and initiate enforcement action if a violation is found. Manufacturers and importers supplying the European market must therefore prepare, and retain, self-certified compliance reports so that they are available in the event that a European member state market surveillance authority requests a copy.

In 2014, the European Commission launched a review of its lighting regulations, conducting an *Ecodesign Preparatory Study on Light Sources* (ENER Lot 8/9/19). This study is intended to provide the European Commission with a technical, environmental and economic analysis of light sources as required under Article 15 of the *Ecodesign Directive 2009/125/EC*.[27]

26 The original legislation scheduled Stage 6 to take place on 1 September 2016, however after a detailed review, the European Commission and Member States voted on 17 April 2015 to delay Stage 6 by two years to 1 September 2018. See: https://ec.europa.eu/energy/en/news/phase-out-inefficient-lamps-postponed-1-september-2018

27 Commission's lighting regulation review website: http://ecodesign-lightsources.eu/

4.3.2 CASE STUDY: LAMP MINIMUM ENERGY PERFORMANCE STANDARDS IN THE UNITED STATES OF AMERICA

The *Energy Independence and Security Act* of 2007 set MEPS for lamps in the US, amending the *Energy Policy and Conservation Act* of 1975 to establish energy conservation standards for general service lamps.[28] This law requires lamps to use 25% to 30% less energy than the most common and inefficient incandescent lamps at that time. The lamp efficiency standards were phased in between January 2012 and January 2014 and set the maximum input power demand (watts) for lamps according to their luminous output (lumens) expressed as a range (or 'lumen bin') for each category. The regulatory requirements are shown in Table 3. These technology neutral MEPS can be met by some tungsten halogen incandescent, CFL and LED lamps. The effective result was that: 100 W incandescent lamps were phased out in 2012; 75 W were phased out in 2013; and 60 W and 40 W in 2014.

The *Energy Independence and Security Act* requires that the US Department of Energy initiate a new rulemaking for general service lamps in 2014 wherein these requirements will be reviewed; potentially, more stringent levels could be adopted. General service lamps include general service incandescent lamps as well as CFLs, general service LED lamps, and, «*any other lamps that the Secretary [of Energy] determines are used to satisfy lighting applications traditionally served by general service incandescent lamps.*» (US Congress)

Table 3
EISA 2007 minimum energy performance standards for general service lamps (US)

Rated Lumen Range	Maximum Rated Wattage	Minimum Rated Lifetime (hrs)	Effective Date
1490–2600 lumens	72 W	1000 hours	1 January 2012
1050–1489 lumens	53 W		1 January 2013
750–1049 lumens	43 W		1 January 2014
310–749 lumens	29 W		1 January 2014

28 For more information on the US regulation, please visit the US Department of Energy website: http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/61

5 RECOMMENDATIONS

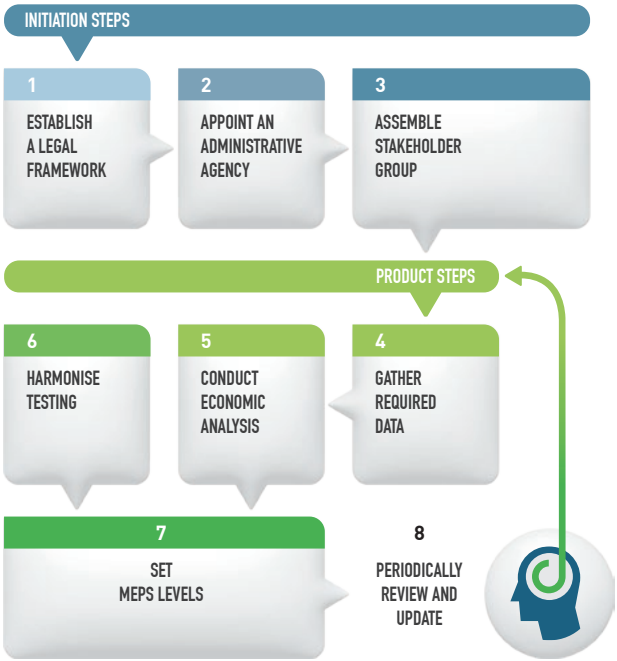
Minimum energy performance standards (MEPS) are the most sustainable option for achieving high levels of energy efficiency and for phasing out inefficient lamps. However, to be effective, they must be carefully implemented. The key recommendations for achieving this are outlined in this chapter.

The key recommendations for achieving the successful development and implementation of MEPS are:

FOLLOW A STRUCTURED APPROACH

It is strongly recommended that a structured, multi-step approach is followed when developing MEPS. The key steps recommended are to:

1. **Establish a legal framework:** Review existing legislation and establish framework legislation to develop a legal basis for, and political commitment to, mandatory efficiency standards and energy labels [29];
2. **Appoint an administrative agency:** Assess existing institutional capacity for developing, implementing and maintaining a standards and labelling programme. Develop an overall standards and labelling plan and assign one government agency with primary responsibility for driving each element of the programme;
3. **Assemble a stakeholder group:** Identify the key relevant people in your economy who would be interested and invite them to participate in the process;
4. **Gather required data:** Establish minimum data needs and develop a plan for collecting the data necessary to conduct analysis to support the programme. This includes information on the market, technology, engineering and usage of the product;
5. **Conduct an economic analysis:** Use cost-effectiveness analysis to determine the appropriate level of ambition for the regulatory measure(s);
6. **Harmonise testing:** To the greatest extent possible, harmonise energy performance test procedures with international protocols (such as International Electrotechnical Commission test standards) to facilitate testing and reduce barriers to trade;
7. **Set MEPS levels:** Determine the technically feasible, economically optimal regulatory level; invite stakeholder comment and refine MEPS if necessary; secure political endorsement; publish regulatory notice; and specify a future date when MEPS will take effect;
8. **Review and update:** Plan to periodically review and update the standards every few years to ensure they remain appropriate and relevant.



Flow diagram illustrating the process of developing lamp minimum energy performance standards

29 Examples of this are the European legal framework established by the *Ecodesign Directive* (2009/125/EC) and the *Energy Labelling Directive* (2010/30/EU). For more information see: http://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficient-products

If these steps are followed, a country will be able to develop and adopt cost-effective lamp MEPS that should yield significant benefits for households and the national economy.

CONSULT AND REVIEW

Performance levels and programme requirements must be developed with stakeholders' input to obtain maximum buy-in and participation. Once implemented, governments must monitor, evaluate, update, and revise the MEPS.

UNDERTAKE AN INTEGRATED POLICY APPROACH

The success of any lamp MEPS 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.

Furthermore, the likelihood of widespread adoption and support is greater if lamp MEPS are linked to national energy and environmental policies, and to other elements of the integrated policy approach. Namely:

- **Supporting policies:** Can play a critical role in preparing the market for lamp MEPS, particularly through awareness-raising campaigns associated with communications and outreach, and through financing initiatives;
- **Monitoring, verification and enforcement:** Plays a critical role in ensuring that lamp MEPS are applied successfully in the market, and compliant companies do not lose out on business due to the activities of non-compliant suppliers or importers;
- **Environmentally sustainable management:** Ensures new lamp products are manufactured in accordance with best practices and regulations regarding hazardous materials, and that spent lamps are recovered, recycled and disposed of responsibly.

CONSIDER HARMONISATION AND TAKE ADVANTAGE OF INTERNATIONAL EXPERIENCE

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. Lamps are a commonly traded commodity, so it may be practical to align lamp MEPS with those of trading partners, or work towards regional harmonisation.

Governments in developing countries may consider the experiences of the UNEP-GEF en.lighten partner countries and regional initiatives to help accelerate and facilitate their development and implementation of lamp MEPS.

6 RESOURCES

To support countries and regions in the development of efficient lighting activities and strategies, the UNEP-GEF en.lighten initiative offers a wide array of practical tools, the most relevant of these are described below.

PUBLICATIONS

Achieving the Transition to Energy Efficient Lighting Toolkit – delivers best practice guidance for policy development and provides technical and practical tools for those directly involved in national phase-out activities. This toolkit is available online in five languages: Arabic, English, French, Russian and Spanish.

http://www.enlighten-initiative.org/ResourcesTools/EfficientLightingToolkit.aspx

Guidebook for the Development of a Nationally Appropriate Mitigation Action Strategy on Efficient Lighting – provides step-by-step guidance on how to transform a National Efficient Lighting Strategy into a proposal for a Nationally Appropriate Mitigation Action.

http://enlighten-initiative.org/portals/0/documents/Resources/publications/UNEP%20Efficient%20Lighting%20NAMA%20Guidebook%20December%202013.pdf

ONLINE TOOLS

Global Policy Map – provides an overview of efficient lighting policies and successes for countries around the world. It constitutes a very useful tool to compare a country's status and potential with other countries in the region or worldwide.

http://map.enlighten-initiative.org/

Country Lighting Assessments – analyse the potential benefits gained through the global adoption of efficient lighting. The on-grid reports provide country-specific estimates of potential energy savings, CO_2 reductions and financial gains. Off-grid reports model a transition from fuel-based lighting to one based on solar-powered light emitting diodes (LED). Regional results can either be compiled from the assessments of the constituent countries, or, in cases where the UNEP-GEF en.lighten initiative does not offer an assessment for each country, the initiative can work with the region to develop estimates based on best available data.

http://www.enlighten-initiative.org/ResourcesTools/CountryLightingAssessments/MethodologyforCountryLightingAssessments.aspx

Efficient Lighting Savings Forecasting Model – this open-source tool helps users model the potential savings that a region, or country, could realise by a rapid transition to energy efficient lighting. The spreadsheet forecasts the electrical energy and CO_2 emission savings potential of efficient lighting regulations relative to a business-as-usual scenario.

http://learning.enlighten-initiative.org/Tools.aspx

Online support centre, 'en.lightened learning' – includes targeted technical advice, webinars and training videos to improve the understanding of the practical elements when executing a transition to efficient lighting.

http://learning.enlighten-initiative.org/HOME.aspx

EXPERTISE AND COLLABORATING CENTRES

The UNEP-GEF en.lighten initiative **Centre of Excellence** – comprised of a network of over 50 lighting experts representing over 30 countries – offers recommendations, technical guidance and efficient lighting expertise to assist countries in the shift to energy efficient lighting. The Centre is based in Paris, France.

http://www.enlighten-initiative.org/

UNEP Collaborating Centre for Energy Efficient Lighting, China – the Global Efficient Lighting Centre offers a wide range of technical services to developing countries including laboratory and establishing systems for lamp quality control.

http://www.enlighten-initiative.org/About/GlobalEfficientLightingCentre.aspx

AMBILAMP Academy, Spain - the AMBILAMP International Academy for the Recycling of Light has been created to provide expertise for establishing environmentally sound management systems for spent lamps in developing and emerging countries.

http://www.enlighten-initiative.org/About/AMBILAMPAcademy.aspx

OTHER RELEVANT RESOURCES

CLASP – CLASP improves the environmental and energy performance of appliances and related systems, lessening their impacts on people and the world around us. CLASP develops and shares practical and transformative policy and market solutions in collaboration with global experts and local stakeholders. It is a non-profit international organisation promoting energy efficiency standards and labels for appliances, lighting, and equipment. Since 1999, CLASP has worked in over 50 countries on six continents pursuing every aspect of appliance energy efficiency, from helping to structure new policies to evaluating existing programmes. CLASP offers an online Policy Analysis Modelling System, MV&E Publication Library and MV&E Guidebook.

http://www.clasponline.org/en

ACEEE – the American Council for an Energy-Efficient Economy (ACEEE) is a non-profit organisation that acts as a catalyst to advance energy efficiency policies, programmes, technologies, investments, and behaviours. Focusing on the US, ACEEE seeks to harness the full potential of energy efficiency to achieve greater economic prosperity, energy security, and environmental protection. ACEEE carries out its mission by: (1) conducting in-depth technical and policy analyses; (2) advising policymakers and programme managers; (3) working collaboratively with businesses, government officials, public interest groups, and other organisations; (4) convening conferences and workshops, primarily for energy efficiency professionals; (5) assisting and encouraging traditional and new media to cover energy efficiency policy and technology issues; and (6) educating consumers and businesses through reports, books, conference proceedings, press activities, and websites. ACEEE was founded in 1980 by leading researchers in the energy field and has grown to a staff of about 50.

http://www.aceee.org/

eceee – the European Council for an Energy Efficient Economy (eceee) is a membership-based, non-profit association. As Europe's largest and oldest NGO dedicated to energy efficiency, it generates and provides evidence-based knowledge and analysis of policies, and facilitates co-operation and networking. eceee members are found among private and public organisations, as well as among all those professions from all sectors who share its goals. eceee offers governments, industry, research institutes and citizen organisations a unique resource of evidence-based knowledge and reliable information. eceee promotes the understanding and application of energy efficiency in society and assists its target groups – from policymakers to programme designers to practitioners – to make energy efficiency happen. eceee participates actively in the European policymaking process and participates in a number of EU policymaking and advisory fora, and frequently comments on European energy policy through position papers and responses to public consultations. eceee has also held expert workshops and briefings for policymakers and, in cooperation with the European Commission, the Parliament and the EU presidency, has held expert seminars.

http://www.eceee.org/

IEA – the International Energy Agency (IEA) is an autonomous organisation which works to ensure reliable, affordable and clean energy for its 28 member countries and beyond. The IEA's four main areas of focus are: energy security; economic development; environmental awareness; and engagement worldwide. Founded in response to the 1973/4 oil crisis, the IEA's initial role was to help countries coordinate a collective response to major disruptions in oil supply through the release of emergency oil stocks. It has a staff of 260 professionals (energy analysts, modellers, data managers/statisticians, technicians, secretaries and support staff) working together on global energy challenges.

http://www.iea.org/

IEA 4E SSL Annex - the Solid State Lighting (SSL) Annex was established in 2009 under the framework of the International Energy Agency's Efficient Electrical End-Use Equipment (4E) Implementing Agreement to provide advice to its ten member countries seeking to implement quality assurance programmes for SSL lighting. This international collaboration brings together the governments of Australia, China, Denmark, France, Japan, The Netherlands, Republic of Korea, Sweden, United Kingdom and United States of America. China works as an expert member of the 4E SSL Annex.

http://ssl.iea-4e.org/

7 REFERENCES

CLASP 2011
Assessment of Opportunities for Global Harmonization of Minimum Energy Performance Standards and Test Standards for Lighting Products.
http://www.clasponline.org/en/Resources/Resources/PublicationLibrary/2011/Global-Harmonization-Lighting-MEPS-TestStandards.aspx

CLASP 2013
Energy Policy Toolkit for Energy Efficiency in Appliances, Lighting, and Equipment.
http://clasp.ngo/Resources/Resources/PublicationLibrary/2013/Energy-Policy-Toolkit-for-Energy-Efficiency-in-Appliances

EUROPEAN COMMISSION 2009
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.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:076:0003:0016:en:PDF

EUROPEAN COMMISSION 2012
Commission Regulation (EU) No 1194/2012 of 12 December 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for directional lamps, light emitting diode lamps and related equipment.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:342:0001:0022:EN:PDF

INTERNATIONAL ENERGY AGENCY 2013
Redrawing the Energy-Climate Map.
https://www.iea.org/publications/freepublications/publication/weo-special-report-2013-redrawing-the-energy-climate-map.html

INTERNATIONAL ELECTROTECHNICAL COMMISSION 2015
Electropedia.
http://www.electropedia.org/iev/iev.nsf/index?openform&part=845

MCMAHON, J. AND S. WEIL 2001
Energy-Efficiency Labels and Standards: A Guidebook for Appliances, Equipment and Lighting; Lawrence Berkeley National Laboratory.
http://escholarship.org/uc/item/0f43k8ss

OSRAM 2014
The phase-out plan for non-directional household lamps until 2016
http://www.osram.com/osram_com/sustainability/strategic-focus/stakeholder-dialogue/phasing-out-inefficient-lighting/eu,-europe,-middle-east-and-africa/non-directional-household-lamps/index.jsp

PHILIPS 2014	*Federal DOE Legislation - Understanding light bulb efficiency standards.* http://applications.nam.lighting.philips.com/cmolegislation/	
UNITED NATIONS ENVIRONMENT PROGRAMME 2012	*Achieving the Global Transition to Energy Efficient Lighting Toolkit.* http://www.enlighten-initiative.org/ResourcesTools/EfficientLightingToolkit.aspx	
UNITED NATIONS ENVIRONMENT PROGRAMME 2013	*Guidebook for the Development of a Nationally Appropriate Mitigation Action on Efficient Lighting.* http://www.unep.org/pdf/Guidebook_for_development_of_a_nationally_mitigation_action.pdf	
UNITED NATIONS ENVIRONMENT PROGRAMME 2013	*National Efficient Lighting Strategy Development Inception Package for Pilot Countries, 2012-2013.* http://enlighten-initiative.org/portals/0/documents/country-support/Development%20of%20a%20National%20Efficient%20Lighting%20Strategy%20project_Inception%20Package_FINAL.pdf	
USAID 2010	*Testing for Quality: Benchmarking Energy-Saving Lamps in Asia.* http://www.lites.asia/library	
US CONGRESS 2007	*Energy Independence and Security Act of 2007 (EISA 2007)* http://www1.eere.energy.gov/buildings/appliance_standards/product.aspx/productid/61	
VITO, BIO INTELLIGENCE SERVICE, ENERGY PIANO AND KREIOS 2009	*Preparatory Studies for Eco-design Requirements of EuPs*, Final report, Lot 19: Domestic lighting. Study for European Commission. 2009/ETE/R/069. http://www.eup4light.net/default.asp?WebpageId=33	

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ABOUT THE UNEP DIVISION OF TECHNOLOGY, INDUSTRY AND ECONOMICS

The UNEP Division of Technology, Industry and Economics (DTIE) helps governments, local authorities and decision-makers in business and industry to develop and implement policies and practices focusing on sustainable development.

The Division works to promote:

- → sustainable consumption and production,
- → the efficient use of renewable energy,
- → adequate management of chemicals,
- → the integration of environmental costs in development policies.

The Office of the Director, located in Paris, coordinates activities through:

- → **The International Environmental Technology Centre** - IETC (Osaka, Shiga), which implements integrated waste, water and disaster management programmes, focusing in particular on Asia.
- → **Production and Consumption** (Paris), which promotes sustainable consumption and production patterns as a contribution to human development through global markets.
- → **Chemicals** (Geneva), which catalyzes global actions to bring about the sound management of chemicals and the improvement of chemical safety worldwide.
- → **Energy** (Paris), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.
- → **OzonAction** (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.
- → **Economics and Trade** (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies.

UNEP DTIE activities focus on raising awareness, improving the transfer of knowledge and information, fostering technological cooperation and partnerships, and implementing international conventions and agreements.

For more information,
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This guidance note illustrates how to develop minimum energy performance standards (MEPS) for lighting products. It is a practical resource for governments on the processes to follow when establishing MEPS in a national or regional market. It presents a step-by-step approach to establishing MEPS, including the legal framework development, administrative agencies appointment, stakeholder considerations and data requirements. It also provides readers with details about how harmonising MEPS with other countries can lower barriers to trade and give consumers more choice, with better efficiency, quality and lower price products. Finally, it recommends best practices for developing lamp MEPS and signposts resources for additional information on ways to encourage energy efficient lighting.

This guidance note was prepared by the United Nations Environment Programme (UNEP)-Global Environment Facility (GEF) en.lighten initiative.

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