Green Paper

Policy Options to Accelerate the Global Transition to Advanced Lighting

Prepared for the Global Efficient Lighting Forum

November 2014

Foreword

This Green Paper is intended to initiate a discussion for the Global Efficient Lighting Forum which will be held November 10-11, 2014, in Beijing, China. The Global Efficient Lighting Forum *("the Global Forum")* aims to generate a global dialogue and a consensus on the policy options that can deliver an accelerated transition to energy efficient lighting. It will do so by convening representatives from governments, the private sector, development partners, international financial institutions, United Nations (UN) agencies and other key stakeholders, given its climate and energy benefits. This Green Paper lays out a variety of policy options for debate prior to and during the Global Forum. The Green Paper seeks the inputs from governments, multilateral development banks, the private sector, donor agencies, UN agencies and civil society. The Global Forum will feature a wide range of topics associated with the transition to energy efficient lighting including: benefits; progress and challenges; financial aspects; monitoring and enforcement of standards and norms; technical capacities; the opportunities created by new technologies such as light emitting diodes (LEDs) and controls; and, the environmentally sound management of lighting products. Ultimately, the Global Forum is expected to generate dialogue and ambition on the policy and financial actions that can enable an accelerated global transition to efficient lighting in the domestic, commercial and industrial sectors, for indoor and outdoor applications. This accelerated transition will be fundamental to achieve the UN Secretary General's Sustainable Energy for All (SE4ALL) initiative's energy efficiency objective.

About the UNEP-GEF en.lighten initiative

The United Nations Environment Programme (UNEP)-Global Environment Facility (GEF) en.lighten initiative promotes and coordinates global efforts in the transition to energy efficient lighting. Its mandate is to accelerate the global commercialisation and market transformation of efficient lighting technologies by providing technical and policy support to developing countries. In doing so, it aims to strengthen capacities in governments to lead successful lighting market transformation programmes. The en.lighten initiative co-leads efforts related to the Sustainable Energy for All (SE4ALL) Accelerator on Lighting, a critical effort in the framework of the SE4ALL energy efficiency objective.

For more information about the UNEP-GEF en.lighten initiative please visit:

www.enlighten-initiative.org

Comments

Your comments on this *Green Paper* are welcome. Please contact:

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Acronyms / Abbreviations

compact fluorescent lamp	**CFL**
Climate Technology Centre and Network	**CTCN**
Economic Community of West African States	**ECOWAS**
Energy Sector Management Assistance Program	**ESMAP**
Global Environment Facility	**GEF**
LEAP Global Lighting and Energy Access Partnership	**Global LEAP**
Global Off-Grid Lighting Association	**GOGLA**
gigatonne	**Gt**
gigawatt-hour	**GWh**
International Energy Agency	**IEA**
International Finance Corporation	**IFC**
kilogram	**kg**
lighting emitting diode	**LED**
least life cycle cost	**LLCC**
Lighting Information and Technical Exchange for Standards	**lites.asia**
minimum energy performance standards	**MEPS**
megatonne	**Mt**
National Appropriate Mitigation Action	**NAMA**
Organisation for Economic Co-operation and Development	**OECD**
Sustainable Energy for All	**SE4ALL**
Super-Efficient Equipment and Appliance Deployment	**SEAD**
terawatt-hour	**TWh**
United Nations Development Programme	**UNDP**
United Nations Environment Programme	**UNEP**
United Nations Framework Convention on Climate Change	**UNFCCC**

Highlights

The increase of CO_2 emissions and the current energy and economic crises underscore the importance of accelerating action on energy efficiency. The escalating consumption of electricity in most developing and emerging economies is outstripping supply. Electricity blackouts negatively impact families and businesses that depend on electricity for services and they weaken investors' confidence. Energy efficiency measures, specifically lighting, are one of the fastest and most cost-effective ways to address these issues while simultaneously postponing or eliminating the need for building new power plants .[1]

Efficient lighting technologies significantly cut electricity bills, improve grid and system reliability, reduce fuel and energy imports, increase the competitiveness of economies, improve end user welfare and mitigate CO_2 emissions. The United Nations Environment Programme (UNEP) estimates that replacing all the inefficient on-grid lighting globally today would result in 1,044 TWh of electricity savings annually, which is equivalent to over $120 billion in avoided electricity bills and over 530 Mt of CO_2 avoided emissions annually.

For off-grid lighting, if solar LED lanterns were used in place of kerosene and candles, they would displace 90 Mt of CO_2 emissions while significantly improving the health and safety of end users. Taken together, the CO_2 savings potential in on-grid and off-grid lighting is 580 Mt of CO_2, greater than the entire annual CO_2 emissions of Belgium and the United Kingdom combined[2]. According to 2 UNEP's conservative estimates, if all light sources were switched overnight to LED lamps, global electricity consumption for lighting would be reduced by more than 52% and produce 735 Mt of avoided CO_2 emissions, which is nearly equivalent to the total emissions of Germany.

With guidance from international lighting experts in governments, private sector and civil society, the UNEP-GEF en.lighten initiative promotes the adoption of an integrated policy approach to support countries so that they can realise a sustainable and permanent market transition to efficient lighting. The integrated policy approach ensures that a market permanently increases the deployment of advanced lighting products, creating a level playing field and ensuring that environmental impacts are minimized or eliminated. An integrated policy approach to lighting includes a mix of:

- **Minimum energy performance standards**
- **Supporting policies**
- **Monitoring, verification and enforcement**
- **Environmentally sound management of spent lighting products**

1 - DG Energy (2011) Energy 2020: A Strategy for Competitive, Sustainable and Secure Energy.

2 - U.S. Energy Information Administration. International Energy Statistics. www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=90&pid=44&aid=8

Many countries have already taken the lead in adopting efficient lighting policies. This trend is growing across the world, but many of these developments fail to adopt systematic policy action to accelerate advanced lighting technologies, despite the fact that efficient and affordable alternatives exist. The reason for this inaction can be attributed to a number of challenges which can be classified into one of four broad categories:

Governance and leadership	including the limited or weak political will and action of governments to develop policies, standards, technical specifications, as well as overall lighting policies which accelerate the transition to efficient lighting;
Technical capacities	which range from limited access to information, the know-how to put in place technical standards, use of supporting policies or other technical aspects related to ensuring control of quality and performance;
Financial	including limited access and limited use of approaches that reduce the upfront cost of efficient lighting and limited budgets for supplementary measures such as monitoring, verification and enforcement, or for collection and recycling; and,
Technology transfer	including issues regarding research and development processes, diffusion of technologies, structural issues with imports and export tariffs, intellectual property rights, trade agreements and technology licensing.

In light of the energy and climate crises, there is an urgent need for a coordinated strategy at the global level to define the priorities to achieve a sustainable market transformation to advanced lighting technologies. A consensual determination of priorities would help to implement successful measures at national, regional and global levels to ensure that there is a coordinated shift to efficient lighting.

The participation of experts, government decision-makers, international agencies, financial institutions and civil society in the Global Efficient Lighting Forum will help in facilitating the development of this consensus. Such consensus will be a fundamental element to achieve the energy efficiency goal of the UN Secretary-General's Sustainable Energy for All (SE4All) initiative.

This paper describes issues that stall progress and possible options to accelerate successful programmes which can be replicated and scaled up at national, regional and global levels; and provides the foundation for dialogue at the Global Forum. Many of the issues, barriers and options described in this paper stem from the development and implementation of National and Regional Efficient Lighting Strategies supported by the UNEP-GEF en.lighten initiative, as well as through the lessons learned in activities supported by other international agencies including the United Nations Development Programme (UNDP), the World Bank and other regional development banks. The Green Paper avoids getting into detail provided that a description of the technical issues, successful policy frameworks, financing mechanisms, enforcement systems and specific effective national and regional case studies are described in detail in the UNEP-GEF en.lighten initiative Achieving the Global Transition to Energy Efficient Lighting Toolkit.

www.enlighten-initiative.org/resourcestools/efficientlightingtoolkit

Key Issues for a Global Acceleration of Advanced Lighting Solutions
Fundamental challenges that need to be addressed in order to achieve an effective, permanent and sustainable transition to advanced lighting include:

- Leadership and governance/institutional frameworks
- Market awareness
- Affordability of efficient lighting products
- Capacities for quality control
- Capacities for environmentally sound management
- Potential impact on local industry
- Donor coordination and country support

Options to Accelerate the Global Transition
In order to accelerate a coordinated transition to energy efficient lighting, this document provides a set of possible options and approaches that could be implemented at national, regional and global levels.

National Level
National authorities have the ownership to select and utilize the various existing tools to deploy efficient lighting solutions. They can choose among a range of mechanisms and approaches.

Governance and leadership
- Develop National Efficient Lighting Strategies
- Implement public awareness and educational campaigns

Technical capacities
- Build and/or strengthen institutional capacities
- Support local manufacturers
- Create or strengthen monitoring, verification and enforcement capacities
- Establish collection and recycling schemes

Financial instruments
- Create financial incentives and fiscal instruments
- Develop lighting NAMAs
- Promote utility programmes

Technology transfer
- Integrate lighting technology roadmaps into national efficient lighting strategies

Regional Level
Regional coordination and planning avoids duplication of efforts and confusion among countries and their trading partners. Through regionally coordinated action integrated frameworks can be harmonized, ensuring that activities are aligned and achieve the intended results in a cost-effective manner. In the context of regional integration processes these approaches also facilitate trade and economic development.

Governance and leadership
- Coordinate development of Regional Efficient Lighting Strategies
- Develop shared regional quality control schemes

Technical capacities
- Harmonise minimum energy performance standards (MEPS) and labelling
- Coordinate collection and recycling schemes

Global Level
Global actors should increase their assistance to eliminate the barriers that countries face to put their markets on the path to energy efficiency. They should provide knowledge and technical capacities as well as help in mobilizing financial resources to those countries that need them. Coordinated global action could also help international financial institutions and donor countries to be strategic, effective and accountable as they support efficient lighting initiatives.

Governance and leadership
- Coordinate the support of efficient lighting strategies
- Develop a global efficient lighting campaign

Technical capacities
- Build capacity in countries to adopt the integrated Policy Approach
- Harmonize testing standards and labels

Financial instruments
- Finance efficient lighting strategies

Technology transfer
- Coordinate the development of common areas identified in national technology roadmaps and support the development and integration of national or regional lighting roadmaps with national or regional lighting strategies

The Role of Private Sector
The private sector has a key role to play in the market transformation to efficient lighting. They have the technological know-how and supply the lighting products. If a sustainable market transformation to efficient lighting is to be achieved globally, the private sector needs to participate and the following options should be considered. These complement the private support that could be fostered at the national level, as described in the national level options.

Leadership
- Strengthen supply chains
- Join public-private partnerships to support the transfer of efficient lighting technologies

Technical capacities
- Promote and expand financial instruments for local manufacturers

Creating a Global Consensus to Accelerate the Transition to Advanced Lighting

The International Energy Agency's (IEA) World Energy Outlook 2012, projects that global energy demand will increase by more than one-third in the period leading up to 2035 [3]. Energy-related CO_2 emissions will increase from 31 Gt in 2011 to 37 Gt in 2035. This trend points to a long-term average global temperature increase of 3.6°C, well above the 2°C target agreed on the Copenhagen Accord at the United Nations Climate Change Conference in 2009. The IEA indicates that energy demand and CO_2 emissions rise even higher when the share of energy demand from countries that are not members of the Organisation for Economic Cooperation and Development (OECD) increases from 55% in 2010 to 65% in 2035.

Building on previous success

Against this backdrop, there are encouraging signs of global advances. According to the most recent UNEP-GEF en.lighten initiative (2012) ***Country Lighting Assessments*** [4], global lighting consumption has decreased from 19% (in 2005) to slightly more than 15% in 2010. This decrease could be attributed, in an important part, to the proactive regulatory approaches implemented in most OECD countries to set performance requirements for lighting products, but it is also certainly tempered by the increase of electricity consumption by other appliances (including televisions, air conditioners, refrigerators and computers).

Another positive trend is the emerging consensus on the need to move away from inefficient lighting technologies and the commitment of 66 developing and emerging countries to take action to transition their markets to energy efficient lighting by phasing out inefficient incandescent lamps by the end of 2016 [5]. These and other initiatives, if scaled up, would have a significant global impact to tackle climate change and create economic benefits well beyond CO_2 emissions reductions [6] .

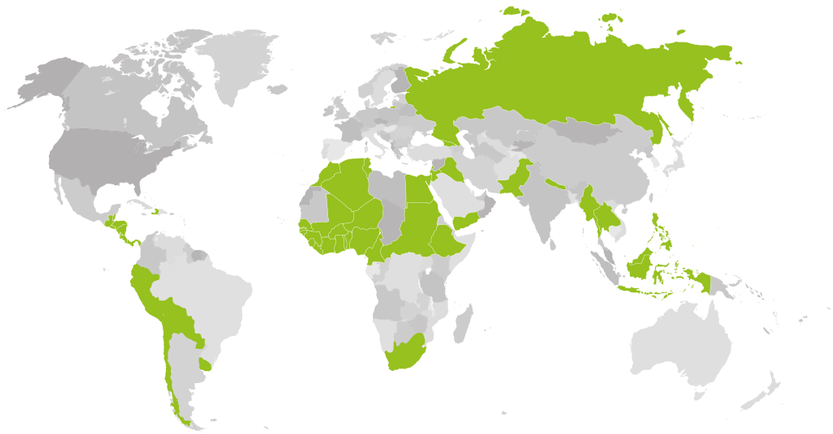
3 - International Energy Agency. 2013. World Energy Outlook 2012

4 - UNEP-GEF en.lighten initiative. 2012. Country Lighting Assessments. Online access: www.enlighten-initiative.org/resourcestools/countrylightingassessments

5 - For additional information please visit: www.enlighten-initiative.org/inAction/GlobalEfficientLightingPartnershipProgramme.aspx

6 - Blok, K. *et al.* 2012. Bridging the greenhouse-gas emissions gap. *Nature Climate Change 2,* 471–474. This paper presents an innovative approach to mitigate climate change by "building on rapid developments in technology and on the great initiatives in many places to bridge the global emissions gap. It consists of amplifying the actions of frontrunners in 21 types of activity by applying them on a large scale, under the leadership of organizations already active in the field". One of these 21 is the UNEP-GEF en.lighten initiative.

Figure 1.
The UNEP-GEF en.lighten initiative Global Efficient Lighting Partnership: 66 members



Pacific Islands:
Cook Islands, Kiribati, Marshall Islands, Micronesia, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu

Most OECD members including Australia, Canada, the European Union and the United States, have already established a staged approach to phase in efficient lighting solutions through a combination of regulatory measures and supporting policies. Other countries have begun or are in the process of taking action, for instance: Argentina, Brazil, China, Ecuador, Ghana, Mexico, Russia, Senegal and South Africa. With the support of UNEP-GEF en.lighten initiative, 27 developing and emerging countries have completed national or regional efficient lighting strategies to achieve a phase-out of inefficient incandescent lamps by the end of 2016.

Despite this encouraging progress, almost half of the countries in the world, mostly developing countries and emerging economies, have not yet initiated a phase-out of incandescent lamps [7].

In some cases the lack of technical capacities, know-how and financial means limit their ability to take action. A coordinated plan on energy efficient lighting would help create the necessary governance, technical and financial conditions to support these countries address the barriers they face as they work to adopt the policies that will place their markets on the path to efficiency.

Advanced lighting: a contribution to achieve the efficiency goal of Sustainable Energy for All

The UN Secretary-General's Sustainable Energy for All (SE4All) initiative [8] was launched in 2012 to mobilize action from all sectors of society to achieve three interlinked objectives by 2030:

1. Ensure universal access to modern energy services
2. Double the global rate of improvement in energy efficiency
3. Double the share of renewable energy in the global energy mix

A transition to energy efficient lighting would reduce the global electricity demand for lighting by close to 14% in year 2030 [9]. Given this tangible reduction and its economic, environmental and social benefits, SE4ALL identified advanced lighting as an "Accelerator" to help realize the energy efficiency goal.

Yet a global transition to advanced lighting requires coordinated efforts from governments, regional organizations, the private sector, development agencies and international financial institutions. It also requires the definition of strategies and the identification of actions needed to drive an accelerated switch to energy efficient lighting in all sectors, at global, regional and national levels.

7 - UNEP-GEF en.lighten initiative. 2013. *Global Policy Map.* This percentage includes two groups of countries: (a) countries that have not initiated a phase out of incandescent lamps, 26%, and (b) countries that have not reported any information to UNEP, 22%.

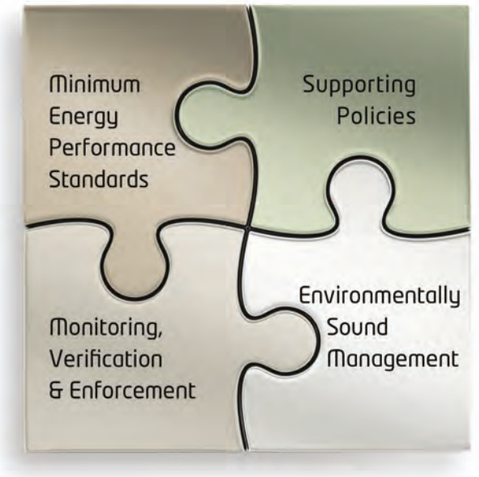
8 - www.sustainableenergyforall.org

1.1 The Integrated Policy Approach

Lighting experts from governments, private sector, civil society and international bodies from over 40 organisations including developing and developed nations, were convened by the UNEP-GEF en.lighten initiative to take stock of successful experiences and lessons learned by countries and regions which have sustainably and gradually transformed their markets to efficient lighting. Their experience shows that following an integrated policy approach to lighting significantly increases the likelihood of success and leads to financial, energy and environmental benefits. It also streamlines the process for those involved in designing and implementing policy. The integrated policy approach ensures that all pertinent policy aspects related to energy efficient lighting are considered in the development of National or Regional Efficient Lighting Strategies, through four elements:

Minimum Energy Performance Standards (MEPS) to ensure the efficiency and quality of energy-saving lighting products and to remove obsolete technologies from the market.

Monitoring, Verification and Enforcement (MVE) to discourage the distribution of non-compliant and obsolete products and ensure a level playing field.



Supporting policies and mechanisms to promote the public acceptance and demand for energy-saving products.

Environmentally sound management to establish maximum mercury content limits and set up extended producer responsibility approaches and the collection, sound disposal and/or recycling programmes for spent lamps.

Minimum Energy Performance Standards

MEPS are regulatory measures specifying minimum efficiency levels allowed for products sold in a particular country or region. MEPS define which products can be marketed and those that should be eliminated. MEPS are the foundation from which to ensure the success of any efficient lighting transition strategy.

Countries or regions should define the parameters, stringency and implementation periods. Performance standards should specify the maximum permissible energy consumption limit for a given lumen output, or the minimum efficacy that a product must meet. Additional lighting quality guidelines may be stipulated for example, rated lifetime, lumen maintenance and colour temperature. MEPS legislation may include or refer to product labelling requirements.

Supporting Policies and Mechanisms

In order to ensure the smooth implementation of MEPS and to secure a broad public acceptance of the transition, a combination of complementary policies and measures should be implemented, including:

- Economic and market-based instruments, often initiated and promoted by regulatory incentives but that may contain elements of voluntary action;
- Fiscal instruments and incentives that impact prices, such as tax breaks, or financial incentives to overcome initial costs;
- Information and communication campaigns that inform end users in order to change or modify their behaviour.

Environmentally Sound Management of Lighting Products

Mercury and other hazardous substance content standards should be established in line with global best practice in order to minimize any environmental or health impact. Special attention should be given to the development of a legal framework for environmentally sound, end-of-life activities. Policy and rigorous legislation should be instituted before the establishment of formal collection channels and recycling facilities. These are important areas of sustainability in lighting that merit the attention of national regulators in their efforts to implement a comprehensive lighting policy. These recommendations reflect global initiatives addressing hazardous waste such as The Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal and the recently agreed Minamata Convention on Mercury, [10] [11].

Monitoring, Verification and Enforcement

The success of any efficient lighting policy depends on a well-functioning system of monitoring, control and testing to ensure enforcement and compliance with MEPS. Unless effective and timely market surveillance systems are in place, substandard products risk entering markets in increasing numbers and reducing energy and financial savings. Poor quality products also create unfulfilled expectations and disappointment for end users who will refrain from purchasing these products on an ongoing basis in the future. They also create an uneven playing field penalizing those producers who comply with the mandated standards.

Governments should integrate monitoring, verification and enforcement (MVE) activities into their lighting programmes. To enhance MVE capacities, the sharing of information and skills between countries and across regions provides an effective means through which to promote best practice quickly and thoroughly. International and regional cooperation for enforcement through the sharing of laboratory and test capacities, programmes and test data, is highly recommended.

9 - This reduction in 2030 (13.7%) comes from accelerating the transition against the slow new policies scenario. It is calculated based on a global on-grid lighting energy forecast created by UNEP-GEF en.lighten initiative. Section 1.2 of this paper provides further information on the model.

10 - United Nations Environment Programme. 1989. *Basel Convention: Protocol on Liability and Compensation for Damage Resulting from Transboundary Movement of Hazardous Wastes and their Disposal.*

11 - In February 2009, the UNEP Governing Council adopted Decision 25/5 on the development of a global legally binding instrument on mercury. This process was completed in January 2013. Details on the Minamata Convention can be found at: www.mercuryconvention.org

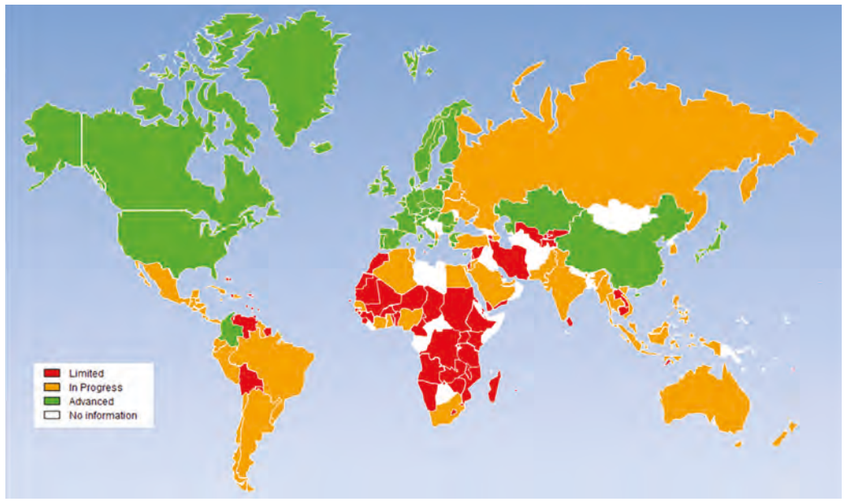
1.2 Lighting Policy Status, by Country

The UNEP-GEF en.lighten initiative reviewed the policy status of approximately 150 countries with regards to the four elements of the integrated policy approach. The review focuses on policies relating to incandescent lamps, compact fluorescent lamps, fluorescent lamps and high-intensity discharge lamps.

European Union countries, the United States, Canada, Colombia, Kazakhstan and China are the only countries that have advanced significantly in a transition to efficient lighting in the residential, commercial, and industrial outdoor sectors, for indoor and outdoor applications. On a regional basis, Latin America, the Economic Community of West African States (ECOWAS) and Asia have made progress and policies are either under development or planned to be developed. Most of African countries fall behind with limited progress in developing lighting policies for a sustainable transition to energy efficient lighting in these sectors (Figure 2).

Meanwhile, global domestic lighting policy [12] and activities have progressed significantly in developed countries, while most developing countries demonstrate significant gaps in terms of minimum standards, supporting policies and actions required to achieve a successful strategy. Most developing and emerging countries have either taken no action or very limited action on the development of MEPS; close to 50% of the countries have not yet initiated a transition to efficient lighting in the domestic sector [13]. With regard to supporting policies and other measures to encourage the supply of efficient products, all regions score higher than for MEPS, without exception. However, supporting policies, encompassing distribution and give-away activities, do not necessarily translate into sustainable market transformation. OECD countries and Latin America and the Caribbean are the most advanced in this area. MVE programmes have a lower level of development than MEPS. While developed countries are the only region where MVE measures are widely implemented, there is still significant room for improvement to ensure compliance with MEPS.

Figure 2.
Global Efficient Lighting Policy Map, December 2013



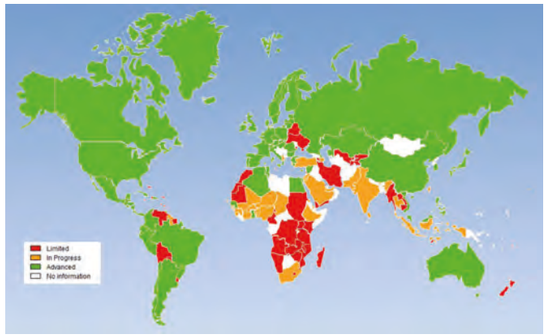
The map shows the national aggregate policy progress towards establishing minimum energy performance standards, supporting policies, monitoring verification and enforcement and environmentally sound management systems for incandescent, compact fluorescent, linear fluorescent and high-intensity discharge lamps.

Compared to the other elements of the integrated policy approach, the status of environmentally sound management programmes indicates that there is a need to improve and expand the number of activities in all regions. And even if a large number of OECD countries count with end of life legislation and schemes for lighting products, their collection and recycling rates are generally low (Figure 3).

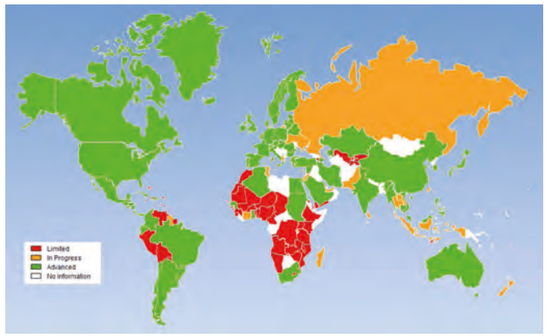
12 - Domestic lighting refers to incandescent and compact fluorescent lamps.
13 -This percentage includes two groups of countries: (a) countries that have not initiated a phase out of incandescent lamps, 26%, and (b) countries that have not reported any information to UNEP, 22%.

Figure 3
Four world maps representing the progress of lighting policies in the domestic sector with regards to the four elements of the integrated policy approach.

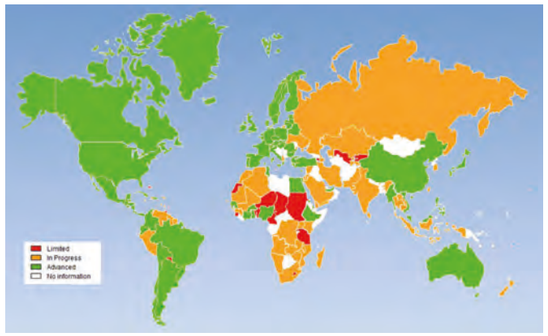
MEPS: Minimum Energy Performance Standards



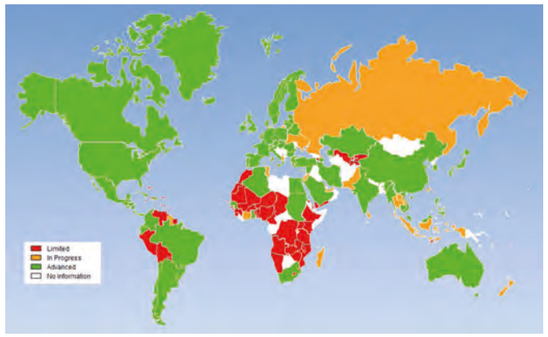
MVE: Monitoring, Verification and Enforcement



SP: Supporting Policies



ESM: Environmentally Sound Management



Limited
In progress
Advanced
No information

1.3 Potential Benefits of the Global Transition to Efficient Lighting

1.3.1 Estimated energy savings in 2010

The UNEP-GEF en.lighten initiative's Country Lighting Assessments indicate that a transition to efficient lighting in all end-use sectors in on-grid lighting (residential, commercial and industrial sectors, for indoor and outdoor applications) would save over $120 billion annually in avoided electricity bills through a reduction of 1044 TW hours of electricity [14]. The transition would also save over $233 billion in avoided investment in 280 large coal-fired power plants [15]. The magnitude of these global energy savings represents approximately 37% of electricity use annually for lighting globally and approximately 140 GW in avoided electricity generating capacity. This electrical capacity would be enough to electrify approximately one billion households [16].

Regional energy savings tend to be between 32 to 42 percent of electricity use for lighting, with the highest share in Eastern Europe and Central Asia. Energy savings in both the residential and commercial/industrial sector outweighs the savings in the outdoor sector for all regions (Figure 4). Furthermore, the greenhouse gas emission savings from this transition to efficient lighting globally would be over 530 Mt of CO_2 annually. Electricity consumed for artificial lighting accounts for 4.6% of greenhouse gas emissions; the avoided emissions from efficient lighting would reduce this share to 3.0%. The highest reduction of carbon dioxide emissions would be achieved by South Asia, followed by the OECD countries and East Asia and Pacific (Figure 5).

Figures 4 and 5 show how on-grid lighting energy savings and avoided emissions are derived on a regional basis, based on a 2010 installed stock of lighting products. For further detail on global and regional electricity savings and avoided carbon dioxide emissions by sector and technology refer to Annex 1. Global and Regional Electricity Savings and Climate Benefits and Annex 2. Regional Breakdown of Financial and Climate Benefits.

In addition to the benefits derived from promoting energy efficient lighting in the on-grid market, there are also immense benefits to the off-grid lighting market waiting to be tapped. The total global savings in the off-grid lighting sector, where solar-powered LED lanterns displace fuel-based light sources like kerosene and candles, is worth a further $25 to $33 billion. This represents the annual end user expenditure of approximately 25.6 billion litres of kerosene and 1.4 Mt of candles.

A global shift to high efficiency lighting in the off-grid market would achieve annual CO_2 reductions of more than 90 Mt. Taken together with on-grid lighting, this represents a savings potential of 580 Mt of CO_2 from lighting, more than the annual emissions of Belgium and the United Kingdom combined.

For off-grid lighting installations, replacing kerosene lamps, candles and other flame-based light sources will improve the quality of life for over 1.3 billion people. Currently, these households have to endure the hazards of fuel-based lighting including; indoor air pollution, kerosene poisoning, burns and house fires that affect tens of thousands of people every year.

Additionally, according to conservative UNEP estimates, if all light sources were switched overnight to advanced LED technology, global electricity consumption for lighting would be reduced by more than 52% and produce over 750 Mt of avoided CO_2 emissions, which is nearly equivalent to the total emissions of Germany. When taking into consideration the national cost savings, the CO_2 reduction and the improvement in quality of life, the transition to energy efficient lighting technologies is one of the most attractive initiatives worldwide and the most straightforward of the energy-efficiency programmes to initiate. Peak power demand, black-outs and kerosene shortages in many countries could be substantially reduced by a rapid transition to efficient lighting, freeing up resources for other critical requirements such as healthcare, education and infrastructure improvements.

14 - The UNEP-GEF en.lighten initiative Country Lighting Assessments are snapshots of lighting stock changes. Theyprovide data on energy and CO2 savings potential across more than 150 countries, based on a 2010 installed stock oflighting products. They are available at: www.enlighten-initiative.org/resourcestools/countrylightingassessments

15 - Assuming $1000/kW and a 500MW power plant operating at 0.85 availability factor, producing 3.72 TWh/yr.

16 - Assuming 1000 kWh/yr.

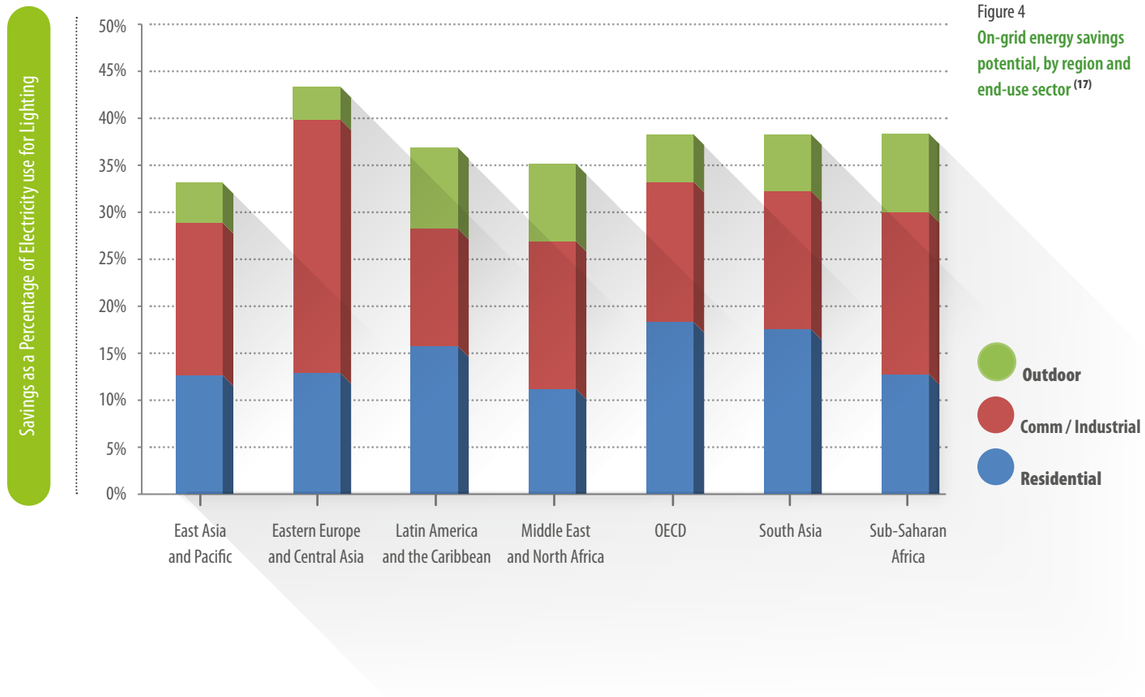


Figure 4
On-grid energy savings potential, by region and end-use sector [17]

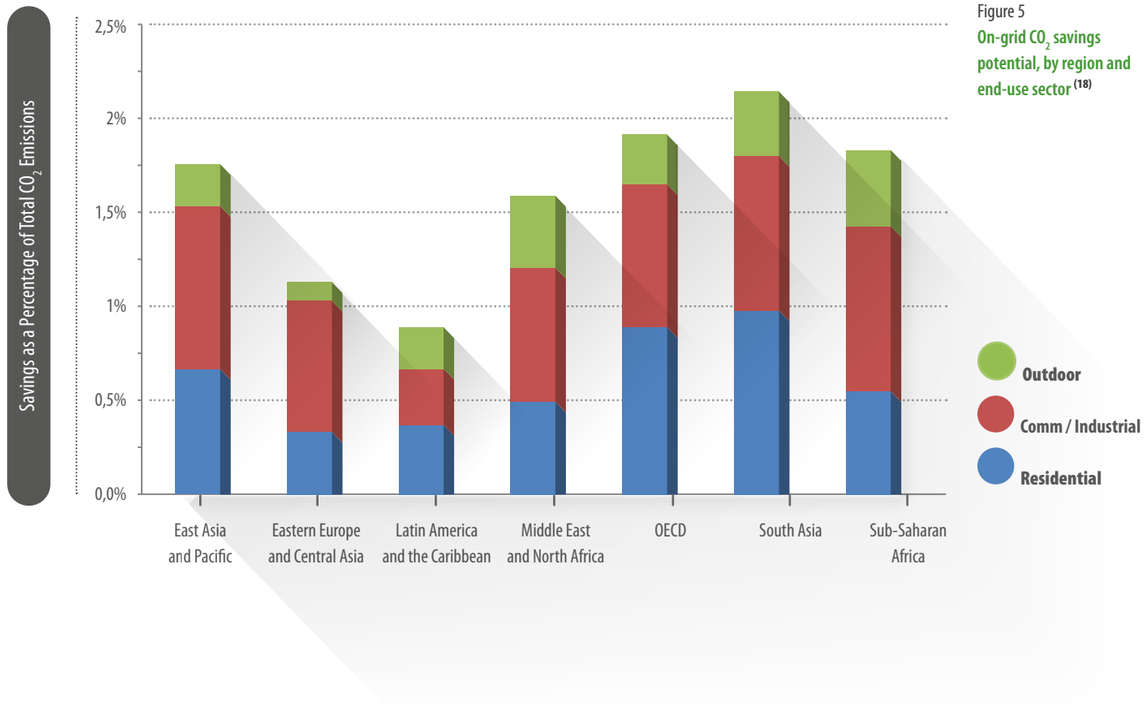


Figure 5
On-grid CO_2 savings potential, by region and end-use sector [18]

17 - UNEP-GEF en.lighten initiative. 2012. Country Lighting Assessments.

18 - ibid. The figure shows how on-grid lighting CO_2 savings are derived on a regional basis, based on a 2010 installed stock of lighting products.

1.3.2 The impact of efficient lighting policies: forecasted benefits from 2010 - 2030

UNEP's On-Grid Global Lighting Forecast Model provides a projected estimate from 2010 to 2030 of the energy and carbon dioxide emissions impact of a global transition to efficient lighting. The installed stock estimate from the 2010 country lighting assessments served as the starting point. As described in Box 1, four policy scenarios were created to assess the impacts of energy efficient lighting policies: (i) No New Policies; (ii) Slow New Policies, (iii) SE4ALL Accelerator ; and, (iv) Least Life Cycle Cost.

Box 1. **Four On-Grid Global Lighting Forecast Model scenarios**

No New Policies: this scenario takes the 2013 Global Policy Map current policies as the reference scenario for no further action. This scenario allows for the adoption of MEPS that are under development and that are expected to be implemented. It assumes that countries with limited progress do not take any policy action.

Slow New Policies: this scenario allows for the adoption of MEPS that are under development to be completed and take effect. In addition, it assumes that countries with limited progress slowly start to plan the development of MEPS. These countries adopt MEPS that become effective in 2026 for incandescent lamps, 2027 for fluorescent lamps and 2029 for high intensity discharge lamps.

SE4ALL Accelerator: this scenario builds upon the expectations of an accelerated transition to energy efficient lighting, which the UN Secretary General's SE4ALL initiative, through its Accelerator on Lighting, aims to achieve. If stakeholders and countries join the SE4ALL Accelerator on Lighting and intensify their efforts, it is assumed that countries worldwide would speed up the process for adopting MEPS no later than 2017.

Least Life Cycle Cost (LLCC): in this scenario every country adopts energy efficiency lighting policies that minimise life cycle costs for the end user. It simulates an overnight global transition to energy efficient lighting. It retroactively calculates the savings for countries adopting MEPS for incandescent lamps in 2011, for fluorescent lamps in 2012 and for high intensity discharge lamps in 2013.

The lighting energy forecast model starts from Country Lighting Assessment 2010 estimates. For each country, it aggregates the lighting stock model into three groups: (i) household lamps – incandescent, tungsten halogen incandescent, compact fluorescent and light emitting diode; (ii) commercial/industrial lamps – fluorescent and efficient fluorescent; and (iii) outdoor lamps – high intensity discharge and efficient high intensity discharge. At the country level, the model calculates energy, efficacy and operating hours for each of these three groups. It converts that energy (TWh) into lighting service (in teralumen-hours) for the year 2010. The model projects lighting service from 2010 to 2030, using regional electricity growth rates for the commercial and residential buildings sectors; which are published in the IEA's World Energy Outlook 2012. The Global Policy Map is used to estimate the year when MEPS will take effect in each country. Once MEPS are in place, the model gradually changes the efficacy of the affected country-level lighting group stock according to the lifetime and operating hours of those lamps. This projected lighting service (in teralumen-hours) is converted into energy by dividing the forecasted lighting service by the changing stock efficacy. The energy consumption is then summed together to establish the regional and global estimates.

1.3.2.1 - The consequences of no action

Lighting in 2010 accounted for 2,815 TWh or approximately 15.1% of global electricity use per annum, an amount equivalent to 11% more than the electricity generated by all the nuclear power stations in the world in 2011 [19]. The resulting emissions of 1,471 Mt CO_2 annually [20] are comparable to18% of the CO_2 emissions of China alone, or 27% of the emissions of the United States [21]. Considering the global population increase and the growing general standard of living, a path of no policy action would make electricity for lighting increase by 27% to 3,575 TWh in 2030 (Figure 6).

This would trigger the increase of global emissions attributed to the lighting sector, the gap between electricity supply and demand and the expenditures to cover the higher cost of energy. In the developing world, by year 2030, the largest share of electricity for lighting would be attributed to Asia if the countries in that region do not establish efficient lighting policies beyond the reference scenario (Figure 7).

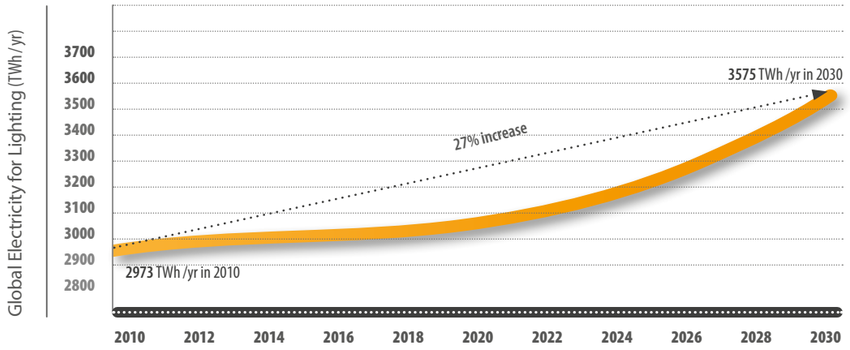
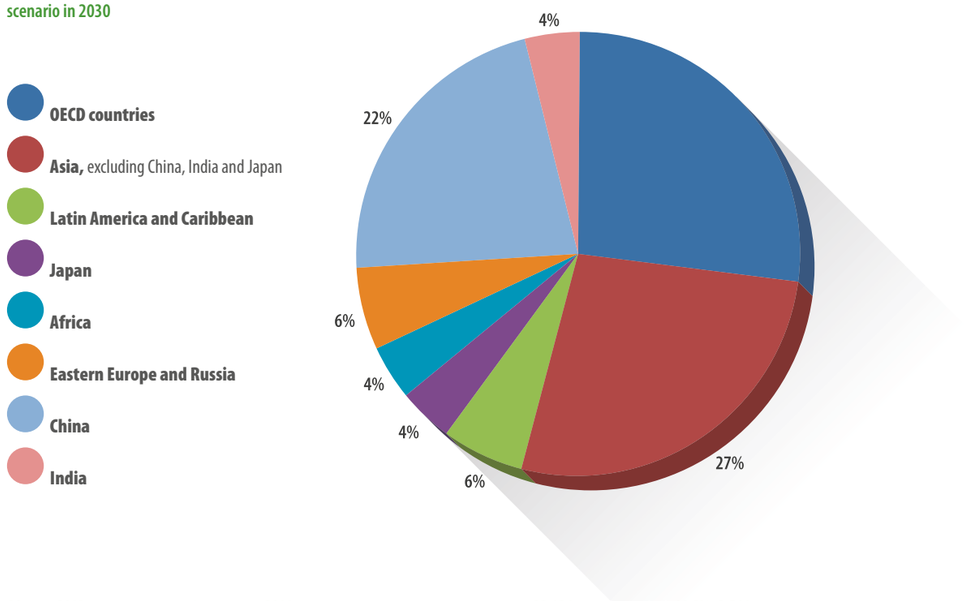


Figure 6
Global electricity for lighting, 2 010-2030, under the No New Policies scenario

Figure 7
Regional electricity consumption for lighting under the No New Policies scenario in 2030



19 - IEA. 2013. Key World Energy Statistics. In 2011 the total world electricity generation was 22,126 TWh, from which 11.5% (2,544 TWh) was produced by nuclear power.
20 - Assuming an emissions factor of 0.512 Mt CO_2 per TWh of electricity production.
21 - IEA. 2013. Key World Energy Statistics. In 2011, global emissions were 31,342 Mt CO_2, to which China contributed 25.5% and the United States 16.9%.

1.3.2.2 - Current policies are not ambitious enough

In addition to most of the OECD countries, only Colombia, China and Kazakhstan have adopted policies for an integrated and sustainable transition to efficient lighting in the residential, commercial and industrial sectors for indoor and outdoor applications. Close to 29% of the countries in the world are making progress and nearly 58% have not yet established energy efficient lighting policies [22]. If the world follows a path of current polices, the savings in global electricity consumption for lighting from 2010 to 2024 would be 1.1%, a minimal amount for a period of 14 years. In this scenario, the countries that currently lag behind would merely start planning gradually the development of minimum energy performance standards and their efforts would reduce the global electricity consumption for lighting by 6.7% only during the six years before the 2030 target of SEA4ALL (Figure 8).

Most of the countries in the group of the 58% are developing and emerging economies. In these nations the gap between electricity supply and demand is increasing rapidly due to the fast economic and population growth. The cost of new power generation and fuel prices are to the disadvantage of these countries and higher demand of electricity for lighting can risk their energy security and encumber them with debt. Even though markets around the world are already adopting new technologies, especially LED lamps, it is key that countries are prepared to use the new technologies by setting up the legislation and policies to avoid becoming a dumping ground for the old technologies and to guarantee a sustainable and integrated market transformation for energy efficient lighting.

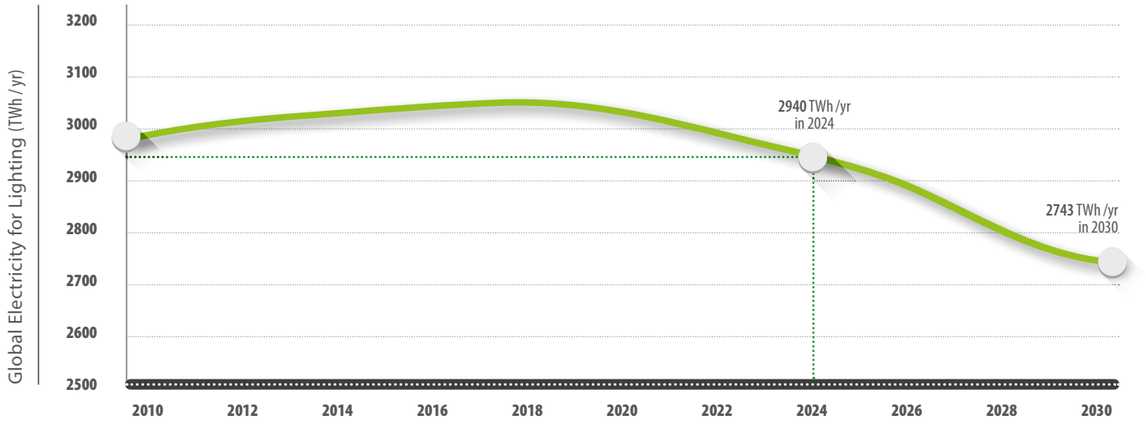


Figure 8
Global electricity for lighting in 2010-2030 under the Slow New Policies scenario

24 - Assuming $1000/kW and a 500MW power plant operating at 0.85 availability factor, producing 3.72 TWh/yr.
25 - Assumes 1000 kWh/yr per newly electrified household.
26 - Assuming an emissions factor of 0.512 Mt CO2 per TWh of electricity production.

22 - UNEP. 2013. *Global Policy Map*. These percentages refer to the national aggregate policy progress towards establishing minimum energy performance standards, supporting policies, monitoring verification and enforcement, and environmentally sound management systems for incandescent, compact fluorescent, linear fluorescent, and high-intensity discharge lamps, Figure 2.

1.3.2.3 - Bold actions globally produce considerable benefits

Most OECD members including Australia, the European Union and the United States, have already established a staged approach to phase in efficient lighting through a combination of regulatory measures and supporting policies. The emerging consensus on the need to move away from inefficient lighting technologies has triggered the commitment of 66 developing and emerging countries to take action to transition their markets to energy efficient lighting by phasing out inefficient incandescent lamps by 2016 . From this group, 27 developing and emerging countries [23] have completed and adopted national or regional efficient lighting strategies to achieve a phase out of inefficient incandescent lamps before or by 2016. In 2013 Chile, Uruguay and Central America successfully launched and adopted their national and regional strategies (Box 2). Notwithstanding, more countries must join forces and commit to energy efficient lighting in order to reduce the risks of increasing the gap between supply and demand of electricity for lighting and reduce the CO_2 footprint of lighting.

Box 2. **Innovations in Efficient Lighting Policy**

CHILE:

The National Efficient Lighting Strategy was adopted by the country's Ministry of Energy in 2013, after a nation-wide public consultation process. The strategy promotes technological innovation through the adoption of efficient lighting products and contributes to fulfilling the national 2020 energy demand reduction. The phase-out of inefficient incandescent lamps will take two years from the adoption of the Strategy. The strategy establishes the distribution of LED lamps to low income sectors of the Chilean population. By implementing this strategy Chile is reducing its emissions by 1.2 Mt CO_2 annually and saving 2.8 TWh annually in annual electricity consumption, equivalent to four thermal plants of 100 MW each. The savings are equivalent to $486.4 million annually. Moreover the strategy set a scheme to control the levels of mercury in lighting products and guarantee their safe disposal at end-of-life.

URUGUAY:

The National Efficient Lighting Strategy was adopted by the Government of Uruguay in December 2013. The Strategy includes a communications campaign to promote the use of efficient lighting products; the strengthening of local laboratories and monitoring capabilities; and also addresses synergies with a UNDP-GEF project on mercury, for the environmentally sound management of lamps. The strategy mandates the use of compact fluorescent lamps in social housing and the development of standards, labels and testing specification for light emitting diodes. In addition, the strategy aims at phasing out high pressure mercury lamps and promotes the introduction of new technologies for public lighting. By implementing this strategy Uruguay is avoiding the emissions of 177 kilo tonnes CO_2 annually and saving 578.2 GWh/yr in annual electricity consumption. The savings are equivalent to $58.5 million per annum.

CENTRAL AMERICA:

The Regional Efficient Lighting Strategy was approved by the Ministers of Energy of the eight countries of the region in December 2013. The strategy involves eight countries: Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panama. Colombia and Mexico provided technical and policy support as a result of their efforts of having already developed a strategy to phase out inefficient incandescent lamps. The Strategy includes the gradual phase-out of inefficient incandescent lamps in the region by the end of 2016. Technical regulations will be developed following an integrated policy approach to phase-out inefficient incandescent and halogen lamps. This includes implementing minimum energy performance standards and environmentally sound management activities, such as collection and recycling. Maximum mercury content limit will also be defined.
By implementing the strategy the region will accrue aggregated energy savings of over $1 billion. Electricity use will be reduced by over 2,400 GWh annually with estimated savings of $530 million annually in fuel consumption. Together, Central American countries will lower CO_2 emissions by almost 2 Mt annually and avoid $660 million in investments in new power generation.

27 - IEA. 2013. *Key World Energy Statistics*. In 2011 the total world electricity generation was 22,126 TWh, of which China contributed 21.5% (4,757.09 TWh).
28 - *ibid*. In 2011, global emissions were 31,342 Mt CO_2, of which the United States contributed 16.9% (5,296.8 Mt CO_2).
29 - *ibid*.

JORDAN:
The efficient lighting initiative in Jordan has been coordinated by the Department of Energy Efficiency within the Ministry of Energy. A Jordan National Efficient Lighting Action Plan will receive high level political endorsement by the end of 2014. The Action Plan includes: the development of policies and regulations for the environmentally sound management of lighting products and the development of a logistical infrastructure for the recycling of spent lamps; the adoption of minimum energy performance standards at the stage currently in effect within the European Union, following European Commission directives 244/2009 (non-directional lamps), 245/2009 (tertiary lighting) and 874/2012 (labeling), effectively phasing out inefficient incandescent lamps; the update of the current market surveillance regulations to strengthen the legal framework for the monitoring, verification and enforcement of lighting products; and the setup of a national performance testing laboratory through the Jordan Standards and Metrology Organization. By implementing the strategy, Jordan will avoid 0.11 Mt of CO_2 emissions and save 210 GWh of electricity consumption, equivalent to $24 million annually.

TUNISIA:
The National Efficient Lighting Strategy of Tunisia, developed by a national committee under the coordination of the National Energy Management Agency is currently being finalized. The final strategy document will be adopted by the Tunisian government by the end of 2014. The strategy includes the mandatory phase-out of incandescent and halogen lamps by 2016, MEPS and labeling for all lighting technologies following the EU directives, large scale CFL and LED lamp distribution programmes (six million lamps in total), along with an extensive communications campaign; and the design of a lamp collection and recycling legislation and infrastructure in Tunisia. By implementing the strategy Tunisia will avoid 0.18 Mt of CO_2 emissions and save 320TWh annually in annual electricity consumption, equivalent to $34 million annually.

ECOWAS:
In collaboration with the Economic Community of West African States (ECOWAS) Centre for Renewable Energy and Energy Efficiency (ECREEE), government representatives from ECOWAS successfully established, in April 2014, a regionally coordinated framework to transition to energy efficient on- and off-grid lighting. Countries will begin national implementation of the program after its high level political endorsement by ECOWAS Energy Ministers in early 2015. The regional strategy establishes common minimum energy performance standards for on- and off-grid lighting, enabling the phase out of inefficient lighting between 2016 and 2020; it also implements a common market surveillance system, with the establishment of two regional accredited laboratories to improve product quality in the marketplace; it establishes harmonized mandatory labeling and certification scheme for on- and off-grid efficient lighting and a preferential tariff and a fiscal structure for imported efficient lighting products with mechanisms to encourage local manufacturers. In addition, the strategy establishes an ECOWAS directive on collection, treatment and recycling of electric and electronic waste and specifically for lighting products. By implementing the strategy ECOWAS will avoid 12.3 Mt of CO_2 emissions, save 3.9 billion litres of kerosene and save 2.4 TWh of electricity consumption, equivalent to $4 billion annually.

The SE4ALL Accelerator scenario depicts a scenario where countries realize the tangible benefits of energy efficient lighting, reach a consensus to accelerate the transition globally and adopt efficient lighting policies that sustainably transform the market no later than 2017. The SE4ALL Accelerator scenario provides significant savings compared with the slow new policies. In year 2030 alone, the global electricity for lighting is 2,366 TWh compared with 2,743 TWh under the Slow New Policies scenario, a reduction equivalent to 14% (Figure 9). This reduction of 377 TWh would save $50 billion in avoided investment in 101 large coal-fired power plants . The magnitude of these energy savings [24] represents approximately 50 GW in avoided electricity generating capacity. The savings would be enough electricity to electrify 377 million households consuming 1,000 kWh/yr. The carbon dioxide [25] savings from this transition to efficient lighting globally would be approximately 190 Mt annually in 2030 [26].

24 - Assuming $1000/kW and a 500MW power plant operating at 0.85 availability factor, producing 3.72 TWh/yr.
25 - Assumes 1000 kWh/yr per newly electrified household.
26 - Assuming an emissions factor of 0.512 Mt CO2 per TWh of electricity production.

More importantly, the cumulative savings comparing the SE4ALL Accelerator scenario with the Slow New Policies scenario between 2014 and 2030 are 4,038 TWh of global electricity, an amount equivalent to 80% of China's electricity generation in 2011 . Furthermore, the cumulative avoided [27] emission from this transition to efficient lighting globally would be approximately 2,067 Mt of CO_2; this would be the equivalent to 36.8% of the emissions of United States in 2011 . Within the [28] non-OECD group, Asia stands out as the region with the highest gains in electricity savings and avoided carbon dioxide emissions (Figure 10).

The savings are significantly larger if the SE4ALL Accelerator scenario is compared with the No New Policies scenario. In 2030 the reduction of electricity consumption for lighting reaches 32.4%. Considering a world that chooses to stall the development of lighting policies, the cumulative savings by 2030 equate to 8,275 TWh or 37% of the total electricity generation worldwide in 2011. These cumulative savings avoid 4,237 Mt CO_2 emissions over that time period, which is equivalent to 11.3% of the global emissions in 2011 [29].

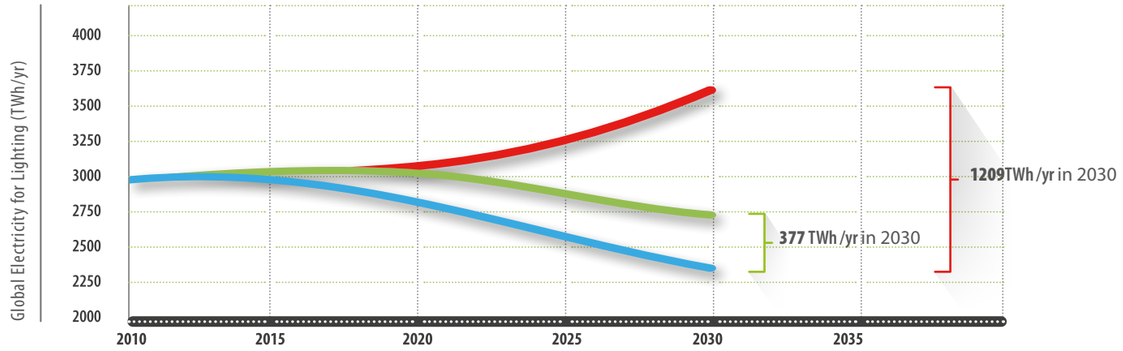


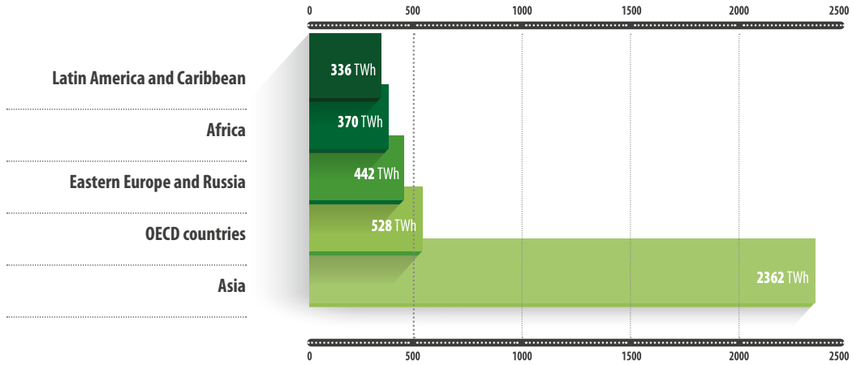
Figure 9
Annual savings under the SE4ALL Accelerator scenario compared to Slow New Policies and No New Policies scenarios

27 - IEA. 2013. *Key World Energy Statistics.* In 2011 the total world electricity generation was 22,126 TWh, of which China contributed 21.5% (4,757.09 TWh).
28 - *ibid*. In 2011, global emissions were 31,342 Mt CO_2, of which the United States contributed 16.9% (5,296.8 Mt CO_2).
29 - *ibid*.

Table 1 Annual and cumulative global energy and climate savings under the SE4ALL Accelerator scenario

Scenario and Year	2015	2020	2025	2030
Annual savings of SE4ALL Accelerator scenario compared to Slow New Policies scenario (TWh/annum)	20	221	364	377
Cumulative Savings (TWh)	26	691	2,211	4,038
Cumulative avoided CO_2 emissions of SE4ALL Accelerator scenario compared to Slow New Policies scenario (Mt CO_2)	13	354	1,132	2,067
Annual Savings of SE4ALL Accelerator scenario compared to No New Policies scenario (TWh/annum)	20	273	698	1,209
Cumulative savings (TWh)	26	767	3,308	8,275
Cumulative avoided CO_2 emissions of SE4ALL Accelerator scenario compared to No New Policies scenario (Mt CO_2)	13	393	1,694	4,237

Figure 10
Cumulative electricity savings by 2030 under the SE4ALL Accelerator scenario



Annex 3 presents a detailed regional breakdown of the annual and cumulative savings in electricity and avoided CO_2 emissions when comparing the SE4ALL Accelerator scenario with the Slow New Policies scenario. The Least Life Cycle Cost scenario is a hypothetical overnight global complete conversion to energy efficient lighting. It would bring sizeable energy and climate benefits.

The world would collectively achieve 10,546 TWh of energy savings by 2030, a sum comparable to over 40% of the world electricity generation in 2011. Saving this amount of energy would prevent the emissions of 5,400 Mt CO_2, a figure equivalent to over 15% of the global emissions in 2011 (Figure 11 and Table 2) [30].

30 - The cumulative energy and CO_2 savings are calculated by comparing the Least Life Cycle Cost scenario with the No New Policies scenario.

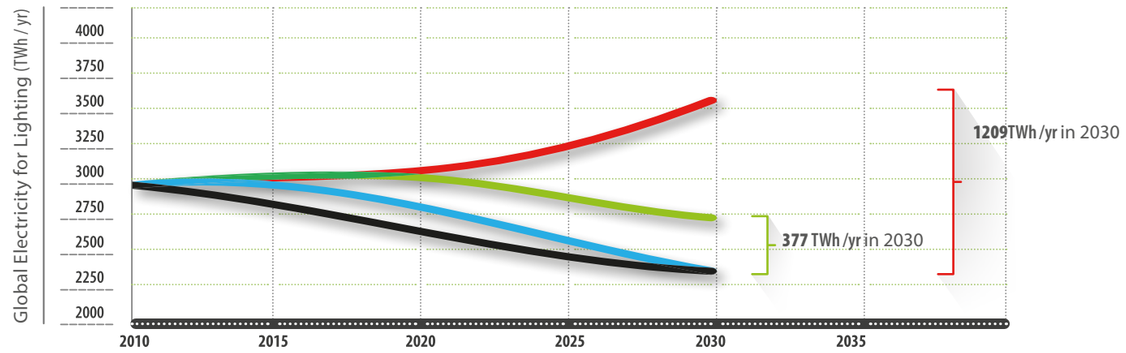


Figure 11
Annual savings under the Least Life Cycle Cost scenario compared to Slow New Policies and No New Policies scenarios

Table 2 Annual and cumulative global energy and climate savings under the Least Life Cycle Cost scenario

Year	2015	2020	2025	2030
Annual savings of Least Life Cycle Cost scenario compared to No New Policies scenario (TWh/annum)	184	424	793	1,212
Cumulative Savings (TWh)	552	2,160	5,356	10,546
Cumulative avoided CO_2 emissions of Least Life Cycle Cost scenario compared to No New Policies scenario (Mt CO_2)	283	1,106	2,742	5,400

All in all, energy efficient lighting continues to offer a significant opportunity for climate change mitigation and for reducing energy consumption. It contributes to substantial reductions in energy use and the related carbon dioxide emissions.

Key Issues to Consider in the Global Transition to Advanced Lighting

Despite encouraging progress, significant challenges exist which slow down the global uptake of efficient lighting technologies at the rate necessary to tackle the current energy and climate crises.

2.1 Leadership and Institutional Frameworks

In spite of being one of the fastest ways to increase the efficiency of economies and one of the most economically attractive options for CO_2 abatement and despite the important progress achieved across the world over the last decade with the move to phase-out inefficient incandescent lamps, efficient lighting is not given yet the attention it deserves in national policy and energy agendas. The attention of many policy-makers is often more focused on promoting new sources of electricity generation rather than in utilizing better existing infrastructure and promoting efficiency.

Government bodies and agencies responsible for developing restrictions on the commercialization of inefficient lighting sometimes fear that their implementation affects the population's purchasing capacity or manufacturer sales. The lack of support from national authorities may be also closely linked to weak institutional frameworks to undertake the transition, including laws, regulations and limited technical capacities. For example, in order to establish monitoring, verification and enforcement schemes, countries require customs regulations to prevent non-compliant products from entering the market. Also, to set up environmentally sound management programmes for spent lamps, countries require hazardous waste regulations and the organizational and financial capacity to facilitate the development of take-back systems. Greater leadership is required from governments and their international partners for the development and implementation of policies and strategies regarding efficient lighting. The significant benefits of such a transition, including the avoided expenditures in the form of electricity bills, need to be broadly communicated and understood.

2.2 Market Awareness

Lack of information and awareness about energy efficient lighting technologies significantly inhibits the implementation of efficient lighting programmes. In countries where energy expenditures represent a small fraction of disposable household income, consumers discount energy efficiency,-making behavioural or lifestyle changes very difficult to institute. In developing countries, the means and resources to communicate efficient lighting benefits may be limited. In public, commercial and industrial organizations, limitations may be linked to the lack of lighting-related knowledge and capacity of businesses to develop a transition strategy. There may also be a lack of skills and technological knowledge among lighting system designers, operators and maintainers of lighting systems.

2.3 Donor Coordination and Support

Although awareness about the benefits and opportunities of efficient lighting is increasing all over the world, current support provided by bilateral and multilateral partners has been insufficient to meet the needs of developing and emerging countries.

Whereas a number of multilateral financial institutions and bilateral donors have supported massive lamp distribution programmes to promote efficient lighting technologies, stand-alone projects overlook the need for integrated policy frameworks that would guarantee sustainability and ensuring a permanent transition to efficient lighting.

Technical and financial support has been provided for activities such as implementing technical standards; labelling; communication campaigns; quality and performance control systems; and collection and recycling schemes. However, this support is not proportionate to the degree of need expressed by developing and emerging countries [31]. The potential for sharing integrated policy approaches with national authorities and stakeholders is still considerable and more needs to be done in order to escalate the transfer of knowledge and technical support to individual countries.

Bilateral donor agencies, international financial institutions and banks are important players in the area of financing for countries to undertake the transition to efficient lighting. Coordination among all them is imperative to ensure that efficient lighting programmes adhere to the integrated policy approach.

2.4 Affordability of Efficient Lighting Products

One of the most common reasons given for delaying the market transformation to energy efficient lighting is the higher cost of efficient lighting products. Given that energy efficient lighting, whether on-grid or off-grid, has a lower operating cost, the payback period to cover the higher initial cost can be just a matter of months for many technologies, or a few years for others, depending on the application. Either way, efficient lighting alternatives result in net savings for end users from a total cost of ownership perspective and for governments in terms of reduced energy imports. Technological advances are already resulting in less expensive products and the cost barrier is expected to decrease even more in the coming years.

Although not as sensitive to price as the consumer segment, the industrial and commercial sectors would also respond favourably to lower prices by making more substantial investments in efficiency, since the payback period would be shorter. The greater involvement of private and public financial institutions would facilitate increased regulatory action and investments and by governments and municipalities for street lighting and public lighting applications. The private sector could also assist with accelerating the transition by working with its clients to develop innovative, more affordable lighting system solutions.

31 - Sixty-six countries have joined the UNEP-GEF en.lighten Global Efficient Lighting Partnership Programme, many of which have not received direct technical and policy support. Increased technical support is necessary to put in place the strategies, policies and actions.

2.5 Capacities for Quality Control

In most developing countries and regions, the ability to strengthen enforcement capacity to ensure that lighting products comply with quality and performance standards is very limited. As a result, markets are flooded with non-compliant products that fail to meet efficiency requirements and put energy efficiency policies at risk. Establishing administrative surveillance and control systems and certification schemes, as well as retrofitting existing testing laboratories or creating new ones (especially at regional levels), becomes a necessity. This requires increased technical capacities and the financial resources to sustain such a programme. While some countries may be willing and able to allocate funding for such efforts, other countries are likely to require external financial and technical assistance.

2.6 Capacities for Environmentally Sound Management

As a number of lighting products may contain hazardous chemicals, such as mercury, lead or other heavy metals, countries should integrate the principles of pollution prevention and environmentally sound management when transitioning to efficient lighting. This approach includes maximizing energy efficiency and minimizing toxicity in products, while instituting the sustainable management of spent lamps. To guarantee a successful environmentally sound management scheme, countries require legislative and administrative frameworks, sustainable funding and a supervised design approach, combined with broad based community participation and support.

Establishing collection and recycling legislation and programmes is difficult for countries that lack the technical skills and resources. Not all countries have the funds for training, acquiring necessary skills and running a programme. It is important that support is provided to countries for the establishment of legal frameworks and self-financed systems for collection and recycling.

2.7 Local Industry Concerns

Global production of lamps is centred in Asia but domestic producers of inefficient lighting products exist throughout the world. Transforming the lighting market into one that offers only efficient lighting products implies that those manufacturers not prepared to make such products may be at a risk of losing business. Consideration of the viability of such a business in a globally changing marketplace could also be called into question and it may justify the need for assistance to help facilitate innovation and transformation.

Options to Accelerate the Global Transition

It is important to determine priorities and activities at national, regional and global levels, including voluntary actions by national and international stakeholders, to achieve a global transition to energy efficient lighting and to meet the SE4ALL objectives. The options proposed below are framed within three key principles:

Effective governance: endorses a country-ownership approach, the subsidiarity principle, public participation and stakeholder engagement.

Sustainability: as reflected in the integrated policy approach.

Development effectiveness: including effective international donor coordination around energy efficient lighting issues.

3.1 National Level

Despite varying needs and stages of progress in implementation, many of the challenges that countries face in the transition to efficient lighting are similar. National authorities are encouraged to utilize the various tools, mechanisms and institutional structures described here to undertake the transition to efficient lighting across sectors. The ultimate selection of these will depend on each country's specific circumstances and ultimate objectives.

Governance and leadership	• Develop National Efficient Lighting Strategies • Implement public awareness and educational campaigns
Technical capacities	• Build and/or strengthen institutional capacities • Support local manufacturers • Create or strengthen monitoring, verification and enforcement capacities • Establish collection and recycling schemes
Financial	• Create financial incentives and fiscal instruments
Technology transfer	• Integrate lighting technology roadmaps with national or regional efficient lighting strategies

3.1.1 Governance and leadership

3.1.1.1 - Develop National Efficient Lighting Strategies

Systematic national action institutionalized through a national policy, strategy or action plan is the basis for implementing a successful transition to efficient lighting. A national strategy outlines concrete steps to ensure the development of an integrated policy approach for lighting, based on a country's unique requirements, needs and conditions.

Key elements of a National Efficient Lighting Strategy include:

- **Minimum energy performance standards;**
- **Supporting policies and mechanisms (economic or market-based), fiscal instruments and incentives, communications programmes and voluntary action;**
- **Monitoring, verification and enforcement activities, including certification and testing capacities; and,**
- **Environmentally sound management, including sustainability and treatment for spent products initiatives [32].**

Developing a National Efficient Lighting Strategy requires countries to define priorities for each of the four above-mentioned elements of the integrated policy approach. A National Efficient Lighting Strategy includes targets, specific activities and a timeline for implementation. It should also designate responsibilities and eventual financial needs. It should be a living document which may need to be updated regularly in order to account for evolving priorities and technological developments. Ministries of energy or national energy efficiency agencies, who are often in charge of crafting the strategy, lead a consultative process, whereby stakeholders from all sectors are involved to guarantee the participation and input and allow for a strategy that results in benefits for all. National stakeholders include: key national authorities (such as ministries of environment, industry, finance, bureau of standards, local authorities and customs and testing authorities), the private sector, lighting associations, electric utilities and consumer groups. Guidelines to develop a National Efficient Lighting strategy can be found under Country Activities at: www.enlighten-initiative.org

Once a National Efficient Lighting Strategy is adopted, a country will have shaped ways to facilitate other actions, such as those described in 3.1.2 through 3.1.4 that would further enable a swift transition to efficient lighting in all sectors.

32 - Refer to Section 1 for a more detailed description of the integrated policy approach.

3.1.1.1 - Implement public awareness and educational campaigns

Public awareness and education reinforce the long-term effects of efficiency measures and provide end users and companies with knowledge about specific efficiency issues along with their environmental and financial impact. They also help to promote general acceptance and create a market for energy efficiency.

Improvement of energy efficiency and related market transformation requires informed consumers and awareness among all segments of society, as well as customised information, education and training for selected stakeholders. Capturing the interest and ensuring the participation of policy makers, for example, requires securing their time and delivering the message at an appropriate level. It is also important that policy makers understand the value proposition of energy efficient lighting and are comfortable with the information. This may be challenging, given the number of other priorities and responsibilities they face. The message should be focused on the national situation with examples that incorporate local terminology and pricing information.

Communication efforts can help increase public acceptance of efficient lighting solutions by demonstrating the full range of benefits attributable to efficient lighting products, not just their energy saving benefits. Key messages in national campaigns may include: monetary savings; a cleaner and safer place for future generations; improved security of energy supply; and the reduction of greenhouse gases and air pollutants from fossil fuel combustion.

3.1.2 Technical capacities

3.1.2.1 - Build or strengthen institutional capacities

Technical capacities are essential to achieving the targets and delivering the activities outlined in the National Efficient Lighting Strategy. Countries should conduct a careful assessment of their institutional, legal and technical capacities and determine whether these are enough to assure the proper establishment of monitoring, verification and enforcement activities; supporting policies, especially market and fiscal instruments; and, sustainable end-of-life initiatives. Furthermore, counties need to have clarity on their national agencies' and institutions' abilities to take on the responsibilities and deliver the outputs identified in their efficient lighting strategy.

In cases where the assessments show regulatory and capacity gaps, countries should promptly work on developing the appropriate legislation and improving the capacities of national institutions. Building or strengthening institutional capacities may come at a financial cost and countries should be ready take responsibility for this activity however, when this is not possible, regional and or global actions should be considered . Projects and initiatives supported by international stakeholders often [33] incorporate institutional capacity-building to help deliver results; countries can take advantage of these frameworks when embarking on the challenge of implementing a National Efficient Lighting Strategy.

3.1.2.2 - Support local manufacturers

In countries that have lamp manufacturing facilities, market transformation may raise concerns about local economic development and industry employment. Governments may support business conversion and improved production. These activities can reduce the potentially adverse economic impact for manufacturers, related industries and services providers. Supporting those workers through training or employment opportunities in a new production facility could be part of the National Efficient Lighting Strategy.

Policy proposals that impact the local lighting industry should be developed in coordination with the local industry and with regard to trade rules. The development of National Efficient Lighting Strategies with dates, technical parameters and details about new lamp requirements will give strong signals to local manufacturers about the impending changes so that they can adapt their operations. Some manufacturers may likely need technical and financial assistance if they decide to produce more advanced and efficient lamps. If they currently manufacture incandescent lamps, for example, the transition to manufacturing LED lamps can be challenging because it requires different skills, facilities, equipment and perhaps an unfamiliar supply chain. Governments may support industrial conversion through reduced taxes, accompanied by policies that facilitate business conversion. Furthermore, government economic development agencies can partner with the private sector to attract financing from private and development banks.

33 - Refer to Sections 3.2 and 3.3 for regional and global actions.

3.1.2.3 - Create or strengthen monitoring, verification and enforcement capacities

Tracking compliance of efficient lighting products is critical to maximise the potential for energy savings and the elimination of inefficient lighting products through Minimum Energy Performance Standards. To guarantee the success of monitoring, verification and enforcement activities, countries should establish a long-term policy commitment through the creation or strengthening of market surveillance systems with adequate allocation of staff, technical capacities, financial resources and administrative competences to ensure compliance.

To counter the existence of poor quality products in the market, the policy response of a country should be to strengthen market surveillance. This can be accomplished through enhanced collaboration with regulators; public authorities acting in cooperation with industry; civil society stakeholders; and others. This highlights the need for information sharing and coordination among national agencies. In addition to reinforcing market surveillance, countries and regions should consider strengthening laboratory capacities or establishing new facilities, especially at the regional level, where these infrastructures are most cost effective. By deciding to do so, they also need to account for the facilities' operation and maintenance costs. If lighting testing capacity already exists or if future needs warrant it, then the next step is to determine the level of activities and services that will require support.

While countries that commit to design a National Efficient Lighting Strategy are expected to plan and budget for monitoring, verification and enforcement activities, it is important to recognize that in some cases, the financial burden may be bigger than a country can assume. In these cases, countries could be supported by regional or global actions [34].

3.1.2.4 - Establish collection and recycling schemes

Given the increasing environmental and health concerns of efficient lighting products, the environmentally sound management of lamps is an important element of any National Efficient Lighting Strategy. In order to succeed, these programmes require adequate legislative frameworks and a comprehensive design approach, combined with broad-based community participation and in some cases, technical support.

The environmentally sound management of spent lamps should include technologies that capture and securely contain mercury vapour and residues (mercury-added lamps) and heavy metals (LED lamps). Further processing to recover mercury and recycle other lamp components is not only manageable, but affordable, given the appropriate system. Regulators should explore and adopt approaches that encourage the collection and recycling of all type of lamps, adapted to national conditions. If effectively designed and managed, they can also create jobs in collection and recycling.

By following the *Basel Convention Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of Elemental Mercury and Wastes Containing or Contaminated with Mercury*, mercury emissions from spent lamps can be virtually eliminated. Moreover, the current global legally binding instrument on mercury, The Minamata Convention on Mercury provides additional guidance to countries [35-36].

Extended producer responsibility systems where all stakeholders have shared responsibility have proven to be most cost-effective [37]. Take-back collection programmes may be part of extended producer responsibility schemes that offer various benefits such as: relieving local governments of the financial and in some cases, operational burden of the disposal of the waste/products/material; encouraging companies to design products with reuse, recyclability and materials reduction in mind; and promoting innovative recycling technology.

34- Refer to Sections 3.2 and 3.3 for regional and global actions.

35 - http://www.basel.int/TheConvention/Publications/TechnicalGuidelines/tabid/2362/Default.aspx

36 - *The Minamata Convention on Mercury* was adopted and opened for signature at a Conference in Kumamoto and Minamata, Japan on October 10-11, 2013.

37 -Extended producer responsibility is defined as "an environmental policy approach in which a producer's responsibility, physical and/ or financial, for a product is extended to the post-consumer stage of a product's life-cycle." "Producer" is defined as one of the businesses putting products on the market (industry lamp manufacturers, traders, wholesalers and retailers).

3.1.3 Financial instruments

3.1.3.1 - Create financial incentives and fiscal instruments

The success of efficient lighting strategies may depend on selecting and implementing a range of finance related approaches to meet the specific needs of a country and the objectives of a National Efficient Lighting Strategy. Financial incentives to overcome upfront costs and fiscal instruments, such as the reduction or elimination of value-added tax, import duties, subsidies, rebates and giveaways, are useful tools that national government could implement to increase public acceptance of efficient lighting strategies. These instruments can be used to influence energy or energy efficient product prices in order to reduce energy consumption and foster the purchase of higher quality products.

Tax incentives are policies used to reward the manufacture and purchase of energy efficient lighting and/or penalize the purchase of inefficient lamps. Subsidies, rebates and giveaways help to overcome the financial barriers that many end users face with respect to investing in energy efficient lighting products. Incentives for manufacturers or suppliers can encourage them to supply more efficient products, with the assumption that most of the incentive will be reflected in a lower price. Vendor incentives can help increase product availability and, by increasing sales volume, reduce prices in the long term. Countries may also consider programs whereby high-income consumers help cover the up-front cost of adopting efficient lighting technologies for low-income consumers.

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

1) Utility companies, when there may be revenue generation as a result of actions to reduce peak demand, eliminate power theft, or increase revenue from additional services or electricity sold;

2) Third party investments by manufacturers or service providers, where there may be increased revenue from expanded sales of products or services; and

3) Governments, when social or environmental benefits are identified and considered achievable.

Additional instruments that countries could consider to overcome the initial lamp costs and accelerate the penetration of efficient lighting technologies include: cooperative procurement (pooling the resources of more than one institution or country to increase scale and decrease costs), engaging energy service companies, especially for commercial, industrial and street lighting projects, or making use of revolving loan funds specifically for lighting.

3.1.4 Technology transfer

3.1.4.1 - Integrate lighting technology roadmaps with National Efficient Lighting Strategies

Technology roadmaps support the development of specific technology and transfer activities and catalyse innovations that allow existing technologies to adapt to new markets. They are designed to provide a common objective, time-specific milestones and a consistent set of concrete actions[38]. As such, lighting technology roadmaps would reflect the country's priorities and plans for stimulating the national acquisition of efficient lighting technologies and their diffusion nationally, regionally, or even globally. Countries could strengthen their national system of innovation and envision becoming a leader in any of the lighting sectors; for example, lighting design with controls, lamp manufacturing and assembly of products, energy auditing of importing products, or recycling technologies for spent lamps.

Whatever the road the country decides to take, it should be clear that lighting technology roadmaps should be aligned and integrated with national efficient lighting strategies. The integration will make the countries plans and strategies more robust and more attractive to donor agencies and multilateral development banks, which could further incentivize the mobilization of international financial support in the forms of lighting NAMAs, for example.

In practical terms, to stimulate lighting technology transfer, countries should consider doing policy interventions, which can range from economy-wide educational programs to funding (such as engagement with universities and research centres, creating innovation centres around universities). Other policy interventions to stimulate lighting technology transfer include tax incentives, intellectual property protection, tariffs on trade, differential taxation and export promotion schemes.

The International Energy Agency (IEA) leads the development of a series of roadmaps for some of the most important technologies. National governments could seize upon the IEA's extensive experience and obtain effective guidance on developing such efficient lighting technology roadmaps[39].

38 - UNFCCC Technology Executive Committee. 2013. Background paper on technology roadmaps.
39 - IEA. 2010. Energy Technology Roadmaps: A Guide to Development and Implementation.

3.2 Regional Level

Regional coordination initiatives help harmonize national activities and ensure they achieve their goals in a cost-effective manner. If regional integration bodies and states within a given region reach a consensus for sharing resources to achieve their efficient lighting goals, actions at the regional level could deliver more effective and sustainable results than independent country actions.

These could include sharing standards and testing requirements; laboratory and quality control systems; and recycling systems for spent lighting products. By engaging in regionally coordinated actions countries may engage in South-South exchanges of best practices, raising jointly awareness and attracting financial and technical resources.

Governance and leadership	• Coordinate development of Regional Efficient Lighting Strategies • Develop shared regional quality control schemes
Technical capacities	• Harmonise MEPS and labelling • Coordinate the development of recycling schemes

3.2.1 Governance and leadership

3.2.1.1 - Coordinate development of Regional Efficient Lighting Strategies

Market transformation at the national level often has cross-border and trade implications. Countries may need to address trade agreements that allow the import of inefficient lamps; the possibility of counterfeiting laboratory results; or the issue of technology transfer to set up laboratories and/or collection and recycling facilities. Developing coordinated Regional Efficient Lighting Strategies would address areas of regional cooperation including the resources that could be shared, along with the available institutional structures and capacities to facilitate a market transformation in the benefit of all participating countries. Ultimately, regional coordination would reinforce synergies among country programmes and make the strategies more cost effective. For example, to increase effectiveness of monitoring, verification and enforcement activities, countries can develop agreements for information sharing (including testing results or non-compliance) and standards harmonization. This would result in a regional quality control system that significantly increases compliance and end user confidence.

Regional strategies are more prone to raise the technical and financial support of international development partners and donors, in light of the larger climate and efficiency implications. ECOWAS and Central America are examples of regions developing joint regional efficient lighting strategies following an integrated policy approach. The European Union developed the transition to efficient lighting in a coordinated manner by harmonizing performance requirements, end of life considerations and sharing compliance information.

3.2.1.2 - Develop shared quality control schemes

Testing and laboratory infrastructure requires significant levels of effort and investment, especially for lamps, which are available in many models and require frequent testing of numerous types. Regional cooperation is an opportunity to improve enforcement capacity through the sharing of test facilities and results of testing and verification. Sharing essential programme information can enhance the capacity and skills of countries to monitor, verify and enforce energy efficiency regulations. Cooperation promotes best practices while reducing the cost burden at the national level.

At the regional level, governments, lighting suppliers and other interested stakeholders can work together to develop a common, harmonized approach to maximize available resources. Stakeholders within a region can work together and coordinate actions to increase monitoring verification and enforcement effectiveness. Regional collaboration can also be used to assist in development of laboratories that would serve as regional reference laboratories. Expanding and enhancing lamp testing facilities and capabilities can reduce costs to individual countries and help establish a network of trained professionals. For example, individual countries could specialize in some aspects of testing and cooperate with regional partners for other aspects of testing.

Moreover, through regional collaboration, countries can agree on specific protocols for monitoring, verification and enforcement, they can also work together through bilateral or regional agreements to improve sampling and surveillance of minimum energy performance standards and verification of labels.

3.2.2 Technical capacities

3.2.2.1 - Harmonise minimum energy performance standards and labelling

Regional harmonisation and cooperation can greatly aid in the success of any labelling and certification programme. Lighting products are commodities that cross national and regional borders. Collaboration would help to prevent the multiplication of standards and labels both for consumers and industries; reduce costs of implementing labelling programme for producers and importers; and reduce non-tariff trade barriers. However, the harmonisation of mandatory rules limiting the sale of inefficient products may require significant collaboration, both within the country that is implementing the programmes and among its cooperating partners. This is especially relevant for small countries for which implementing a national labelling programme may not be cost-effective due to the small size of the market.

A good example of regional efforts to harmonise minimum energy performance standards is lites.asia, a stakeholder group for Asian policy makers to discuss product quality and monitoring, verification and enforcement issues.

3.2.2.2 - Coordinate collection and recycling schemes

Regional collection and recycling systems can be the optimal solution in cases where national approaches are not financially viable to support the recycling of lamps in one single country, or in instances where national capacities are not capable of operation and maintenance. A regional approach allows countries to engage and cooperate for improving collection and recycling schemes at the national level. This includes not only building and sharing collection and recycling facilities, but also, encourages the transfer of technology and the development of training programs to enhance the skills needed in the design, operation and maintenance of a system.

Countries within a region also have the option to group themselves into clusters to establish regional collection and recycling facilities, as appropriate. This approach would be suitable for small countries where investing in a larger regional facility might not be as cost effective as it would be to invest in a centre that would collect a manageable volume of glass, phosphor, metals and other elements. It might be more difficult, though, given the Basel Convention and the many national laws that establish strict guidelines for the movement of hazardous wastes to other countries. Nonetheless, exceptions can be made if certain conditions are met by the proposed programme.

3.3 Global Level

It is critical that global stakeholders act in concert around globally agreed priorities. A set of coordinated actions at the global level would enable greater integration and efficiency in the work of multi-lateral and bilateral development partners. Coordinated global actions would further assist in providing a joint framework for mobilization of financial resources and avoiding duplication and waste of resources.

Governance and leadership	• Coordinate the support of efficient lighting strategies • Develop a global efficient lighting campaign
Technical capacities	• Build capacity in countries to adopt the integrated Policy Approach • Harmonize testing standards and labels
Financial	• Finance efficient lighting strategies
Technology transfer	• Global support to the development and integration of national or regional lighting roadmaps with national or regional lighting strategies

3.3.1 Governance and leadership

3.3.1.1 - Coordinate the support of Efficient Lighting Strategies

It is imperative to coordinate global efforts to promote the transition to energy efficient lighting in all sectors. A variety of institutions are leading efficient lighting programs worldwide, from regional integration bodies and regional development banks, to global organizations as the World Bank, regional banks, donor agencies, GEF, international non-governmental organisations and the United Nations (Annex 4). Each agency has comparative advantages that could be harmonized to achieve cost-effective and efficient donor coordination for delivering to countries in need.

Since the UNEP-GEF en.lighten initiative was established, it has led efforts to achieve the accelerated transition to energy efficient lighting in the residential sector by supporting countries in the development of efficient lighting activities and strategies. Experience shows that countries are keen to utilize the tools and receive the support that the UNEP-GEF en.lighten initiative provides however, these resources alone are not sufficient to deliver to all countries and as a result, some countries have not yet benefitted from the initiative.

These sort of initiatives should be scaled up to assist more countries and expand the transition to energy efficient lighting to the commercial and industrial sectors, for indoor and outdoor applications. The participation of and coordination with international institutions is crucial for the success of a global transition because it will help to develop a framework in which each institution is assigned a responsibility in accordance with its comparative advantage. For example, while the UNEP provides the policy and technical support by developing guidance, policy and technical advice, the World Bank and regional development banks could assume the role of financing efficient lighting programmes. If global coordination is achieved, countries will be able to receive targeted technical and financial expertise to support the development of lighting policies and will ultimately be able to minimize the time and resources required to implement viable National and Regional Efficient Lighting Strategies.

3.3.1.2 - Develop a global campaign

National efforts to create awareness about energy efficient lighting could be complemented and supported by a global multi-stakeholder campaign. The global campaign would be led by international agencies, in cooperation with other institutions with technical experience in market transformation programmes, private sector companies and associations (manufacturers and retailers), utilities, foundations and multilateral donors. The global campaign would target national governments and regional bodies. A global campaign would have two objectives. The first objective would be to convince governments (top-level authorities) of the economic, financial and environmental benefits of a national transition to efficient lighting in all end-use sectors following the integrated policy approach. This would target countries that have not made much progress in the phase-out of efficient lighting and that have not committed or taken action towards the phase-in of efficient lighting. The second objective would be to provide the necessary arguments and information to facilitate the development of efficient lighting policies and enabling actions in all countries.

3.3.2 Technical capabilities

3.3.2.1 - Build capacity with the integrated policy approach

Provided that the integrated policy approach is the core of a successful transition to efficient lighting, countries and regions need guidance and support in order to incorporate the methodology into their planning activities and the strategy design and implementation. Global coordination could involve the support of a global Centre of Excellence to foster and facilitate the exchange of best practices, cooperation and the creation of training programmes.

Such Centre could be linked to the Climate Technology Centre and Network (CTCN) of the United Nations Framework Convention on Climate Change (UNFCCC). The Centre of Excellence would focus on technical assistance in each of the elements of the integrated policy approach. Furthermore, donor agencies and international financial institutions would play an important role in providing the financing resources to make the centre operational. The global coordinating body would liaise with leading regional institutions that are active in the field of efficient lighting and that would serve as the hub facilitator for each region.

The Centre would specialize in offering support to governmental authorities as appropriate, within the context of each country or region. And it would also offer technical assistance and policy guidance in designing enabling policies and implementing activities.

3.3.2.2 - Harmonize testing standards and labels

Testing standards underpin all product standards and labelling programmes because they are the means by which product energy performance is measured and compared. Harmonization of energy performance test procedures is a means of facilitating technology diffusion and trade objectives.

Harmonized test methods can encourage trade, conformity assessment, comparison of performance levels, technology transfer and the accelerated adoption of best practice policy. Both governments and manufacturers stand to gain from the harmonization of testing methods.

Benefits to governments include:

Lower development costs for preparing test methods, especially for emerging products such as LED lighting systems and controls;

Comparative test results for products sold domestically and in neighbouring economies;

The ability to transpose and adapt analyses from other markets to determine appropriate domestic efficiency requirements;

Adopting minimum performance thresholds and applying them as a starting point in a domestic regulatory programme;

Adopting a common set of upper thresholds that can be used for market pull programmes such as labelling and incentive schemes; and

Faster and less expensive testing (for compliance and other purposes), as harmonized testing creates a larger choice of laboratories who can conduct product tests.

Having one harmonized test method used by markets around the world would reduce testing costs associated with demonstrating regulatory and/or product labelling compliance. Manufacturers need only conduct one test and the result would be universally accepted by these markets as being accurate and representative of the performance of their product. A harmonized test method also enables producers to look ahead to longer-term rewards for innovation around advanced product designs that will be more energy efficient and have lower life-cycle costs for consumers.

3.3.3 Financial instruments

3.3.3.1 - Finance Efficient Lighting Strategies

Development partners, be it development banks, multilateral development agencies or donor countries should consider supporting and providing targeted financial aid to developing countries to facilitate the transition to efficient lighting. In this context, international financial institutions and bilateral and multi-lateral donor agencies play an important role in financing efficient lighting programmes, especially in those countries where the cost for a transition to efficient lighting becomes a financial burden.

International financing institutions should create or increase dedicated lines of investment to assist countries in the implementation of their National or Regional Efficient Lighting Strategies as a whole. In particular, they should consider the financing of national surveillance systems, regional laboratories and collection and recycling schemes in their portfolio of investment.

National Appropriate Mitigation Actions (NAMAs) for efficient lighting constitute an instrument to create a National Efficient Lighting Strategy with a financial case aimed at obtaining support from donor agencies and international financial institutions. UNEP (2013) developed a *Guidebook for the Development of a Nationally Appropriate Mitigation Action on Efficient Lighting* to assist countries in the creation of NAMAs for efficient lighting based on a country-led national efficient lighting strategy.

3.3.4 Technology transfer

3.3.4.1 - Support the integration of lighting technology roadmaps into lighting strategies

The process of developing and integrating lighting technology roadmaps into national or regional efficient lighting strategies can be supported by the Technology Executive Committee and the Climate Technology Centre and Network (CTCN). Both were created by the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC – COP17) to stimulate technology cooperation and enhance the development and transfer of technologies to developing country parties at their request.

The Technology Executive Committee and CTCN can help countries catalyse the development of lighting technology roadmaps, coordinate the development of common areas, facilitate collaboration among research centres and universities, foster the development of national and regional innovation centres, as well as facilitate private and public sector investments and access to financing for their implementation. Lighting technology roadmaps can complement efforts and actions undertaken by countries, including national efficient lighting strategies and lighting NAMAs. This synergy could help build confidence of stakeholders and development partners and mobilize international financial support.

3.4 The Role of the Private Sector

The private sector has a critical role in making possible the market transformation to efficient lighting. Private sector has the technology know-how and supply efficient lighting products. If a sustainable market transformation to efficient lighting is to be achieved globally, the private sector should play a leading role and be fully engaged in the development of national, regional and global action. These options complement the private support that could be fostered at the national level, as described in the national level options above.

Leadership	• Strengthen supply chains • Join public-private partnerships to support the transfer of efficient lighting technologies
Financial instruments	• Promote and expand financial instruments for local manufacturers

3.4.1 Leadership

3.4.1.1 - Strengthen supply chains

Fostering partnerships between manufacturers and retailers could assist in accelerating the market transformation globally for the adoption of energy efficient lighting in all sectors. They could provide the best lighting technologies to end-consumers at affordable prices. A partnership between producers and retailers could see reduced prices of energy efficient lighting products from manufacturers to distribution, while the retailer provides sufficient shelf space with point-of-purchase material and trained salespeople to guide consumers in their purchase decision.

This option resembles IKEA's plan to eliminate all traditional lighting technologies from their shelves by 2016 and sell only LED lamps and luminaires. A partnership between IKEA (retailer) and Lemnis Lighting (manufacturer) was designed to bring down the cost of the general purpose LED lamp.

Companies like Philips and Osram have set examples of effective partnerships with retailers and utility companies to support the availability of lamps at affordable prices and to provide a variety of choices at the shelf level. In the process, these companies create awareness of efficient lighting initiatives, support phase out programmes and provide education to consumers.

3.4.1.2 - Join public-private partnerships

Public-private partnerships serve to mobilize private sector resources, (technical, managerial and financial) to help governments achieve and deliver a transition to energy efficient lighting. Public-private partnerships can support the establishment of regulatory and institutional frameworks, build technical capacity among policy makers and bring more innovative and energy efficient lighting technologies into the mass market.

The private sector can coordinate with governments to systematically deploy communication campaigns that convey the benefits of efficient lighting and which inform about the variety of technology options available in the market, as well as the technical specificities of their products.

3.4.2 Financial instruments

3.4.2.1 - Promote and expand financial instruments for local manufacturers

A global transition to efficient lighting in all end-use sectors requires the participation of the private sector. Advanced lighting technologies are available, but much research and development needs to be done in order to produce lighting technologies that are within the reach of end-consumers. Private lending arms of international financial institutions have the capability to provide financial assistance to manufacturers to advance investments in research and development activities that would yield high quality, technologically-advanced products that would still be affordable to end users. They can also assist manufacturers in upgrading their production lines to the manufacturing of efficient lighting products that comply with the minimum energy performance standards and environmental regulations. Furthermore, they can create and offer financial instruments to foster the creation of new companies and green jobs in the lighting production sector, fostering development through the private sector in countries that would benefit from it.

A.1 Annex 1 Global and Regional Electricity Savings and Climate Benefits

Table 3 **GLOBAL** electricity savings from an immediate transition to energy efficient lighting

Electricity Savings, by Type of Lamp (2010) (TWh)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	461.0	150.0	22.9	**633.8**
Tungsten halogen incandescent	47.0	59.7	17.1	**123.8**
Compact fluorescent	-107.3	-36.1	-6.9	**-150.3**
LED	12.0	-13.3	-2.7	**-28.1**
High intensity discharge	0.4	41.0	90.0	**131.4**
Linear fluorescent	52.5	252.7	27.8	**333.0**
Electricity savings potential	441.7	453.9	148.2	**1,043.7**

Note: Negative values mean the stock is increasing thus power consumption is increasing for those lamp types.

Table 4 **GLOBAL** CO_2 savings from an immediate transition to energy efficient lighting

CO_2 Savings, by Type of Lamp (Mt)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	224.0	72.8	12.0	**308.7**
Tungsten halogen incandescent	22.2	33.1	10.9	**66.2**
Compact fluorescent	-51.6	-17.6	-4.3	**-73.5**
LED	-6.2	-7.4	-1.3	**-14.8**
High intensity discharge	0.2	20.7	45.3	**66.3**
Linear fluorescent	30.0	135.3	15.3	**180.6**
Electricity savings potential	218.6	236.9	78.0	**533.5**

Note: Negative values mean the stock is increasing thus CO_2 emissions are increasing for those lamp types.

Table 5 **EAST ASIA AND PACIFIC** electricity savings from an immediate transition to energy efficient lighting

Electricity Savings, by Type of Lamp (2010) (TWh)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	80.2	28.6	3.3	**112.1**
Tungsten halogen incandescent	8.4	16.8	5.2	**30.5**
Compact fluorescent	-17.7	-6.1	-1.8	**-25.6**
LED	2.9	-4.6	-0.4	**-7.8**
High intensity discharge	0.0	7.1	15.0	**22.2**
Linear fluorescent	20.5	72.1	8.3	**100.9**
Electricity savings potential	88.5	114.0	29.7	**232.2**

Note: Negative values mean the stock is increasing thus power consumption is increasing for those lamp types.

Table 6 **EAST ASIA AND PACIFIC** CO_2 savings from an immediate transition to energy efficient lighting

CO_2 Savings, by Type of Lamp (Mt)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	56.2	20.0	2.3	**78.5**
Tungsten halogen incandescent	6.0	11.8	3.5	**21.3**
Compact fluorescent	-12.4	-4.2	-1.2	**-17.9**
LED	-2.0	-3.2	-0.3	**-5.5**
High intensity discharge	0.0	5.0	10.6	**15.6**
Linear fluorescent	14.6	51.3	5.9	**71.7**
Electricity savings potential	62.3	80.7	20.8	**163.8**

Note: Negative values mean the stock is increasing thus CO_2 emissions are increasing for those lamp types.

Table 7 **EAST EUROPE AND CENTRAL ASIA** electricity savings from an immediate transition to energy efficient lighting

Electricity Savings, by Type of Lamp (2010) (TWh)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	32.1	41.0	2.2	**75.3**
Tungsten halogen incandescent	1.3	8.1	0.9	**10.4**
Compact fluorescent	-7.2	-10.0	-0.7	**-17.9**
LED	-0.6	-1.5	-0.1	**-2.2**
High intensity discharge	0.1	3.3	4.3	**7.7**
Linear fluorescent	2.3	18.1	1.0	**21.3**
Electricity savings potential	28.0	58.9	7.6	**94.6**

Note: Negative values mean the stock is increasing thus power consumption is increasing for those lamp types.

Table 8 **EAST EUROPE AND CENTRAL ASIA** CO_2 savings from an immediate transition to energy efficient lighting

CO_2 Savings, by Type of Lamp (Mt)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	11.5	14.5	0.8	**26.8**
Tungsten halogen incandescent	0.6	3.0	0.3	**3.9**
Compact fluorescent	-2.6	-3.5	-0.2	**-6.3**
LED	-0.2	-0.6	-0.0	**-0.9**
High intensity discharge	0.0	1.3	1.8	**3.1**
Linear fluorescent	1.1	7.0	0.5	**8.6**
Electricity savings potential	10.4	21.7	3.1	**35.1**

Note: Negative values mean the stock is increasing thus CO_2 emissions are increasing for those lamp types.

Table 9 **LATIN AMERICA AND CARIBBEAN** electricity savings from an immediate transition to energy efficient lighting

Electricity Savings, by Type of Lamp (2010) (TWh)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	27.8	11.9	2.4	**42.0**
Tungsten halogen incandescent	2.8	2.1	1.6	**6.4**
Compact fluorescent	-6.0	-2.3	-0.7	**-9.0**
LED	-1.1	-0.9	-0.2	**-2.3**
High intensity discharge	0.0	1.8	9.4	**11.3**
Linear fluorescent	4.4	9.7	3.0	**17.1**
Electricity savings potential	27.9	22.3	15.4	**65.6**

Note: Negative values mean the stock is increasing thus power consumption is increasing for those lamp types.

Table 10 **LATIN AMERICA AND CARIBBEAN** CO_2 savings from an immediate transition to energy efficient lighting

CO_2 Savings, by Type of Lamp (Mt)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	6.3	2.5	0.7	**9.4**
Tungsten halogen incandescent	0.5	0.5	0.4	**1.4**
Compact fluorescent	-1.3	-0.5	-0.2	**-2.0**
LED	-0.2	-0.2	-0.1	**-0.5**
High intensity discharge	0.0	0.5	2.2	**2.7**
Linear fluorescent	1.1	2.3	0.7	**4.0**
Electricity savings potential	6.3	5.0	3.7	**15.0**

Note: Negative values mean the stock is increasing thus CO_2 emissions are increasing for those lamp types.

Table 11 **MIDDLE EAST AND NORTH AFRICA** electricity savings from an immediate transition to energy efficient lighting

Electricity Savings, by Type of Lamp (2010) (TWh)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	21.2	9.1	3.2	**33.5**
Tungsten halogen incandescent	1.6	4.5	2.2	**8.2**
Compact fluorescent	-4.8	-2.3	-1.0	**-8.1**
LED	-0.5	-0.9	-0.3	**-1.7**
High intensity discharge	0.0	2.6	7.4	**10.0**
Linear fluorescent	3.3	16.4	4.0	**23.7**
Electricity savings potential	20.9	29.4	15.4	**65.7**

Note: Negative values mean the stock is increasing thus power consumption is increasing for those lamp types.

Table 12 **MIDDLE EAST AND NORTH AFRICA** CO_2 savings from an immediate transition to energy efficient lighting

CO_2 Savings, by Type of Lamp (Mt)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	13.1	5.7	2.1	**20.8**
Tungsten halogen incandescent	1.0	2.9	1.4	**5.3**
Compact fluorescent	-2.9	-1.5	-0.7	**-5.1**
LED	-0.3	-0.5	-0.2	**-1.1**
High intensity discharge	0.0	1.7	4.8	**6.4**
Linear fluorescent	2.1	10.3	2.6	**15.0**
Electricity savings potential	12.9	18.6	10.0	**41.4**

Note: Negative values mean the stock is increasing thus CO_2 emissions are increasing for those lamp types.

Table 13 **OECD** electricity savings from an immediate transition to energy efficient lighting

Electricity Savings, by Type of Lamp (2010) (TWh)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	267.5	47.6	10.0	**325.1**
Tungsten halogen incandescent	31.5	22.6	2.4	**56.5**
Compact fluorescent	-64.3	-12.3	-1.3	**-77.9**
LED	-5.9	-4.4	-1.5	**-11.8**
High intensity discharge	0.2	24.2	49.3	**73.7**
Linear fluorescent	17.8	123.6	9.1	**150.5**
Electricity savings potential	246.7	201.3	68.0	**516.1**

Note: Negative values mean the stock is increasing thus power consumption is increasing for those lamp types.

Table 14 **OECD** CO_2 savings from an immediate transition to energy efficient lighting

CO_2 Savings, by Type of Lamp (Mt)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	110.2	19.5	4.7	**134.4**
Tungsten halogen incandescent	13.1	10.2	1.2	**24.5**
Compact fluorescent	-26.4	-5.2	-0.8	**-32.4**
LED	-2.5	-1.9	-0.6	**-5.0**
High intensity discharge	0.1	10.7	22.2	**32.9**
Linear fluorescent	7.5	53.8	3.6	**64.9**
Electricity savings potential	101.9	87.1	30.2	**219.3**

Note: Negative values mean the stock is increasing thus CO_2 emissions are increasing for those lamp types.

Table 15 **SOUTH ASIA** electricity savings from an immediate transition to energy efficient lighting

Electricity Savings, by Type of Lamp (2010) (TWh)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	25.0	8.3	0.7	**33.9**
Tungsten halogen incandescent	1.0	4.3	4.0	**9.3**
Compact fluorescent	-5.2	-2.1	-1.1	**-8.4**
LED	-0.8	-0.9	-0.2	**-1.8**
High intensity discharge	0.0	1.3	2.9	**4.3**
Linear fluorescent	3.6	9.0	1.7	**14.3**
Electricity savings potential	23.6	19.8	8.1	**51.5**

Note: Negative values mean the stock is increasing thus power consumption is increasing for those lamp types.

Table 16 **SOUTH ASIA** CO_2 savings from an immediate transition to energy efficient **lighting**

CO_2 Savings, by Type of Lamp (Mt)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	22.4	7.5	0.7	**30.6**
Tungsten halogen incandescent	0.9	3.9	3.7	**8.4**
Compact fluorescent	-4.7	-1.9	-1.0	**-7.6**
LED	-0.7	-0.8	-0.2	**-1.6**
High intensity discharge	0.0	1.2	2.7	**3.9**
Linear fluorescent	3.3	7.9	1.5	**12.7**
Electricity savings potential	21.2	17.8	7.4	**46.4**

Note: Negative values mean the stock is increasing thus CO_2 emissions are increasing for those lamp types.

Table 13 **OECD** electricity savings from an immediate transition to energy efficient lighting

Electricity Savings, by Type of Lamp (2010) (TWh)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	267.5	47.6	10.0	**325.1**
Tungsten halogen incandescent	31.5	22.6	2.4	**56.5**
Compact fluorescent	-64.3	-12.3	-1.3	**-77.9**
LED	-5.9	-4.4	-1.5	**-11.8**
High intensity discharge	0.2	24.2	49.3	**73.7**
Linear fluorescent	17.8	123.6	9.1	**150.5**
Electricity savings potential	246.7	201.3	68.0	**516.1**

Note: Negative values mean the stock is increasing thus power consumption is increasing for those lamp types.

Table 16 **OECD** CO_2 savings from an immediate transition to energy efficient lighting

CO_2 Savings, by Type of Lamp (Mt)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	110.2	19.5	4.7	**134.4**
Tungsten halogen incandescent	13.1	10.2	1.2	**24.5**
Compact fluorescent	-26.4	-5.2	-0.8	**-32.4**
LED	-2.5	-1.9	-0.6	**-5.0**
High intensity discharge	0.1	10.7	22.2	**32.9**
Linear fluorescent	7.5	53.8	3.6	**64.9**
Electricity savings potential	101.9	87.1	30.2	**219.3**

Note: Negative values mean the stock is increasing thus CO_2 emissions are increasing for those lamp types.

Table 17 **SUB-SAHARAN AFRICA** electricity savings from an immediate transition to energy efficient lighting

Electricity Savings, by Type of Lamp (2010) (TWh)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	7.3	3.6	1.1	**11.9**
Tungsten halogen incandescent	0.4	1.4	0.8	**2.6**
Compact fluorescent	-2.1	-1.0	-0.4	**-3.5**
LED	-0.2	-0.2	-0.1	**-0.5**
High intensity discharge	0.0	0.6	1.7	**2.3**
Linear fluorescent	0.6	3.7	0.9	**4.2**
Electricity savings potential	6.0	8.1	3.9	**18.0**

Note: Negative values mean the stock is increasing thus power consumption is increasing for those lamp types.

Table 16 **SUB-SAHARAN AFRICA** CO_2 savings from an immediate transition to energy efficient lighting

CO_2 Savings, by Type of Lamp (Mt)	Residential	Commercial Industrial	Outdoor	Total
Incandescent	4.4	3.0	0.8	**8.2**
Tungsten halogen incandescent	0.2	0.8	0.4	**1.5**
Compact fluorescent	-1.2	-0.8	-0.2	**-2.2**
LED	-0.1	-0.1	-0.1	**-0.3**
High intensity discharge	0.0	0.4	1.2	**1.7**
Linear fluorescent	0.4	2.6	0.6	**3.7**
Electricity savings potential	3.7	6.0	2.8	**12.5**

Note: Negative values mean the stock is increasing thus CO_2 emissions are increasing for those lamp types.

A.2 Annex 2 Regional Breakdown of Financial and Climate Benefits

This annex discusses the regional benefits of an immediate transition to efficient lighting, illustrating the significant savings to could be made around the world. This data is derived from the UNEP-GEF en.lighten initiative Country Lighting Assessments (2012).

East Asia and Pacific
In the East Asia and Pacific region, which has approximately two billion people, a transition to efficient lighting in all end-use sectors would save approximately $28.2 billion in annual bills through a reduction of 232.8 TWh of electricity[40]. It would also save approximately $15.6 billion in avoided investment in 63 large coal-fired power plants (assumes $2000/kW). The magnitude of these energy savings represents 33% of electricity use annually for lighting in the region and approximately 31.3 GW in avoided electricity generating capacity. This is enough electricity to electrify 116.4 million households (assuming 2000 kWh/yr). The carbon savings from this transition to efficient lighting in the East Asia and Pacific region would be 163.8 Mt annually. This would be the equivalent of taking 40.9 million mid-sized cars off the road. This transition would have further benefits in the region, including a reduction of 18,500 kg of mercury emissions, a reduction of 1.10 Mt of sulphur dioxide and 0.59 Mt of nitrous oxides. The following three tables present the estimated energy savings potential, CO_2 savings potential and installed stock of lamps by lighting sector and technology for this region.

Eastern Europe and Central Asia
In the Eastern Europe and Central Asia region, which has approximately 300 million people, a transition to efficient lighting in all end-use sectors would save approximately $9.1 billion in annual bills through a reduction of 94.6 TWh of electricity[41]. It would also save approximately $6.4 billion in avoided investment in 25 large coal-fired power plants (assumes $2000/kW). The magnitude of these energy savings represents 43% of electricity use annually for lighting in the region and approximately 12.7 GW in avoided electricity generating capacity. This is enough electricity to electrify 47.3 million households (assuming 2000 kWh/yr). The carbon savings from this transition to efficient lighting in the Eastern Europe and Central Asia region would be 35.1 Mt annually. This would be the equivalent of taking 8.8 million mid-sized cars off the road. This transition would have further benefits in the region, including a reduction of 2,800 kg of mercury emissions, a reduction of 0.17 Mt of sulphur dioxide and 0.09 Mt of nitrous oxides. The following three tables present the estimated energy savings potential, CO_2 savings potential and installed stock of lamps by lighting sector and technology for this region.

Latin America and the Caribbean
In the Latin America and the Caribbean region, which has approximately 600 million people, a transition to efficient lighting in all end-use sectors would save approximately $7.1 billion in annual bills through a reduction of 65.6 TWh of electricity[42]. It would also save approximately $4.4 billion in avoided investment in 18 large coal-fired power plants (assumes $2000/kW). The magnitude of these energy savings represents 37% of electricity use annually for lighting in the region and approximately 8.8 GW in avoided electricity generating capacity. This is enough electricity to electrify 32.8 million households (assuming 2000 kWh/yr). The carbon savings from this transition to efficient lighting in the Latin America and the Caribbean region would be 15 Mt annually. This would be the equivalent of taking 3.7 million mid-sized cars off the road. This transition would have further benefits in the region, including a reduction of 400 kg of mercury emissions, a reduction of 0.02 Mt of sulphur dioxide and 0.01 Mt of nitrous oxides. The following three tables present the estimated energy savings potential, CO_2 savings potential and installed stock of lamps by lighting sector and technology for this region.

Middle East and North Africa
In the Middle East and North Africa region, which has approximately 500 million people, a transition to efficient lighting in all end-use sectors would save approximately $4.6 billion in annual bills through a reduction of 65.7 TWh of electricity[43]. It would also save approximately $4.4 billion in avoided investment in 18 large coal-fired power plants (assumes $2000/kW). The magnitude of these energy savings represents 35% of electricity use annually for lighting in the region and approximately 8.8 GW in avoided electricity generating capacity. This is enough electricity to electrify 32.8 million households (assuming 2000 kWh/yr). The carbon savings from this transition to efficient lighting in the Middle East and North Africa region would be 41.4 Mt annually. This would be the equivalent of taking 10.4 million mid-sized cars off the road. This transition would have further benefits in the region, including a reduction of 600 kg of mercury emissions, a reduction of 0.03 Mt of sulphur dioxide and 0.02 Mt of nitrous oxides. The following three tables present the estimated energy savings potential, CO_2 savings potential and installed stock of lamps by lighting sector and technology for this region.

40- This region includes the following countries: Brunei Darussalam, Cambodia, China, Indonesia, Lao People's Democratic Republic (the), Malaysia, Mongolia, Myanmar, Papua New Guinea, Philippines (the), Singapore, Thailand, Timor-Leste and Viet Nam.
41 - This region includes the following countries: Democratic People's Republic of Korea (the), Kazakhstan, Kyrgyzstan, Republic of Korea (the), Russian Federation (the), Tajikistan, Turkmenistan, Ukraine and Uzbekistan.
42 - This region includes the following countries: Argentina, Bolivia (Plurinational State of), Brazil, Chile, Colombia, Costa Rica, Dominican Republic (the), Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay and Venezuela (Bolivarian Republic of).
43 - This region includes the following countries: Algeria, Armenia, Azerbaijan, Bahrain, Egypt, Georgia, Iran (Islamic Republic of), Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Tunisia, Turkey, United Arab Emirates (the) and Yemen.

South Asia
In the South Asia region, which has approximately 1.6 billion people, a transition to efficient lighting in all end-use sectors would save approximately $3.9 billion in annual bills through a reduction of 51.5 TWh of electricity [44]. It would also save approximately $3.5 billion in avoided investment in 14 large coal-fired power plants (assumes $2000/kW). The magnitude of these energy savings represents 38% of electricity use annually for lighting in the region and approximately 6.9 GW in avoided electricity generating capacity. This is enough electricity to electrify 25.8 million households (assuming 2000 kWh/yr). The carbon savings from this transition to efficient lighting in the South Asia region would be 46.4 Mt annually. This would be the equivalent of taking 11.6 million mid-sized cars off the road. This transition would have further benefits in the region, including a reduction of 3,400 kg of mercury emissions, a reduction of 0.20 Mt of sulphur dioxide and 0.1 Mt of nitrous oxides. The following three tables present the estimated energy savings potential, CO^2 savings potential and installed stock of lamps by lighting sector and technology for this region.

Sub-Saharan Africa
In the Sub-Saharan Africa region, which has approximately 800 million people, a transition to efficient lighting in all end-use sectors would save approximately $1.3 billion in annual bills through a reduction of 18 TWh of electricity [45]. It would also save approximately $1.2 billion in avoided investment in five large coal-fired power plants (assumes $2000/kW). The magnitude of these energy savings represents 38% of electricity use annually for lighting in the region and approximately 2.4 GW in avoided electricity generating capacity. This is enough electricity to electrify nine million households (assuming 2000 kWh/yr). The carbon savings from this transition to efficient lighting in the sub-Saharan Africa region would be 12.5 Mt annually. This would be the equivalent of taking 3.1 million mid-sized cars off the road. This transition would have further benefits in the region, including a reduction of 1000 kg of mercury emissions, a reduction of 0.06 Mt of sulphur dioxide and 0.03 Mt of nitrous oxides. The following three tables present the estimated energy savings potential, CO_2 savings potential and installed stock of lamps by lighting sector and technology for this region.

OECD Countries
The OECD countries have a total population of approximately one billion people [46]. A transition to efficient lighting in all end-use sectors would save approximately $69.5 billion in annual bills through a reduction of 516.1 TWh of electricity. It would also save approximately $34.7 billion in avoided investment in 139 large coal-fired power plants (assumes $2000/kW). The magnitude of these energy savings represents 38% of electricity use annually for lighting and approximately 69.4 GW in avoided electricity generating capacity. This is enough electricity to electrify 258 million households (assuming 2000 kWh/yr). The carbon savings from this transition to efficient lighting in the OECD countries would be 219.3 Mt annually. This would be the equivalent of taking 54.8 million mid-sized cars off the road. This transition would have further benefits, including a reduction of 20,700 kg of mercury emissions, a reduction of 1.23 Mt of sulphur dioxide and 0.67 Mt of nitrous oxides. The following three tables present the estimated energy savings potential, CO_2 savings potential and installed stock of lamps by lighting sector and technology for these countries.

44 - This region includes the following countries: Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka.
45 - This region includes the following countries: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic (the), Chad, Cote d'Ivoire, Democratic Republic of Congo (the), Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia (the), Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger (the), Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Swaziland, Togo, Uganda, United Republic of Tanzania (the), Zambia and Zimbabwe.
46 - This region includes the following countries: Australia, Canada, European Union, Japan, New Zealand and United States of America (the).

A.3 Annex 3 Forecasted Savings by Regions

The following tables present the savings impact of the SE4ALL lighting accelerator scenario over the Slow New Policies scenario.

→ Non-OECD Countries	2015	2020	2025	2030
Electricity Savings (TWh/yr)	19.8	205.3	315.8	306.6
Cumulative Electricity Savings (TWh)	25.4	653.1	2,002.5	3,509.7
Cumulative CO_2 Savings (Mt)	13.0	334.4	1,025.3	1,796.9

→ Africa	2015	2020	2025	2030
Electricity Savings (TWh/yr)	0.7	18.0	34.2	34.5
Cumulative Electricity Savings (TWh)	0.7	47.9	194.5	369.6
Cumulative CO_2 Savings (Mt)	0.3	24.5	99.6	189.2

→ Asia	2015	2020	2025	2030
Electricity Savings (TWh/yr)	11.0	130.0	219.8	221.2
Cumulative Electricity Savings (TWh)	14.1	397.2	1,297.6	2,361.6
Cumulative CO_2 Savings (Mt)	7.2	203.4	664.3	1,209.1

→ East Europe and Russia	2015	2020	2025	2030
Electricity Savings (TWh/yr)	7.4	42.0	29.8	17.1
Cumulative Electricity Savings (TWh)	9.6	166.5	342.1	442.0
Cumulative CO_2 Savings (Mt)	4.9	85.3	175.1	226.3

→ Latin America and Caribbean	2015	2020	2025	2030
Electricity Savings (TWh/yr)	0.8	15.3	32.1	33.9
Cumulative Electricity Savings (TWh)	1.1	41.5	168.4	336.5
Cumulative CO_2 Savings (Mt)	0.5	21.2	86.2	172.3

A.4 Annex 4 International Efficient Lighting Programmes and Initiatives

Asian Development Bank – Energy for All Initiative
www.energyforall.info
The Energy for All Partnership is a bank-led partnership that acts as a platform for collaboration between governments, civil society and the private sector to share knowledge, build capacity and develop projects. Energy for All has six working groups for biogas, small wind, enterprise development, lighting for all, the Pacific and liquefied petroleum gas. The partner organizations share the objective of providing 100 million people access to modern energy by 2015.

CLASP
www.clasponline.org
The Collaborative Labeling and Appliance Standards Program (CLASP) was founded in 1999 through a strategic cooperation of three organizations (Alliance to Save Energy, International Institute for Energy Conservation and Lawrence Berkeley National Laboratory)to address the growing energy demand and contributions to climate change of developing countries. CLASP supports policymakers to develop and revise energy efficiency standards and works with governments and regulatory bodies to develop, implement and revise performance standards in a non-prescriptive way; and collaborates with stakeholders during the public review and revision phases of standards and labels development and implementation.

ENERGY STAR
www.energystar.gov
ENERGY STAR is a U.S. Environmental Protection Agency voluntary program that helps businesses and individuals save money and protect the climate through superior energy efficiency. It serves as a national platform and a catalyst to deliver real energy efficiency by addressing market barriers. To move energy efficiency into the future, the Agency continues to increase the stringency of ENERGY STAR performance specifications across all products, homes, buildings and plants. Today, an ENERGY STAR clothes washer uses about 70% less energy and 75% less water than a standard washer used 20 years ago. In 2012, the Agency completed the transition to new, more rigorous requirements for homes to earn the ENERGY STAR label. Homes certified under the new requirements are at least 15% more efficient than those built to the 2009 International Energy Conservation Code and include additional energy–saving features to deliver a performance advantage of up to 30% compared to typical new homes.

Global Environment Facility
www.thegef.org
The GEF unites 183 countries in partnership with international institutions, civil society organizations (CSOs) and the private sector to address global environmental issues while supporting national sustainable development initiatives. Today the GEF is the largest public funder of projects to improve the global environment. An independently operating financial organization, the GEF provides grants for projects related to biodiversity, climate change, international waters, land degradation, the ozone layer and persistent organic pollutants. Since 1991, the GEF has achieved a strong track record with developing countries and countries with economies in transition, providing $11.5 billion in grants and leveraging $57 billion in co-financing for over 3,215 projects in over 165 countries. Through its Small Grants Programme (SGP), the GEF has also made more than 16,030 small grants directly to civil society and community based organizations, totalling $653.2 million.

Global Lighting Association
www.globallightingassociation.org
The GLA unites on a global level the leading national and regional industry associations for lighting technology. GLA functions as a forum for exchange and formulation of technical and policy information and is a recognized authority on issues of concern to the global lighting industry. The Global Lighting Association is the voice of the lighting industry on a global basis. The primary mission of the GLA is to share information, within the limits of national and EU competition law, on political, scientific, business, social and environmental issues of relevance to the lighting industry and to develop, implement and publish the position of the global lighting industry to relevant stakeholders in the international sphere.

The Global Lighting and Energy Access Partnership (Global LEAP)
www.cleanenergyministerial.org/OurWork/Initiatives/EnergyAccess.aspx
Global LEAP is a transformative new collaboration to catalyse markets for off-grid energy products and services. This voluntary partnership includes regional market development efforts, a global quality assurance framework, a global awards programme to spur product development and a set of commonly agreed guiding principles. Global LEAP's ten partners include: the U.S. Department of Energy, Italy's Ministry of Land and Sea, the World Bank, IFC, the UN Foundation, the Energy and Resources Institute, the African Development Bank, the Global Environment Facility, the United Nations Development Programme and Japan's Ministry of Economy, Trade and Industry. In addition, over 100 private sector and civil society organizations affirmed support for Global LEAP and its guiding principles.

Global Off-Grid Lighting Association
www.gogla.org
Global Off-Grid Lighting Association (GOGLA) has been established to act as the industry advocate with a focus on small and medium enterprises. It is a neutral, independent, not-for-profit association created to promote lighting solutions that benefit society and businesses in developing and emerging markets. GOGLA will support industry in the market penetration of clean, quality alternative lighting systems. Formed in 2012 as public-private initiative, GOGLA was conceived out of the joint World Bank/IFC effort to provide a sustainable exit strategy for Lighting Africa initiative.

IEA-4e Solid State Lighting (SSL) Annex
ssl.iea-4e.org
The goal of the IEA-4e's Solid State Lighting Annex is to develop simple tools to help government and consumers worldwide quickly and confidently identify which solid state lighting products have the necessary efficiencies and quality levels to effectively reduce the amount of energy that is currently consumed by artificial lighting. Its main tasks are to develop solid state lighting quality assurance, harmonize solid state lighting performance testing and to work with existing accreditation bodies to develop a structure for world-wide interim reliability of solid state lighting testing labs' performance data. The Annex operates with the assistance of twenty technical solid state lighting experts from ten countries: Australia, China (expert member), Denmark, France, Japan, The Netherlands, Republic of Korea, Sweden, UK and USA.

International Energy Agency – Sustainable Building Centre
www.sustainablebuildingscentre.org
The Sustainable Building Centre is part of the International Energy Agency's Energy Efficiency Unit. The Centre aims to lower the energy demand of the buildings sector globally. The Centre path to low energy buildings includes the effective implementation of energy sufficiency measures followed by energy efficiency measures and the use of renewable energy sources when technically feasible and economically viable. The Centre recommends the implementation of a holistic approach to lowering building energy consumption that includes aligning energy requirements in building energy codes, standards and labels policies and energy targets included in land-use policies and energy efficiency action plans. The Centre makes policy recommendations and provide governments and other stakeholders with knowledge on proven building energy policies; enhances global information sharing on energy efficiency policies for buildings; develops energy efficiency indicators to enhance analysis of policy scenarios and monitor progress on policy implementation; promotes exchanges of knowledge among policymakers and energy policy and technical experts in the buildings sector; and, creates networks and opportunities for collaboration on low energy policies and technologies.

Lighting Africa
International Finance Corporation and the World Bank
www.lightingafrica.org
Lighting Africa is a joint International Finance Corporation (IFC) and World Bank programme that works towards improving access to better lighting in areas not yet connected to the electricity grid. It catalyses and accelerates the development of sustainable markets for affordable, modern off-grid lighting solutions for low-income households and micro-enterprises across the continent. It is also a key element of the Solar and LED Energy Access program, an initiative of the Clean Energy Ministerial, a global forum that encourages the transition to a clean energy economy. Lighting Africa has piloted its approach in Kenya and Ghana and is now expanding its activities to Tanzania, Ethiopia, Senegal and Mali.

lites.asia
www.lites.asia
Lighting Information and Technical Exchange for Standards (lites.asia) seeks to facilitate policy maker cooperation within the Asia region to improve knowledge of the standards in force and under development across the region, increase participation of regional economies in the IEC standards development process to ensure resulting test methods and performance standards are appropriate to the region and develop national and regional capacity for compliance in standards and labelling processes. Lites.asia was developed by a forum of representatives from Australia, China, India, Indonesia, Philippines, Sri Lanka, Thailand, USA and Vietnam in 2009. Since then, its network has increased to over 600 participants from 20 economies, including policy makers, standards and labels organizations, industry and laboratories.

Regional Centre for Lighting South Asia
www.rclsa.org
The Regional Centre for Lighting works to increase the awareness and affordability of energy efficient, reliable and clean lighting technologies, catalyse regional manufacturing of energy efficient lighting products and train and educate the necessary workforce in South Asia. These efforts aim to reduce electricity demand and make lighting affordable to underprivileged citizens. The Centre was established within the Sri Lanka Sustainable Energy Authority with assistance from the South Asia Regional Initiative for Energy and funding from USAID. Its knowledge partner is the Lighting Research Center, Rensselaer Polytechnic Institute (USA).

Sustainable Energy for All (SE4ALL)
www.sustainableenergyforall.org
UN Secretary-General Ban Ki-moon is leading this global initiative to mobilize action from all sectors of society in support of three interlinked objectives to be achieved by 2030: providing universal access to modern energy services; doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in the global energy mix. SE4ALL provides a global platform for existing and planned initiatives to reinforce one another. Ongoing initiatives include Energy for All (Asian Development Bank), the Clean Energy Ministerial, the Low-Emissions Development Strategies Global Partnership, Lighting Africa (World Bank Group), Energy+ (Norway), Energy for the Poor (OPEC Fund for International Development), the Paris-Nairobi Climate Initiative, the Africa-EU Energy Partnership, the Small Island Developing States Sustainable Energy Initiative, the Global Alliance for Clean Cookstoves. SEA4ALL also counts EU's decision to make access to sustainable energy a development priority through its "Agenda for Change." Countries such as China, India, Nepal, Brazil and South Africa are also leading the way with national initiatives. At the same time, the UN Global Compact and UN country teams on the ground are facilitating public-private partnerships to scale up investment and accelerate progress.

Super-Efficient Equipment and Appliance Deployment (SEAD) Initiative
www.superefficient.org
An initiative of the Clean Energy Ministerial, SEAD seeks to engage governments and the private sector to transform the global market for energy efficient equipment and appliances. SEAD's Standards and Labels Working Group has initiated an international collaboration of technical and policy experts in solid state lighting, which is intended to promote alignment and improvements in the scope and stringency of international standards and labelling programmes. The collaboration participants include Australia, Canada, France, Korea, Mexico, the United Kingdom and the United States. SEAD's member governments include Australia, Brazil, Canada, the European Commission, France, Germany, India, Japan, Korea, Mexico, Russia, South Africa, Sweden, the United Arab Emirates, the United Kingdom and the United States. China maintains an observer status.

TopTen
www.topten.info
TopTen is a consumer-oriented online search tool, which presents the best appliances in various categories of products. The Key criteria are energy efficiency, impacts on the environment, health and quality. TopTen ranks the most energy efficient and highest-lighting-quality LED products in several categories. TopTen was launched in 2000 in Switzerland. Since then, 16 other national TopTen sites have gone online, including fourteen European sites, TopTen China and TopTen USA.

UNDP-supported National Energy Efficiency Lighting Activities
www.undp.org
UNDP is present in a total of 167 countries and a great deal of its mission is to build and reinforce capacity particularly at national government and institutional level. Energy efficiency policies for appliances contribute to the transition towards low carbon and sustainable societies. UNDP currently supports 35 countries to design and implement energy efficiency standards and labels for lighting and appliances. Some of these projects take place in China, Nigeria, Kazakhstan, the Russian Federation, Ukraine, Egypt and Armenia.

World Bank – ESMAP
www.esmap.org
Established in 1983, the Energy Sector Management Assistance Program is a global, multi-donor technical assistance trust fund administered by the World Bank and cosponsored by 13 official bilateral donors. Its mission is to assist low- and middle-income countries to increase know-how and institutional capacity to achieve environmentally sustainable energy solutions for poverty reduction and economic growth. Since its inception in 1983, the program has supported more than 800 energy-sector activities that promote poverty reduction, economic growth and low carbon development in over 100 countries.

Zhaga Consortium
www.zhagastandard.org
Zhaga is a cooperation between companies from the international lighting industry. They are working to standardise the electrical, thermal and mechanical connections between LED modules and drivers and other LED lighting components. This work will enable interchangeability of LED modules made by different manufacturers into a given fixture. Zhaga has members from over 200 companies internationally.

Other resources and programmes:

CALiPER
www1.eere.energy.gov/buildings/ssl/caliper.html
CALiPER is the U.S. Department of Energy's commercially available LED product evaluation and reporting programme focused on product testing and reporting of market-available products in the USA.

L Prize
www.lightingprize.org
The L Prize is a technology competition to spur lighting manufacturers to develop high-quality, high-efficiency solid-state lighting products. The prize for the 60W incandescent replacement was awarded to Philips Lighting North America. The PAR38 competition is suspended.

PILESLAMP
www.eelighting.cn/english/index.html
PILESLAMP is an initiative focusing on the phasing-out of incandescent lamps and the promotion of energy saving lamps. It is a collaboration between the GEF, UNDP and the Chinese Government, whereby GEF has contributed $14 million to a total project cost of over $70 million. The goal is to create the institutional, regulatory, economic and social framework to enable phase-out of inefficient lighting in China and the promotion of efficient alternatives. This programme includes industrial restructuring, such as support for pilot conversions of manufacturers of incandescent lamps to efficient alternatives (in parallel with similar government supported activities).

LUMINA project
luminanet.org
An initiative of the Lawrence Berkeley National Laboratory, U.S. Department of Energy, the Lumina project provides analysis and information on off-grid lighting solutions for the developing world. Activities combine laboratory and field-based investigations to help ensure the uptake of products and policies that maximize consumer acceptance and market impact.