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**United Nations Development Programme
Country: Viet Nam**

PROJECT DOCUMENT

Project Title: Local Development and Promotion of LED Technologies for Advanced General Lighting in Viet Nam

UN One Plan III Focus area(s): Focus area 1: Inclusive, Equitable and Sustainable Growth

Expected OP Outcome(s)/Indicator(s): Outcome 1.3: By 2016, key national and sub-national agencies, in partnership with the private sector and communities, have established and monitor multi-sectoral strategies, mechanisms and resources to support implementation of relevant multilateral agreements and effectively address climate change adaptation, mitigation and disaster risk management

Outcome Indicator 1: CO₂ emissions, total, per capita and per \$1 GDP (PPP)

Expected OP Output(s) and Indicator(s): Output 1.3.3: A national system for Reduced Emissions from Deforestation and forest Degradation (REDD), and Nationally Appropriate Mitigation Actions (NAMAs) for a number of strategically chosen sectors and localities are formulated and operationalized with clear potential benefits

Output Indicator 1: Number of sub-sectors/ cities/ towns/ provinces with NAMAs developed and submitted to an international register

Executing Entity: Viet Nam Academy of Science and Technology (VAST)

Implementing Entity: Center for High Technology Development (CHTD) under VAST

Brief Description

The objective of the Project is to mitigate GHG emissions through transformation of the lighting market towards greater usage of locally produced LED lighting products in Viet Nam. This objective will be achieved by removing barriers to increased production and utilization of locally produced LED lighting products in Viet Nam through two components: i) the transfer of skills, knowledge and technology for the manufacturing of LED lamps in Viet Nam; and ii) the demonstration of cost-effective local commercial production of LED lighting devices. The Project will be implemented over a 4-year period and is expected to achieve GHG emission reductions through the displacement of electricity generation from fossil-fuelled power plants. Direct GHG reduction estimates are 0.623 ktonnes CO₂. Direct post-project GHG reductions are estimated to be 69.38 ktonnes CO₂. The estimated range of potential indirect emission reductions is e6 to 5,154 ktonnes CO₂eq that is cumulative for a 10-year period after the end of the Project.

| | |
|-------------------------|--------------|
| Programme Period: | 2015 - 2019 |
| Atlas Award ID: | 00084024 |
| Project ID: | 00092227 |
| PIMS # | 5193 |
| Start date: | 1 July 2015 |
| End Date | 30 June 2019 |
| Management Arrangements | NIM |
| PAC Meeting Date | TBD |

| | | |
|---------------------------------------|----|------------------|
| Total resources required | \$ | 8,146,794 |
| Total allocated resources: | \$ | 8,146,794 |
| • GEF | \$ | 1,517,400 |
| • Parallel | | |
| o UNDP ongoing project | \$ | 100,000 |
| o Other parallel (In kind & In cash): | | |
| o National Government | \$ | 440,000 |
| o Private Sector | \$ | 6,089,394 |

Agreed by (Executing Entity/Implementing Partner):

Date/Month/Year

Agreed by (UNDP):

Date/Month/Year

TABLE OF CONTENTS

| | |
|---|----|
| Acronyms | 4 |
| SITUATION ANALYSIS | 7 |
| Context and Global Significance | 7 |
| Threats and Root Causes | 9 |
| Barrier Analysis | 11 |
| Stakeholder Analysis | 16 |
| Baseline Analysis | 17 |
| STRATEGY | 24 |
| Project Rationale and Policy Conformity | 24 |
| Country Ownership: Country Eligibility | 25 |
| Country Drivenness | 25 |
| Alternative Scenario | 26 |
| Project Objective, Outcomes and Output/Activities | 27 |
| Key Indicators, Risks and Assumptions | 37 |
| Cost Effectiveness | 39 |
| Sustainability, Replicability and Impacts | 39 |
| PROJECT RESULTS FRAMEWORK | 41 |
| TOTAL BUDGET AND WORK PLAN | 44 |
| MANAGEMENT ARRANGEMENTS | 48 |
| Project Organization Structure | 48 |
| General | 51 |
| MONITORING FRAMEWORK AND EVALUATION | 53 |
| LEGAL CONTEXT | 56 |
| Annex I: Risk Analysis | 59 |
| Annex II: Detailed CO₂ Calculations and Assumptions | 61 |
| Annex III: Overview of LED Software | 73 |
| Annex IV: Overview of Other LED Manufacturing Equipment for Viet Nam | 77 |
| Annex V: Annual Targets | 79 |
| Annex VI: Agreements on Implementation Support Service | 80 |
| Annex VII: Terms of Reference for Project Staff and Consultants | 83 |
| Annex VIII: UNDP-GEF Environmental and Social Screening Procedure (ESSP) | 99 |

ACRONYMS

| Acronym | Meaning |
|---------|--|
| AOI | Automatic Optical Inspection |
| APRC | Asia Pacific Regional Centre |
| AWP | Annual work plan |
| BAU | Business-as-usual |
| BoA | Bureau of Accreditation (under MoST) |
| CCIT | “Strengthening capacity on climate change initiatives in the industry and trade sectors” Project |
| CCT | Correlated color temperature |
| CDM | Clean Development Mechanism |
| CFL | Compact fluorescent lamps |
| CHTD | Center for High Technology Development |
| CME | Coordinating management entity (for CDM-PoA) |
| CP | Country Programme |
| CPAP | Country Programme Action Plan |
| CRI | Color rendering index |
| DoST | Department of Science and Technology |
| DoSTE | Department of Science, Technology and Environment (under MoC) |
| DQ | Dien Quang Light Source Company |
| DSTES | Department of Science, Technology and Energy Savings (under MoIT) |
| EE&EC | Energy Efficiency & Energy Conservation |
| EECO | Energy Conservation and Energy Saving Office (under MoIT) |
| EEL | Energy efficient light |
| EIAs | Environmental Impact Assessments |
| EOP | End of Project |
| ESCO | Energy service company |
| ESL | Energy standards & labelling |
| EVN | Electricity of Viet Nam |
| FIRST | Fostering Innovation through Research, Science and Technology (WB-loan Project) |
| FY | Fiscal year |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |
| GHG | Greenhouse Gases |
| GIZ | German International Assistance |
| GoV | Government of Viet Nam |
| GJ | Gigajoules |
| HACT | Harmonized Approach to Cash Transfers to Implementing Partners |
| HCMC | Ho Chi Minh City |
| HID | High Intensity Discharge |
| HPS | High Pressure Sodium |
| IC | Integrated circuit |

| Acronym | Meaning |
|-----------|---|
| ICL | Incandescent lights |
| IEA | International Energy Agency |
| IEC | International Electro-technical Commission |
| IES | Illuminating Engineering Society |
| ISPONRE | Institute of Strategy and Policy on Natural Resources and Environment (under MoNRE) |
| JSC | Joint Stock Company |
| kgoe | Kilogram oil equivalent |
| kWh | Kilowatt hours |
| LED | Light emitting diode |
| LGF | Loan guarantee fund |
| MDG | Millennium Development Goals |
| MEPS | Minimum energy performance standards |
| M&E | Monitoring and evaluation |
| MFI | Micro-finance institution |
| MH | Metal halide |
| MIS | Management Information System |
| MJ | Megajoules |
| MOCVD | Metal organic chemical vapor deposition |
| MoC | Ministry of Construction |
| MoF | Ministry of Finance |
| MoIT | Ministry of Industry and Trade |
| MoNRE | Ministry of Natural Resources and Environment |
| MoST | Ministry of Science and Technology |
| MPa | Megapascal (a unit of pressure) |
| MTDF | Medium Term Development Framework |
| mtoe | Million tonnes of oil equivalent |
| MWh | Megawatt-hours |
| NAFOSTED | National Foundation for Science and Technology Development |
| NCCS | National Climate Change Strategy |
| NGOs | Non-Government Organizations |
| NIM | National Implementation Modality |
| NPD | National Project Director |
| NPFE | National Portfolio Formulation Exercise |
| OSH | Occupational safety and health |
| PCB | Printed circuit board |
| PFC | Power factor correction |
| PIR | Project Implementation Report |
| PMU | Project Management Unit |
| PoA | Programme of Activities under CDM |
| ProDoc | UNDP Project Document |
| PSC | Project Steering Committee |
| QUATEST 1 | Quality Assurance and Testing Center 1 |

| Acronym | Meaning |
|---------|--|
| Ralaco | Rang Dong Light Source and Vacuum Flask Joint Stock Company |
| R&D | Research and Development |
| SBAA | Standard Basic Assistance Agreement |
| SMD | Surface Mount Device |
| SMT | Surface Mount Technology |
| SNC | Second National Communications |
| STAMEQ | Standard, Metrology and Quality under DoST |
| TCVN | National technical standards of Viet Nam from VSQI |
| TIA | Technical Infrastructure Agency (Under MoC) |
| TJ | Tera joules |
| toe | Tons of oil equivalent |
| ToR | Terms of Reference |
| TTC | Technology Transfer Centers (located in provincial centers) |
| UNDP | United Nations Development Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VAA | Viet Nam Architect Association |
| VAST | Viet Nam Academy of Science and Technology |
| VEECA | Energy Efficiency and Conservation Association of Viet Nam |
| VEEPL | Viet Nam Energy Efficient Public Lighting Project (UNDP-GEF) |
| VILAS | Viet Nam Laboratory Accreditation Scheme (under BoA) |
| VLA | Viet Nam Lighting Association |
| VSQI | Viet Nam Standards and Quality Institute |
| WB | World Bank |

Currency Equivalents¹

Currency Unit = Vietnamese Dong, VND
1 USD = VND 21,222

¹ <http://www.un.org/depts/treasury/> (exchange rate effective 01 October 2014)

SITUATION ANALYSIS

Context and Global Significance

1. Viet Nam's economy grew at an average of 6.5% per year since 2000. This strong growth is expected to continue for decades to come as the country transitions from a centrally planned to a market-based economy. While various annual GDP growth projections for Viet Nam are in the order of 5.5% up to 2016, Viet Nam is rapidly "urbanizing" at 3% per year. Rapid urbanization and economic growth have led to a proliferation of buildings with an accompanying surge in lighting demand. While worldwide demand for lighting is projected to rise 12% per year to 2016, this figure is likely to be even higher in Viet Nam.
2. According to Viet Nam Electricity's (EVN) 2012 annual report, total electricity consumption in Viet Nam during 2012 was 117.59 million MWh, a consumption level that ranks in the top 20 developing countries. With electricity consumption for lighting estimated at 25.3% or 29.75 million MWh, CO₂ emissions from Viet Nam's lighting sector in 2012 were 17.15 million tonnes CO_{2eq}². Notably, energy intensity, as measured by electricity consumption/GDP, has been steadily increasing as living standards improve, and lighting loads significantly contribute to system peak demands that occur in the evening. Reducing peak power demand could forestall the need to build new power plants. According to Viet Nam's 7th Electricity Development Plan, the total electricity consumption of Viet Nam in 2020 and 2030 is expected to be 330 million MWh and 695 million MWh respectively. The Plan also forecasts during the period of 2015-2030, an increase in thermal power generation with a corresponding reduction of hydropower generation. The 2008 grid emissions factor of 0.5764 tCO₂/MWh (2008)³ has already increased to 0.6244 tCO₂/MWh for 2011⁴, and is assumed as the grid emissions factor for the period 2015-2030. As such, with electricity consumption for lighting assumed to remain at 25.3% until 2030, the lighting sector CO₂ emissions will be 52.1 million tCO₂ and 109.8 million tCO₂ in 2020 and 2030 respectively.
3. With rising electricity prices and mounting concerns over climate change and energy security, the Government of Viet Nam (GoV) is promoting widespread adoption of EE measures for lighting. This commenced in the early 2000s with the migration away from incandescent lighting to compact fluorescent lamps (CFLs). Widespread adoption of LED lighting technologies is expected to provide significant reductions in energy consumption and GHG emissions from the current lighting loads from CFLs, T8 and High Intensity Discharge (HID) lamps.
4. GoV's initial interest in LED lamps was demonstrated through a 2011-2012 Ministry of Industry and Trade (MoIT) pilot project that demonstrated energy savings of 50% compared to traditional lamps. A rapid evolution of LED lighting technology has occurred since 2010 where greater levels of energy savings have been achieved. Figure 1 depicts the results of a 2012 study by the U.S. Department of Energy that found the most advanced LED lamps consume 1,630 MJ per functional unit compared to 3,780 MJ for CFL lamps and 15,100 MJ for incandescent lamps. On the basis of EVN's expansion plans, the CO₂ reduction potential of replacing all traditional lighting systems in Viet Nam (i.e. incandescent, CFLs, T8, HID

² Assumes the 2008 grid emission factor of 0.5764 tCO₂/MWh as referenced from:
<http://cdm.unfccc.int/filestorage/D/Y/M/DYMN5CES6BQH14VRAIO0UJZW7239GK/Translation%20GEF%20Vietnam.pdf?t=NDJ8bjd4d211fDB7--pGfZOqydZtzgaz2PTG>

³ Ibid 3

⁴ MoNRE, May 2013

lamps) with LED lamps is estimated to be in the order of 18.7 and 39.4 million tonnes CO_{2eq} in 2020 and 2030 respectively⁵. Table 1 provides a comparison between LED and fluorescent tube lamps.

Figure 1: Lifetime energy consumption of conventional and LED lighting technologies⁶

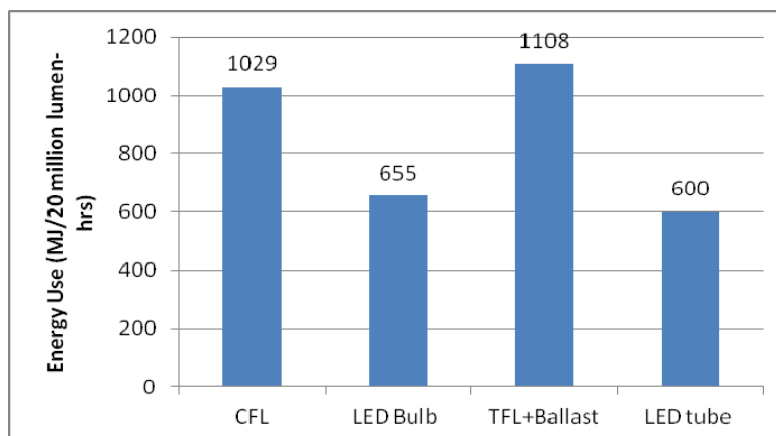


Table 1: Cost savings when functional CFL and TFL replaced by LED bulb and LED tube

| Lamp Type | CFL | LED Bulb | TFL+ Ballast | LED tube |
|---|-------|-----------|--------------|-----------|
| Lamp Cost in 2013 (USD) | 2 | 9.4 | 7 | 25 |
| Life time (hr) | 6,000 | 25,000 | 8,000 | 25,000 |
| Number of lamps to produce 20 MJ-Im-hr | 4 | 1 | 0.9 | 0.3 |
| Functional Unit lamps cost (USD) | 7.9 | 9.4 | 6.6 | 7.6 |
| Lamps Power (W) | 12 | 7 | 41 | 22 |
| LED Life-Cycle (25000 h) electricity cost (USD) | 714 | 455 | 769 | 417 |
| Total (Lamps + Energy) cost (USD) | 722 | 464 | 776 | 425 |
| FL/LED One Life-Cycle cost saving (USD) | | 258 | | 351 |
| Annual cost saving for lighting time 3560hr (USD) | | 64 | | 88 |
| Relative saving (%) | | 36 | | 45 |
| Replacement times | 3 | 0 | 2 | 0 |
| Replacement costs | n/a | n/a | n/a | n/a |

⁵ Assumes a 36% energy saving from CFL to LED lamp as shown on Table 1. This is not used as the estimate for market potential of GHG reductions from LEDs over a 10-year period; a more detailed estimate of this market potential is provided in Annex II based on actual lighting devices used, and the assumption that 20% of all lighting devices will be LEDs in 2028 without any external interventions from GEF or others.

⁶ U.S. Department of Energy, Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products, 2012

5. Local production of improved EE lighting (EEL) products (CFL, T8, HID lamps) has increased from 37.5 million in 2008 to 41.4 million in 2009, and 46.3 million in 2010. Among them, about 50% were exported abroad. By the end of 2010, there were 89% EELs in urban streets, 91% EELs in rural streets, and 65% EELs in all educational buildings in Viet Nam⁷. Surveys indicate that 90% of locally produced indoor lighting lamps in Viet Nam are made by two companies: Rang Dong Light Source and Vacuum Flask JSC (Ralaco) based in Hanoi and Dien Quang Light Source Company (DQ) based in Ho Chi Minh City (HCMC). The remaining production is distributed amongst small manufacturers.
6. Estimation of outdoor general lighting in Viet Nam is in order of 600,000 lamps, most of which are used for lighting highways, roads, street, and alleys. The annual sale of outdoor lighting lamps is estimated at 120,000. The Hanoi Public Lighting Company is the largest local outdoor lamp fixture manufacturer in Viet Nam with annual production of more than 50,000 pieces for both local and export markets. The Rang Dong Company is the only other company in Viet Nam that manufactures metal halide (MH) and high pressure sodium (HPS) bulbs in Viet Nam for outdoor usage⁸.
7. Despite the energy savings of LED lighting technologies, LED lighting devices still have not significantly penetrated the Viet Nam lighting market. The LED lighting devices used today in Viet Nam are largely sold for use in buildings owned by direct foreign investors (such as higher class luxury apartments and office buildings) who pay higher electricity rates and thus have more incentive to use costlier LED lamps. Table 2 is a comparison of indoor LED lamps to conventional indoor lighting technologies in terms of their total cost consisting of electricity cost (for 60,000 hrs) and lamp purchase replacement costs. In all cases, the net cost of LED lighting is less than the conventional technologies
8. Although there is increased awareness of the value of LED lighting devices and associated global environmental benefits amongst some Vietnamese consumers, the current outlook for growth of LED sales in Viet Nam is not healthy, mainly due to higher costs. The GoV has a number of programs to promote the use of LED lighting products and to support increased local manufacturing of LED lighting products in Viet Nam. In response to these programs, Vietnamese lighting manufacturers have made some efforts to upgrade their knowledge, skills and manufacturing equipment to produce LEDs locally at reduced cost that would improve their position to generate revenue from LED sales. These efforts to date, however, have not resulted in increased LED sales and wider use of LEDs for general lighting in Viet Nam. This is mostly due to a number of market forces and barriers contributing to a lack of knowledge as detailed in this document.

Threats and Root Causes

9. A root cause of the lack of greater adoption of LEDs in Viet Nam is the low price of electricity and energy that is a consequence of indirect subsidies. The low electricity prices strongly dissuade household and commercial consumers from purchasing expensive imported and high quality LEDs that would have the impact of reducing electricity consumption.

⁷ VEEPL final report 2011

⁸ Ralaco sales of MH and HPS lamps comprise a small proportion of their total sales.

Table 2: Comparisons between LED lamps and conventional lighting technologies⁹

| Lighting tech | Service Life (hrs) | Power Rating (W) | kWh (for 60,000 hrs) | Electricity cost (USD) ¹⁰ | Number of lamps used for 60,000 hrs | Total cost of lamps used (USD) ¹¹ | Net Cost (USD) |
|--------------------|--------------------|------------------|----------------------|--------------------------------------|-------------------------------------|--|----------------|
| <i>LED and CFL</i> | | | | | | | |
| CFL | 10,000 | 9 | 540 | 64.80 | 6 | 25.60 | 90.94 |
| LED | 60,000 | 5 | 300 | 36.00 | 1 | 35.00 | 71.00 |
| <i>LED and T8</i> | | | | | | | |
| T8 | 15,000 | 35 | 2,100 | 252.00 | 4 | 3.30 | 255.30 |
| LED | 60,000 | 18 | 1,080 | 131.80 | 1 | 50.00 | 181.80 |
| <i>LED and HPS</i> | | | | | | | |
| HPS | 16,000 | 150 | 9,000 | 1,080.00 | 3.75 | 297.00 | 1,377 |
| LED | 60,000 | 100 | 6,000 | 720.00 | 1 | 500.00 | 1,220 |
| <i>LED and MH</i> | | | | | | | |
| MH | 10,000 | 346 | 20,760 | 2,491.20 | 6 | 553.40 | 3,044.60 |
| LED | 60,000 | 149 | 8,940 | 1,072.80 | 1 | 1,300 | 2,372.80 |

10. Notwithstanding this lack of purchasing incentive, there has been limited uptake of LED lighting products, *resulting in slow growth in the use of LED lighting products*. In addition, there had been little or no attention paid by GoV until 2008 to consider the use of LED lighting products as a vehicle of energy conservation. Since 2009, however, there have only been demonstrations and sporadic efforts to increase the knowledge and production of locally produced LED lighting products. The market penetration of the current LED market is limited by:

- Inability of locally-based lighting manufacturers such as Ralaco and Dien Quang to produce quality LED lighting products at competitive market prices. This is primarily due to the lack of a developed regulatory regime for LED lamp production and sales in Viet Nam that would guide local LED lamp manufacturers on quality of LED lighting products to produce for the market;
- Lack of consumer confidence in locally sold LED lamps, some of which are improperly labelled to mislead consumers into believing the LED lamps meets international standards, but are actually poor quality LED lamps that have a short service life;
- Lack of consumer confidence in locally produced LED lamps due to their poor quality in terms of service life¹²; and
- The high cost of imported LED lamps where there is a perception that imported LED lamps from manufacturers such as Philips, Osram, do meet international standards¹³. The cost of these imported LED lamps, however, is significantly higher to discourage their general use.

⁹ GEO-Technik GmbH & Co KG (<http://www.dimmer.de>)

¹⁰ Assumes electricity cost of USD 0.12/kWh

¹¹ This is based on 2009 unit prices of these lamps. For example, the 9W CFL unit price was USD 4.26.

¹² Locally produced LED lamps do not meet international LED standards, and are intentionally produced at these low standards to be competitive with smaller local LED producers who use imported low-cost LED manufacturing equipment.

¹³ There is a small proportion of these LED lamps that do not international standards

Barrier Analysis

11. **Regulatory barriers:** The absence of a regulatory framework over the quality of LED lamps produced in Viet Nam has led to the flooding of sub-standard LED lamps that are locally produced or imported on the Vietnamese lighting market. Mandatory standards and regulations for LED lamp production such as those mentioned below have not yet been promulgated:
 - Energy performance standards for LED lighting products;
 - Formalized testing method standards for LED lamps and their components;
 - Monitoring and evaluation (M&E) regulations for LED lighting product minimum energy performance standards (MEPS) enforcement; and,
 - M&E regulations for LED lighting product standards & labelling.
12. There are two international standards that have relevance for the production of quality LED lamps in Viet Nam:
 - *IES LM-79-2008, Approved Method for the Electrical and Photometric Testing of Solid State Lighting Devices*, that provides a foundation for accurate comparisons of luminaire performance for solid state lighting (SSL) and all other sources¹⁴;
 - *IES LM-80-2008, Approved Method for Measuring Lumen Depreciation of LED Light Sources* that defines a method of testing lamp depreciation. LED packages have a long lifetime in comparison with other lighting devices and may become unusable long before they actually fail; hence, this mode of failure can be accounted for in this standard¹⁵.
13. In addition, there are no regulations specifying the use of energy saving lamps such as LED lamps in the building codes of the Ministry of Construction (MoC). While there are specifications in the building code for lighting requirements, the codes do not include considerations of energy efficiency of the building which would include specifying the use of energy saving lamps such as LED lamps. The updating of these codes would provide a regulatory push for the use of energy efficient lighting devices such as LEDs.
14. **Institutional barriers:** There are weak institutional arrangements for the standard testing of LED lamps, R&D for the advancement of LED lighting products, and for the promotion, appraisal and standards enforcement of LED lighting products:
 - The Viet Nam Standards and Quality Institute (VSQI) under STAMEQ is responsible for the setup of an enforcement regime for lighting suppliers to meet minimum testing requirements. For LED lamps, the QUATEST testing centers have not yet obtained accreditation as a LED lighting product testing laboratory, in part due to voluntary compliance of the aforementioned IES standards¹⁶. They are currently in need of the appropriate equipment and knowledge to test locally-produced LED lamps;

¹⁴ LM-79 enables the calculation of LED luminaire efficacy (net light output from the luminaire divided by the input power and measured in lumens per watt). Luminaire efficacy is the most reliable way to measure LED product performance or measuring luminaire performance as a whole instead of relying on traditional methods that separate lamp ratings and fixture efficiency.

¹⁵ LM-80 establishes a standard method for testing LED lumen depreciation. Note that LED source depreciation to a particular level of light, should not be construed as a measure of lifetime for luminaires, however, as other failure modes also exist which can, and in most cases will, shorten that lifetime.

¹⁶ LED lighting products have several specifications and types that need to be tested. QUATEST currently is only able to test LED lamps including LED bulbs and LED tubes for safety and performance. The Bureau of Accreditation (BoA) provides accreditation only for specifications, not products. Presently, accreditation has been provided for safety and performance specifications testing for two types of LED lamps. The pool of other specifications and types of LED lamps cannot be tested by Quatest and cannot receive accreditation from BoA.

- Weak national research and development (R&D) programmes for LED lighting product advancement that need to be more strongly linked with the work being done in private-sector R&D centers and local manufacturers on advances made in LED lighting products and LED lamp fabrication. These stronger linkages may result in more useful LED lighting product development that meets new and adopted Vietnamese LED lamp standards and regulations and is more responsive to consumer demand trends for LED lighting products; and
- Lack of institutional focus for promoting LED lamps as a mainstream lighting device:
 - The Ministry of Construction (MoC):
 - is not yet monitoring or promoting installation of LED lighting systems;
 - is not conducting information dissemination campaigns on EE lighting and its benefits of reduced energy consumption;
 - does not undertake activities on rating of public lighting performance; and
 - has limited capacity to appraise and approve LED lighting codes and norms;
 - The Ministry of Finance (MoF) has limited capacity to appraise public LED lighting projects for approval. The current practice of financial analysis of lighting projects needs to be upgraded to reflect the benefits of LED lighting;
 - The Ministry of Science and Technology (MoST) has limited capacity to formulate and promulgate LED lighting product standards. The limited capacity is related to the lack of testing equipment, standards, procedures, protocols for LED lighting products, and a shortage of qualified personnel on testing and certification of LED lighting products and oversight of intellectual property rights (IPR) infringement¹⁷;
 - The Ministry of Industry and Trade (MoIT) possesses full awareness on the benefits of LED lighting but do not have sufficient details in policy circulars and in national level activities to promote and encourage LED lighting technology development and application;
 - Limited experience amongst most Government ministries in negotiating with equipment manufacturers to increase the level of energy efficiency of their products;
 - Local governments have insufficient capacity to promote energy efficient lighting products such as LED lamps along with related benefits in terms of energy cost savings. There is also insufficient capacity to evaluate technical, financial and economic feasibility of the LED lighting projects at local level, and as a consequence, local governments experience difficulties in allocating budgets for projects on high-cost LED lighting.

15. Local capacity and knowledge barriers: Local LED lamp manufacturers have insufficient knowledge and capacity on best practices for LED lamp manufacturing and best strategies on improving their production lines to successfully supply LED lamps to the Viet Nam lighting market. This has resulted in a low level of investment into LED lamp production lines. For local LED lamp manufacturers to increase their sales, knowledge and capacity barriers on locally producing LEDs and increasing domestic LED lamp sales, need to be lowered. Figure 2 provides a schematic of the entire LED lamp manufacturing process; the area enclosed by the red lines represents the processes that could be undertaken by Vietnamese-based LED lamp manufacturers¹⁸. Figures 3 and 4 provide more detail on the LED driver and the LED lamp manufacturing processes respectively.

¹⁷ MoST have taken the lead on IPR enforcement according to <http://vietnam.usembassy.gov/iprtoolkitvn.html>

¹⁸ Processes outside the red enclosure such as wafer fabrication, MOCVD system equipment, the associated clean room, photolithography and wafer processing, are very costly and are sourced mostly from G7 countries as well as Taiwan, Korea and China

Figure 2: LED Manufacturing Process

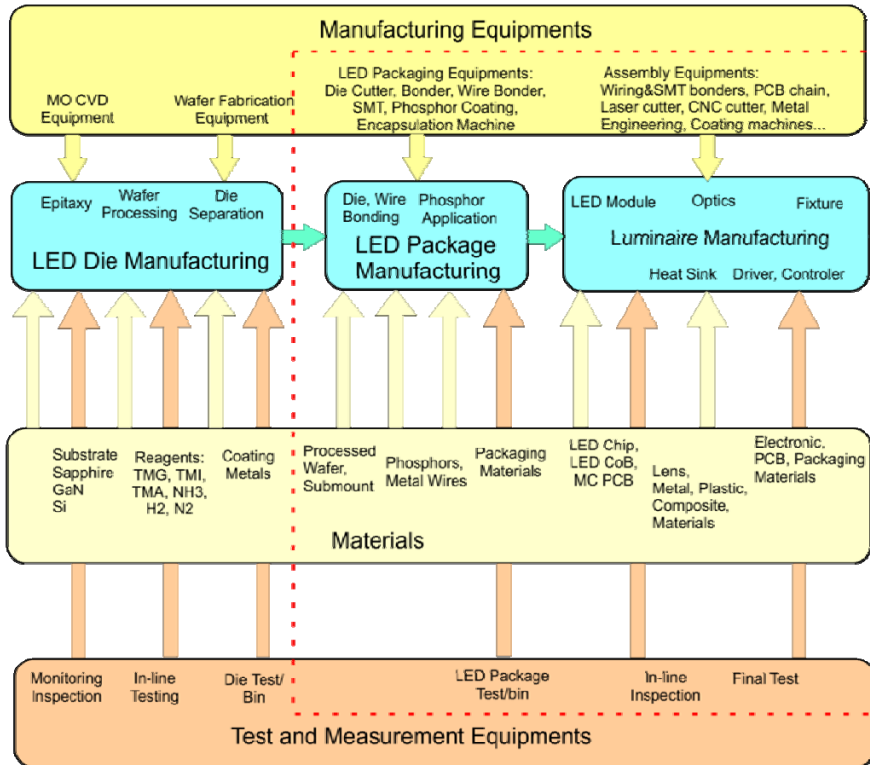


Figure 3: LED Package Manufacturing Process

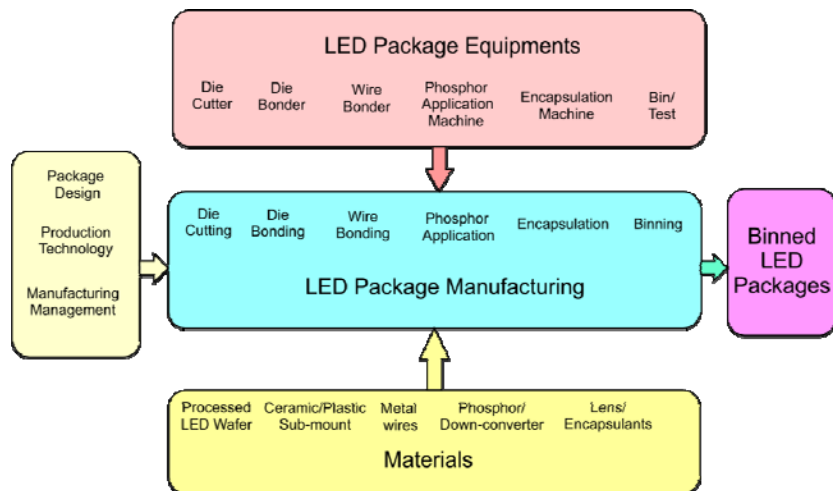
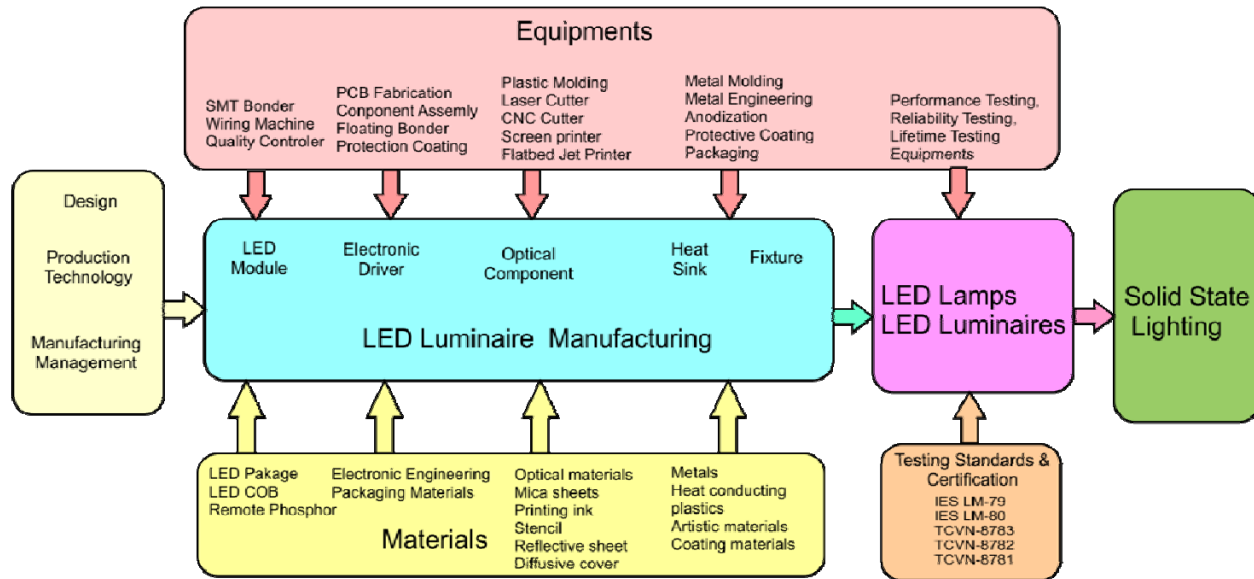


Figure 4: LED Luminaires Manufacturing Process



16. An example of the lack of capacity of local LED lighting manufacturers can be found with Viet Nam's two largest lighting companies, Ralaco and Dien Quang, who have made commitments to invest in scaled-up production of LED lighting products, both indoor and outdoor LED lights to align with the GoV's objectives under the National Program on High Technology Development to 2020. Although these companies do have some capacity for LED production, their LED lighting products do not meet international standards, and are mainly sold on the local market at prices that compete with the poor quality imported LED lamps that currently flood the Viet Nam lighting market. Their inability to secure foreign technical assistance is related to the reluctance of foreign consultants to share their expertise without stronger protection of their intellectual property and their views that Viet Nam is not ready to transform the lighting market towards LED lighting products until there are standards and regulations that would only allow compliant LED lighting products to be sold on the market.

17. Detailed descriptions of the LED lamp manufacturing process are contained in Annex IV. The capacity and knowledge barriers include:

- The lack of technical knowledge of equipment required for local production of international standard LED lamps at competitive prices. While Vietnamese-based lighting producers understand that LED die manufacturing is dominated by G7 countries, there remains an opportunity for them to provide key and advanced LED lamp production technology for LED chips, LED chip packaging, printed circuit board (PCB) fabrication, component assembly, electronic driver production including IC, heat sinks, and other auxiliary components;
- Limited exposure and access to best practices and international standards for the design and manufacturing of LED lamps and their components. Most Vietnamese-based lighting manufacturers experience difficulties in the recruitment of short-term LED technical

experts¹⁹. These experts mainly work for their own R&D centers and are difficult to recruit due to commitments to their employers;

- Weak research and development (R&D) programmes under the private sector for LED product advancement:
 - R&D centers located in the facilities of these lighting manufacturers do not have the appropriate testing facilities for research and advancement of LED lighting technologies;
 - A number of these centers do not have international procedures and methodologies for testing LED lamp quality; and
 - There is ineffective coordination between these centers, local manufacturers and the Government on advances made in LED products and LED lamp fabrication;
- Lack of capacity to develop business strategies to increase production of local LEDs and reduce production costs. Local lighting manufacturers to date have not had the incentive or the exposure to the formulation of comprehensive business strategies for the local production of high quality LEDs. Development of these business strategies would entail the collection of knowledge on general public awareness of LEDs, collecting intelligence of competition from international companies on LED production, thinking on the marketing of a disruptive technology, and understanding the concerted efforts required to implement innovative LED production processes. With these components in place, a sound LED production focussed business strategy would aim to have locally produced LEDs sold on the local lighting market at competitive prices.

18. Awareness barriers: With most LEDs sold in Viet Nam to foreign companies and for decorative purposes, there is little awareness of the benefits of LED lamps amongst Vietnamese-based businesses and residents. Moreover, there is an ongoing perception that quality LED lamps are imported and very costly, and that locally produced LED lamps are of poor quality with no additional benefits resulting in a general lack of consumer confidence in LED lamps. With the low cost of electricity in Viet Nam²⁰, there has been a lack of developed and implemented awareness raising campaigns for increased LED lamp usage.

19. Market barriers: Poor quality of local-produced LED lamps and the high price of quality imported LED lamps are major barriers to higher market penetration and usage of LED lamps in Viet Nam. Currently, for many LED lamp producers to sell their products on the Vietnamese market, they produce LED lamps by compromising various quality procedures to compete with entities who import cheaper manufacturing and assembly LED equipment. The impact of these compromises is the assembly of LED lamp components from different sources that are not properly engineered and fail to provide an improved service life over other traditional lighting devices. This results in three market failures: (i) local LED lamps are not labelled for energy consumption and service life which reduces consumer confidence in local LED lamp technology; (ii) there is limited or no market monitoring or sampling due to lack of government capacity and a lack of LED standards to keep low quality LED lamps off the market; and (iii) the disparity of price between conventional lighting technologies and imported high quality LED lighting products discourages widespread adoption for local use.

¹⁹ There are two or three Vietnamese-based lighting manufacturers who have signed partnerships with reputable international LED makers. While these manufacturers have the ability to recruit the appropriate international LED expertise to provide advice on upgrading their Vietnamese-based lighting manufacturing base, the cost of bringing these experts to Viet Nam is high. In addition, the advice of these experts is fraught with risk given that the LED-production lines recommended by these experts are specific to a certain international brand name, and may not represent the best options for a Vietnamese-based LED manufacturer.

²⁰ Consumer electricity prices in Viet Nam are equivalent to USD 0.07/kWh, a rate that is heavily subsidized.

20. **Technical barrier:** The lack of mandatory standards and regulations on the production and sale of LED lamps in the Vietnamese lighting market has led to LED lighting product quality issues that need to be addressed to improve consumer confidence:
- **Colour Quality:** Many LED lighting products have demonstrated excellent colour quality with CRI greater than 90, good R9 values, and a range of CCTs. However, the perception remains that LED lighting products have fundamentally worse colour quality than conventional sources, in particular halogens;
 - **Lighting System Performance:** For lighting products and lamp bulbs, in particular, consumers have come to expect full inter-changeability between various light source technologies. Replacement products are expected to be compatible with the legacy dimmer circuit and match the colour quality, light distribution, form factor, and light output of the products they are replacing.

Stakeholder Analysis

21. Stakeholders involved with the promotion of local LED manufacturing and in the supply and demand of LED lamps in Viet Nam includes:
- Public sector stakeholders at the central level that set policies to promote and regulate the growth of LED lamp production and usage. These include:
 - The **Viet Nam Academy of Science and Technology (VAST)**, a governmental agency responsible for developing technologies as directed by the State that includes LED lighting technologies. They will serve as the UNDP's Executing Entity for this Project;
 - The **Center for High Technology Development (CHTD)** under VAST is responsible for conducting science and technology services under the direction of VAST. CHTD is the designated Implementing Entity of the project on behalf of the VAST;
 - The **Technical Infrastructure Agency (TIA)** under the MoC, which provide advice and assist the Ministry in enforcing various policies on urban infrastructure development that would include LED lighting policies. TIA will support implementation of the information dissemination program of the Project;
 - The **Department of Science, Technology and Environment (DoSTE)** under MoC, which provide advice and assistance to MoC from scientific, technological and environmental perspectives on scientific research, technology development, application of technical progress, transfer of technology, standards, and measurement, and development and management of the energy efficient building codes. DoSTE will assist in the promotion of LED lamps with revised energy efficient building codes;
 - The **Directorate of Standards, Metrology and Quality (STAMEQ)** under MoST to assist in the setting of standards for new technologies including LED technologies for energy performance and service life. The **Viet Nam Standard and Quality Institute (VSQI)** under STAMEQ is responsible for the issuance of national standards identified under the abbreviation TCVN (standing for "Tiêu chuẩn Việt Nam") followed by a number, a colon, and the year issued. The **Quality Assurance and Testing Center 1 (QUATEST 1)** is the science-technological organization under STAMEQ is responsible for State management on standards, measurements, quality and other service activities. These stakeholders will implement the new testing protocols and standards for LED lamps;
 - The **Energy Conservation and Energy Saving Office (EECO)** under MoIT that currently implements the National Targeted Program on Energy Saving and Conservation (VNEEP). EECO will implement technology transfer activities;

- The **Department of Science, Technology and Energy Savings (DSTES)** under MoIT is responsible for State management on energy efficiency and conservation, and other energy sciences and technologies. DSTES will assist in the development of the LED lighting products development roadmap and implement the LED lamps labelling program;
- The **Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE)** under MoNRE that is currently executing the UNEP-GEF project on “Phasing out Incandescent Lamps through Lighting Market Transformation in Viet Nam and assist with coordination of its activities with this Project;
- Public sector stakeholders at the provincial levels that implement central policies and would be tasked to work with the private sector to implement central government policies;
- Private sector stakeholders that are:
 - Local private sector LED lamp manufacturers (such as Ralaco, Dien Quang, Viet Nam Schreder) that are producing LED products for indoor and outdoor general lighting as well as planning additional investments to manufacture quality LED devices for the Viet Nam market;
 - Local energy service providers that have the capacity to install LED lighting and control systems. These stakeholders will be identified during the Project; and,
 - Industrial and commercial stakeholders that will be hosting the indoor LED lighting applications (e.g., Nha Be Garment Factory in HCMC) and outdoor applications of LEDs (e.g., Hoa Lac High Tech Park near Hanoi);
- Civil social service organizations (such as the Viet Nam Lighting Association (VLA) and the Energy Efficiency and Conservation Association of Viet Nam (VEECA)) that can raise the profile of local LED products, their usage and its national environmental and social benefits through advocacy, awareness raising and training.

Baseline Analysis

22. The National Energy Efficiency Program (VNEEP) under the coordination of MoIT forms the key baseline project for this proposed initiative estimated at USD 44 million until 2020. Phase I of VNEEP was implemented between 2006 and 2010 to secure savings of 3 to 5%. Phase II (VNEEP II) is now under implementation until 2015 with the aim of securing 5 to 8% savings. VNEEP II's key specific activities that have a strong link with LED lighting products includes:
- Component 1: Improvement of EE targets, goals and strategy. MoIT is in the midst of developing and preparing roadmaps for various components of VNEEP II that articulates how sector-based EE goals are integrated and contribute to national socio-economic goals;
 - Component 2: Capacity building. MoIT is developing specific capacity building programmes to support and expand the pool of local expertise for various areas where VNEEP II are focused;
 - Component 3: Enforcement of Minimum Energy Performance Standards (MEPS) and Labelling. MoIT is supporting implementation of MEPS development for specific energy consuming products according to the Law on Energy Efficiency and Conservation. In addition, the MoIT will also coordinate with MoST on the periodic review of equipment and appliances to be included in national EE promotion programmes, and with MoC on the enforcement of the Building Energy Code and effective engagement of the building and construction industry on EE programmes;

- Component 4: Specific improvements in selected sectors. MoIT is providing technical support to enable local manufacturers of various EE equipment and appliances to possibly reduce the costs to the Vietnamese consumer;
- Component 5: Improvement on implementation of EE&EC programs. This would include awareness raising programs supported by MoIT on the financial viability of EE&EC programmes; and
- Component 6: Improvement of energy data collection and MRV protocols. MoIT is responsible for evaluating the capacities of various organizations to EE, and delegating lead roles to those organizations qualified for M&E roles for EE initiatives. In addition, MoIT is implementing detailed plans for the collection of data on end-use energy usage from the residential sector.

23. UNDP Viet Nam project “Strengthening capacity on climate change initiatives in the industry and trade sectors” (CCIT) aims to strengthen the capacity of policy makers and stakeholders in the industry sector to reduce GHG emissions, and remove barriers that are restricting industrial enterprises from adopting technologies to improve resource efficiency and productivity. With a budget of US\$ 2.9 million the project is being implemented from January 2013 – December 2016. Key activities that are considered as baseline to the Project include:

- Quantification of GHG emission reduction potentials and energy savings from identified climate change mitigation actions such as the use of energy efficient lamps particularly LED lighting devices in the industry and trade sectors;
- Development of data collection framework and methodologies for estimating GHG emission reductions for specific climate change mitigation options (e.g., utilization of EE lighting) that will be initially piloted in specific industry sectors, but are also applicable to other industry sub-sectors such as the lighting products manufacturing industry;
- Development of policies and institutional mechanisms for the promotion of market reform to enable involvement of the private sector and service providers in low carbon development of the industry sector;
- Capacity development of staff within MOIT at both national and provincial levels, energy efficiency conservation centers, auditors and enterprise managers through development and delivery of training packages on development, implementation and monitoring of climate change policies, development and implementation of mitigation action plans, GHG emission reduction potential assessment, energy audits and MRV.

Policies, Directives and Institutional Arrangements

24. The promotion and production of locally-produced LED lighting products falls under the following government policies and strategies:

- The Second National Communications for Viet Nam (SNC, December 2010) mentions the importance of GHG mitigation options for energy efficiency in lighting in the residential sector and public lighting, and also the need for “deployment of additional environmentally sound technologies to develop a low-carbon economy” that includes LED lighting technology²¹;

²¹ The SNC Viet Nam also acknowledges the continued use of old and outdated technology, and the high priority needed for advancing energy efficiency and conservation. With lighting technology listed as one of the applications of new environmentally sound technologies under “energy use”, the SNC identifies the need for their deployment through more investment and technical experts.

- The Law on Environmental Protection²² calls for prioritizing scientific research, technology transfer and application of technological advances, high and eco-friendly technologies. LED lighting products would be included under environmentally-friendly technologies.
- Decision No. 1874/2010/QĐ-CP on approving the Strategic Direction on Viet Nam Urban Lighting Development up to 2025²³;
- National Green Growth Strategy for the period 2011-2020 with a vision to 2050 was approved by Prime Minister on September 25, 2012 at Decision No.1393/2012/ QĐ-TTĐ with specific objectives of the Strategy that includes conducting research and enhancing application of appropriate advanced technologies to reduce GHG emission intensity and to contribute to an effective response to climate change that would include LED lighting technologies;
- National Action Plan on the Green Growth (2014-2020) approved by the Prime Minister on March 20, 2014 at Decision No. 403/2014/QĐ-TTĐ especially Activity 13 refers to minimum energy efficiency standards and energy labeling for products; and Activity 12 refer to the development of energy efficient and savings technologies and techniques; and Activity 16 calls for support and encouragement of R&D for and investment in application of green technologies.
- The National Targeted Program on Response to Climate Change was approved by Prime Minister at Decision No158/2008/QĐ-TTĐ dated 2 December 2008 with strategic objectives and tasks for development of technologies to mitigate GHG emissions and for promotion of international cooperation in scientific and technological activities, effective application and transfer of climate friendly technologies.
- The Law on Energy Efficiency and Conservation (1 January 2011);
- Circular No. 08/2006/TT-BCN (16 November 2006) issued by MoIT regulates process and procedures of EC&EE labelling. The Circular details lighting products to be labelled, the testing agency to grant certification and standards as a basis for evaluating energy-saving products. The Circular is also being constantly revised to update its contents with best international practice, and recently completed evaluations and testing;
- Decision 51/2011/QĐ-TTĐ on approval of a list of mandatory labeling equipment, MEPS and roadmap. This includes the prohibiting of the importation, production, and circulation of tungsten light bulbs with the capacity higher than 60W;
- Decision 68/2011/QĐ-TTĐ (12 December 2011) on a list of means and energy efficiency equipment to be procured by units, organizations using state budget;
- Circular 07/2012/TT-BCT (4 April 2012) guiding procedures for registration, evaluation, certification, suspension of certificates, nomination for conducting test and energy labelling for vehicle and appliances under obligatory energy labelling list issued by the Prime Minister or other voluntary energy labelling.

²² Promulgated in 1993, updated by the National Assembly on 23 June 2014 at the Decision No.55/2014/QH13, and effective from 1 January 2015

²³ Objectives of the Strategic Direction for the lighting sector are by 2015: a) For big cities (Category I), lighting for 100% length of streets and alleys (street width >2m); b) For middle cities/towns (Categories II and III), lighting for 95% - 100% length of main streets, 80% - 85% length of small streets, and 70% – 75% length of alleys; c) For small towns (Categories IV and V), lighting for 80% - 85% length of streets and 60 – 65% length of alleys; d) 100% of products used for lighting new streets, public areas and advertising lighting are energy efficient; e) Use of advanced dimming, remote control equipment and renewable energy (solar, wind) for these lighting systems; and f) By 2025, 100% of products used for public lighting are energy efficient and > 30% of public lighting projects will use solar energy.

While the GoV plans to include LED lighting technologies within the “Strategic Direction on Viet Nam Urban Lighting Development up to 2025” under VNEEP II, *it has been unable to do so due to its lack of specific information on how the LED lighting technology industry will scale-up its activities. This lack of specific information is related to barriers related to a lack of specific knowledge on scaled-up LED lamp production.*

25. With Viet Nam being an associate member of the IEC, STAMEQ (under MoST) has oversight in the process of adopting IEC standards. They have developed test method standards for lighting fixtures including CFLs, fluorescent ballasts and lamps, and ICLs. They have also developed 3 voluntary TCVN standards for LED lamps (one on performance requirements, and two on safety specifications for LED modules and self-ballasted LED lamps) as follows:

- **TCVN 8783:2011:** Self-ballasted LED lamps for general lighting services - Performance requirements. Reference standard: IEC/PAS 62612:2009; Year Published: 2011; Year Effective: Voluntary base;
- **TCVN 8782:2011:** Self-ballasted LED-lamps for general lighting services by voltage > 50V; Safety specifications; Reference standard: IEC 62560:2011; Year Published: 2011; Year Effective: Voluntary base;
- **TCVN 8781:2011:** LED modules for general lighting - Safety specifications Reference standard: IEC 62031:2008; Year Published: 2011; Year Effective: Voluntary base.

Under initiatives of VNEEP II (Component 3) to support enforcement of MEPS, STAMEQ has ongoing efforts to upgrade testing method standards for LED lamps and their components to mandatory standards²⁴. *Current efforts by STAMEQ in this regard, however, are stagnant, hampered by the lack of knowledge of international standards on testing methods and the equipment required for implementing these tests.*

26. The "Viet Nam Energy Star" was adopted as the official label applied by MoIT for energy efficient products under Component 3 of VNEEP II²⁵; the EECO under MoIT serves as the focal point for certifying products and manage labelling²⁶ under which they devised a mechanism for post-labelling inspection and supervision where:

- Energy-certified businesses will be required to send statistics on their energy-labelled products to MoIT;
- The Market Management Department of MoIT will conduct regular inspections of energy-labelled products available on the market; and

²⁴ STAMEQ has oversight of these regulations and the Bureau of Accreditation (BoA) under MoST provide approvals for testing laboratory accreditation under VILAS system standards, IECEE schemes systems (to test energy using products as a basis for the certification of energy saving product) or accreditation bodies which have signed mutual recognition agreements (ILAC and APLAC). The BoA provides VILAS to the accredited testing labs. The IECEE is the international organization providing international accreditation. Presently, in Vietnam there are no national testing labs with international accreditation

²⁵ A comparative energy label must contain: a) a Certification Code issued by MoIT; b) Name/code of product as registered by the business and issued by MoIT in the certificate of energy saving product; c) Manufacturer: The name of the organization / enterprise producing the product and registering for energy labelling; d) The name of the organization/enterprise importing the energy labelled product if applicable; e) Information on energy performance level parameters (corresponding to 5 levels on the number of stars on the label as determined by MoIT through evaluating the testing results of EE of the product shown in the Certificate; f) Energy consumption level of the product in kWh per year; and g) Other information.

²⁶ This EE office of MoIT was also supported by the GEF Project “Barrier removal to the cost-effective development and implementation of energy efficiency standards and labelling” (BRESL)

- All electronic appliances will fall under a mandatory MEPS by 2015.

To support the increased use of LED lighting products in Viet Nam as mandated under VNEEP II, EECO has plans for labelling LED products produced in Viet Nam under this mechanism. *These plans, however, cannot be developed until the STAMEQ sets mandatory standards for LED lighting products and when an LED production line is operational producing LED lamps of consistent quality that meets international standards.*

27. The standard for the use of energy efficient lighting in buildings falls under the Construction Standard on Energy Efficiency Building Code (EEBC) numbered QCXDVN 09:2013 issued under decision number QCVN 09:2013/BXD by MoC. The standard applies to new buildings or buildings greater than 2500m². The building code sets design requirements for outside layers, ventilation, lighting, energy consumption, water heating, and outlines how to calculate energy efficiency for the entire building. The code, however, does not include the use of LEDs. MoIT and MoC are coordinating efforts under Component 3 of VNEEP II to include specific guidelines of the use of LED lighting products in the Code. Their efforts, however, are insufficient in terms of defining the technical specifications on where the LED lighting products are used in buildings and within the public realm that guarantees economical and efficient use of energy. This effort will not be complete until more LED lighting products are locally developed for sale in Viet Nam.

Institutional Capacity for Testing

28. In Viet Nam, institutional capacity for testing lighting products exists in the facilities of research, product quality inspection and production including:
- Research facilities in the Institute of OSH Viet Nam, Viet Nam Academy of Science and Technology, and Hanoi University of Technology;
 - Product quality inspection facilities at Test Laboratories for Quatest 1, 2 and 3 that are located in the North, Central and South regions of Viet Nam respectively; and
 - Production facilities at JSC Thermos Bulbs Rang Dong (Ha Noi), Dien Quang Company (Ho Chi Minh City), and Philips Company (Ho Chi Minh City).
29. The Quatest Laboratories are the largest and best known nationally accredited product testing laboratories in Viet Nam that were developed under the Directorate for Standards, Metrology and Quality Control under MoST. Prior to any product being sold on the market, the seller, distributor or producer of the product is obligated to obtain certification of compliance to national standards from Quatest. The capacity of the Quatest laboratories, however, is limited due to personnel shortages, lack of specific testing equipment and shortage of space in their facilities. For LEDs, Quatest have the capacity to test some LED specifications related to safety, performance and efficacy. However, they do not have the equipment for other testing for electrical compliance, energy performance and photometry, and can only test LED bulbs and LED tubes. As such, LED producers would need to send their products to other laboratories, often foreign testing labs at higher cost. *In support of strengthening MEPS and labelling under Component 3 of VNEEP II, MoIT in coordination with MoST plans to upgrade the capacity of the QUATEST laboratories for testing all locally manufactured LED lighting products.* They are constrained, however, by a lack of confidence on the testing equipment to be procured.

Ongoing LED Promotion Initiatives

30. The National Program on Technology Innovation up to 2020 was approved by the Prime Minister in May 2011 to focus on the development and implementation of a road map for enhancing national technology capacity, applied research in manufacturing of advanced technologies, promoting key national products, and supporting SMEs to develop innovative technologies. LED lighting technology constitutes one of the key advanced technologies under this program. A “National Fund for Technology Innovation” established in August 2011 under this Program²⁷. In 2013, a project proposal “Study and Development of LED technology roadmap” was shortlisted along with 16 other proposals for funding and project development²⁸. Two GEF-funded projects have provided the foundation and spirit behind this Fund: the Viet Nam Energy Efficient Public Lighting (VEEPL) project (closed in 2011), and the UNEP-supported project on “Phasing out Incandescent Lamps through Lighting Market Transformation in Viet Nam” (to be completed in 2014).
31. The National Program on High Technology Development up to 2020 was approved by the Prime Minister in 2010 to focus on R&D for development of advanced technologies, manufacturing of products, formation of enterprises and development of high technology industries (such as the opto-electronic devices technology industry that is linked to LED production). Phase 1 of the program runs from 2011-2015, while Phase 2 will extend from 2016-2020.
32. There is also an on-going USD 7 million project with the Hanoi Department of Science and Technology (DoST) with objectives of producing indoor 8-40W LED lamps and outdoor 150W LED lamps. They have procured equipment for 8 production chains at different stages of LED lamp production, namely: LED package chain from blue dies; aluminium printed board production chain; SMD soldering production chain; heat sink production chain; electronic driver production chain; optical component production chain; and two assembly chains. The Hanoi DoST have also been receiving technical assistance from the Japanese equipment suppliers that may possibly end in 2014. The Hanoi DoST are in negotiation with a number of Vietnamese-based LED lamp manufacturers to supply locally-produced LED packages which has some potential to decrease the cost of locally produced LEDs; the agreement between the Hanoi DoST and the local LED lamp manufacturers is pending resolution of quality issues of products from the Hanoi DoST facilities.
33. The State also has a number of ongoing projects and programs on LED production including:
- "Research, design and fabricate the energy saving and intelligent lighting system using LEDs and solar cells" under KC.05.07/11-15 State Science and Technology Program that is being implemented for the period of 2011-2015. This project is developing solar cells as well as a lighting system using LED lamp modules;
 - "Research and development of LED lighting technology for Tay Nguyen's Agriculture Sector" that is being implemented by HTD under the State's Tay Nguyen - 3 Program (VND 6.4 Bill) that is being implemented during January 2013- December 2015 period to research and develop LED lighting technology for application in agriculture for Tay Nguyen region.

²⁷ Prof. Hoang van Phong, a former minister of MoST, is the president of this Fund that is valued at USD 50 million to provide loans at concessionary interest rates and act as a guarantor for individuals and enterprises to research, transfer, innovate and improve technologies, including LED lamp manufacturing technology. The fund is replenished annually through the State budget.

²⁸ As of June 2013, this proposal has still not received approval

34. VAST are currently planning a number of indoor and outdoor lighting demonstrations as a part of Component 5 under VNEEP II. Through the planned use of locally made LED lamps over the next 2 to 4 years, these demonstrations will boost confidence of local consumers in the LED lighting products from local LED manufacturers.

Current local LED manufacturer initiatives to scale-up LED Production

35. There are more than eight lighting manufacturers in Viet Nam who are already assembling LED lamps for sale within the country. Out of these lighting manufacturers, Ralaco²⁹ in Hanoi and Dien Quang³⁰ in HCMC produce more than 90% of the LED lamps in Viet Nam that are sold mainly to foreign-owned companies with building assets in Viet Nam. For these companies, LED lamp manufacturing comprises less than 5% of their overall sales of lighting devices to the Vietnamese market. This is due to their limited capacity consisting of “printed circuit board (PCB) assembly” (based on surface mounted technology) and an LED lamp assembly line using imported LED packages, LED drivers, LED heat sinks and other components. As such, the capacities and expertise of most of these companies for LED lamp production are limited to the importation of various LED lamps components from different countries and assembling them for sale³¹.
36. Ralaco and Dien Quang have stated their intentions of increasing their sales of LED lamps to the Vietnamese lighting market through committing investment plans for LED manufacturing infrastructure development and technology transfer in the order of USD 4 million each during the 2013-2017 period³². To realize this goal, they have also made modest investments into their own research and development (R&D) facilities, staffed with local lighting experts. Their current research includes design of new LED lighting devices for various indoor and outdoor usages. This, however, has not resulted in increased domestic sales of LED lighting products due to the lack of national LED standards and the lack of access to formal training on LED lamp design and manufacturing activities.
37. For these manufacturers, implementing these investments in scaling up LED lamp production has been difficult without foreign strategic alliances to provide the design and technical assistance on the equipment configurations for scaled-up LED lamp production. *Without specific assistance from VNEEP II and despite their own numerous attempts to secure foreign technical assistance related to LED lamp manufacturing, these manufacturers are still experiencing difficulties in securing their services to advise them on how to approach these investments* that may include the processes within the red enclosure on Figure 2 including:
- LED driver production technology which the manufacturers can design and assemble themselves;
 - Design and control of spare parts such as the PCB and heat sink for which the manufacturers need a guideline on heat management design for LED lamps produced by their facilities;

²⁹ www.rangdongvn.com

³⁰ www.dienquang.com

³¹ Their limited capacity consists of PCB fabrication (based on surface mounted technology) and an LED lamp assembly line using imported parts

³² For Ralaco, the additional investment was justified with the 2013 sale of LED lamps around USD 2.5 million comprising 2.5% of total sales of all lamps. The 1,300,000 LEDs sold in 2013 was a three-fold increase in the number of LEDs sold in 2012.

- LED packaging manufacturing that is dominated by G7 countries as well as Taiwan, Korea and China and comprises 65% of the manufacturing costs of an LED light. One of the large lighting manufacturers in Viet Nam has expressed interest in an investment and technology transfer for this equipment in Viet Nam to be supplied from either the Nihon Garter or JTU Company of Japan.

Further details of other LED manufacturing equipment of interest to Vietnamese-based LED lighting manufacturers can be found in Annex IV.

38. Under the baseline scenario, future demand for LED lamps in Viet Nam is expected to remain suppressed due to the barriers and aforementioned constraints. Moreover, the lighting market will likely be dominated by CFLs, T8 TFLs and HIDs as the main types of EE lamp used in Viet Nam. The LED market share in 2020 will be 5% for LED bulb and 3.3% for LED tubes. A recent report by UNEP-GEF “en.lighten” on Efficient Lighting in Southeast Asia assesses Viet Nam’s relative readiness to transition to efficient lighting as only “moderate.” CFLs would likely continue to represent the main type of EE lamp used in Viet Nam due to:

- The limited design and manufacturing capacity in Viet Nam for LED lamps;
- Prevailing quality concerns with the LED lamps available in the Vietnamese market; and,
- The technology transfer disconnect between State-run LED demonstrations and research projects and private sector LED lamp manufacturers.

As a consequence, the share of LED lamps in the lighting market would likely remain below 10%. If only the baseline projects are implemented and the current situation (with the aforementioned barriers still present) persists, there will be no growth in the local manufacture of LED lamps and GHG emissions from the lighting demands in Viet Nam will more than triple by 2030.

STRATEGY

Project Rationale and Policy Conformity

39. The proposed Project is consistent with the first objective of climate change mitigation strategy for GEF to promote the demonstration, deployment, and transfer of innovative low-carbon technologies that focuses on innovative, emerging low-carbon technologies at the stage of market demonstration or commercialization where technology push is still critical. The Project will also contribute to the achievement of the objectives laid out by the Poznan Strategic Program on Technology Transfer as well as GEF’s core objective of reducing GHG emissions at the global level. It will identify and help to remove barriers that restrict Viet Nam’s ability to develop highly energy efficient LED-based lighting technology for general indoor and outdoor lighting purposes using local resources and expertise and international partnerships.
40. This Project responds to one of the Government’s priority projects identified under the National Portfolio Formulation Exercise (NPFE). Moreover, Viet Nam’s Second National Communication (SNC) to the UNFCCC underscores the need for the adoption of environmentally sound technologies and the need for capacity building in technology development and transfer.

41. The Project is also fully consistent with the Technical Needs Assessment (TNA) under the country's SNC, which highlights the significant energy saving potential in the lighting sector:
- The National Climate Change Strategy (NCCS) as per Decision No. 2139/QD-TTg dated 05 December 2011 of the Prime Minister calls for research, development and adoption of energy-efficient equipment and products contributing to greenhouse gas (GHG) emission reduction;
 - The need for technology transfer is reflected in the Law on Technology Transfer No. 80/2006/QH11 dated 29 November 2006 prioritizing technology development and transfer, including the transfer of energy efficient and environmentally friendly technologies; and
 - The Law on Intellectual Property No. 50/2005/QH11 dated 21 November 2005 also calls for the implementation of technology transfer activities and ensure the right of intellectual property in technology transfer activities.

Country Ownership: Country Eligibility

42. The GoV ratified the UN Framework Convention on Climate Change on 12 May 1994. The Second National Communication (SNC) issued in 2010 articulates the importance of Viet Nam's actions towards addressing climate change, and actions towards climate change mitigation that includes the need for environmentally sound technologies for a low carbon economy. This includes the use of high efficiency technologies such as LED lamps.

Country Drivenness

43. Viet Nam's drivenness for this Project is reflected in its policies and strategies as described in Paras 22 to 26 that includes the Law on Energy Efficiency and Conservation (in effect from 1 Jan 2011), and the National Targeted Energy Efficiency Program for the period 2006 to 2015 under VNEEP (Decision 79/2007/QD-TTg, 14 April 2006). In addition, the following decisions further demonstrate the Government's resolve to promote LEDs to further increase its energy efficiency:
- QCVN 09:2013/BXD - "Energy Efficiency Building Code" which was enacted by the MoC under Circular 15 /2013/TT-BXD, dated on September 26, 2013 that applies to new buildings or buildings greater than 2500 m². The building code sets amongst other design requirements, indoor and outdoor lighting systems (Part 2) to regulate the maximum limit of the consumption power for lighting systems as well as regulate the limit of allowed performance for the common lighting equipment (lamps and ballasts). Energy efficient lighting system is also defined as the system with good illumination, flexibility, and less energy consumption;
 - The Law on Technology Transfer as under Decision No 80/2006/QH11 (dated November 29, 2011) that provides for the transfer of technologies in Viet Nam, from Viet Nam to abroad and from abroad into Viet Nam. This includes LED technologies, classified as a "high or advanced technology" that creates new products of high competitiveness and saves energy;
 - The Law on High Technology was approved under Decision No 21/2008/QH12 (dated November 13, 2008) that provides for hi-tech activities and policies and measures to encourage and promote hi-tech activities. This would include LED technologies;

- The “National Program on Technology Innovation up to 2020” was approved by the Prime Minister under Decision No667/QD-TTG (dated 10 May 2011). The program was designed to apply research of advanced technologies in the manufacturing of key products, targeted products, national products where LED products can be included;
- Decision No49/2010/QD-TTG promulgated by Prime Minister on July 19, 2010 provides an approved “List of High Technologies” prioritized for development investment and development promotion. This List included LED lighting technology investment under the group #33:“Opto-electronic and photonic material and component technology”, and for LED lighting development promotion under the group #60 “Opto-electronic and photonic materials for telecommunications, automation, robot, high-definition flat-panel displays and energy-saving high-efficiency lighting”;
- Decision No1874/2010/QD-TTG on approval of orientation of urban lighting development up to 2025 (promulgated on 11 October 2010) that amongst other requirements, specifies the use of LEDs and solar energy for urban lighting at a rate of 30 to 50% of new buildings and other infrastructure;
- Government Decree No79/2009/ND-CP on Urban Lighting Management (promulgated on September 28, 2009) that clearly specifies the use of EE&C certified or EE labelled lighting sources and lighting devices for public infrastructure assets.

Alternative Scenario

44. Under an alternative scenario with GEF support, the aforementioned barriers would be reduced. On the supply side, the Project will lay the groundwork for a supportive policy environment that will catalyse investment and development of a solid manufacturing base to sustain sales of locally produced LED lamps, and stimulate subsequent investments in this sector.
45. Further improvements on the supply side are envisaged with the Project providing assistance to improve local technical capacity and technology at Vietnamese-based LED lamp manufacturing companies, their respective R&D centers and their technical service providers³³. This will assist in achieving the development and sustained supply of locally produced LED lamps to an international standard and maximum usage of LED lamps for lighting in Viet Nam. Personnel from the R&D centers and local lighting manufacturers will be trained on all aspects of LED lamps design and production respectively, thus strengthening their capability to sustain production of locally produced LED lamps. In addition, the knowledge of technical service providers with all aspects of LED lighting systems will improve their services in the installation of LED lighting systems.
46. On the demand side, the Project will support activities to enhance public awareness on the quality and benefits of LED lamps to boost their confidence on increased usage of LED lamps. This will increase the likelihood of LED lamp usage amongst more owners of commercial, existing residential buildings, new buildings and manufacturing facilities who will be aware of the proven benefits from the longer life and energy savings of LED lamps. Project activities will strengthen the relevant Government agencies in promoting LED

³³ The lighting sector in Vietnam comprises of enterprises that manufacture, supply, distribute, and retail lighting system products and devices for both indoor applications in residential, commercial and public buildings and outdoor applications such as street lighting. There are also technical service providers for the design, installation, repair and maintenance of lighting systems.

lighting product development that would encourage local private sector lighting companies to increase their investments in advanced LED lamp production technology.

47. This enhanced capacity along with quality standards and successful demonstrations and enhanced public awareness of LED lamps will catalyze a transformation in the lighting market through increased availability of high quality LED lamps at a competitive cost. As the market develops and economies of scale are reached, the cost of LED lamps are expected to come down, which should increase demand for LED lighting products. The extent of growth of demand for LED lamps will, however, be largely dependent on the price of electricity; a rise in electricity tariffs in Viet Nam will result in increased demand for LED lamps. Viet Nam already has one of the lowest prices for commercial or household electricity in the ASEAN Region.
48. This Project will strategically build upon VNEEP and the other national programs, as well as the results of the two GEF lighting initiatives to promote LED lighting technology and catalyze LED demand on the Vietnamese lighting market. The UNEP-GEF project on “Phasing out Incandescent Lamps through Lighting Market Transformation in Viet Nam”, which focuses primarily on the introduction of CFLs, offers a good model on how to improve the quality of energy saving lamps. Due to the quality standards and other measures introduced, the quality of CFLs in Viet Nam has improved considerably in recent years as evidenced by the improvements in the average lifetime of CFLs in Viet Nam being less than 4,000 hours in 2006 but now exceeding 6,000 hours. This Project will build upon that success and apply a similar approach to the LED lamp market. With the objective of this GEF Project to mitigate GHG emissions through transformation of the lighting market towards greater usage of locally produced LED lighting products in Viet Nam, all Project activities will be aimed towards this objective and the development of a local sustainable LED manufacturing industry.

Project Objective, Outcomes and Output/Activities

49. The objective of this proposed Project is *to mitigate GHG emissions through transformation of the lighting market towards greater usage of locally produced LED lighting products in Viet Nam*. To achieve this objective, the Project will comprise of two components: (1) Transfer of skills, knowledge, and technology in support of local LED lamp manufacturing, and (2) Demonstration of cost-effective local commercial production of LED lighting devices.
50. **Component 1: Transfer of skills, knowledge, and technology in support of local LED lamp manufacturing:** This component addresses the absence of supporting LED lamp standards and regulations, insufficient professional expertise and technical skills to support the enforcement of new LED lamp standards and regulations, insufficient capacity of testing and R&D facilities, and insufficient local knowledge to implement scaled-up local production of LED lamps. This component is on developing supportive policy and regulatory measures to improve the quality and promote the adoption of LED lamp technologies *and lead to an expected outcome of a local LED lamp industry that provides locally produced quality LED lamps that are increasingly in demand by local consumers*. This outcome will be achieved through the delivery of the following outputs:
 - Output 1.1: Completed biennial reviews of national roadmap for LED lighting development. The MoIT through the baseline project VNEEP II is formulating the roadmaps for various components of VNEEP that articulates how sector-based EE goals

are integrated and contribute to national socio-economic goals. In its efforts to include LED lamps in the “*Strategic Direction on Viet Nam Urban Lighting Development up to 2025*”, GEF resources are required to assist MoIT with the following incremental activities:

- Review of the results of the LED market surveys (from Output 2.3) to compare the implementation of the roadmap of the previous year, and revise the roadmap for LED market transformation. The review meetings would include a wide range of stakeholders involved with the supply of LED components, LED assembly and manufacture, LED distribution and sales, policy making and raising public awareness;
 - Setting targets for LED market penetration based on information in the national roadmap for LEDs;
- *Output 1.2: Improved LED lighting standards that meet international norms.* To augment ongoing and planned STAMEQ efforts under the MoIT administered Component 3 of VNEEP II to upgrade testing method standards for LED lamps and their components to mandatory standards, *incremental GEF assistance for the following activities:*
- Develop two national standards (TCVN) on (i) Approved method for electrical & photometric measurements of solid state lighting products; and (ii) Approved method for measuring lumen maintenance of LED light sources that refer to IES LM-79-08³⁴ and IES LM-80-08³⁵. This will also involve translation of the IES LM-79-08 & IES LM-80-08 codes into Vietnamese, and the formulation of a new TCVN technical code for lighting where the technical specifications on lighting products including LED lights towards energy efficiency, and service life are defined with planned enforcement actions. These will be developed and promulgated by MoST;
 - Conduct workshops to discuss the contents of the new TCVN standards and plans for promulgation and enforcement of the new standards. The workshops involve critical review of the new standards to ensure appropriateness and compliance with international standards for new LED lighting products made in Viet Nam. This would include an assessment of clauses linked to heat dissipation for indoor and outdoor LED lamps that can adapt to temperatures of up to 40°C and high humidity typically associated with a tropical climate, particularly under a warming climatic scenario. The discussion will strengthen standards to define the required heat sink and electrical driver components of LED lamps and automatic assembly and packaging technologies for 8-40W LED indoor lamps and 110-160W outdoor lamps. Such standards will be related to international standards for performance, health and safety and will contribute to increased confidence of existing LED manufacturers and suppliers in an automated LED lamps production line;

³⁴ IES LM-79-08, Approved Method for the Electrical and Photometric Testing of Solid State Lighting Devices, enables the calculation of LED luminaire efficacy (net light output from the luminaire divided by the input power and measured in lumens per watt). Luminaire efficacy is the most reliable way to measure LED product performance, measuring luminaire performance as a whole instead of relying on traditional methods that separate lamp ratings and fixture efficiency. LM-79 helps establish a foundation for accurate comparisons of luminaire performance, not only for solid state lighting, but for all sources

³⁵ IES LM-80-08, Approved Method for Measuring Lumen Depreciation of LED Light Sources, defines a method of testing lamp depreciation. LED packages, like most light sources, fade over time, which is referred to as lumen depreciation. However, because LED packages have a long lifetime in the conventional sense, they may become unusable long before they actually fail, so it is important to have a sense of this mode of failure. LM-80 establishes a standard method for testing LED lumen depreciation. Note that LED source depreciation to a particular level of light, should not be construed as a measure of lifetime for luminaires, however, as other failure modes also exist which can, and in most cases will, shorten that lifetime

- Develop a TCVN standard on the energy performance of LED lighting products. This standard will be used as the basis for the standards and labeling program under MoIT and under Output 1.4;
- Output 1.3: Training workshops to strengthen LED lamp testing and enforcement regime. As a part of the GoV's drive for energy efficient lighting, MoST has plans to enhance the capacity of the QUATEST laboratories for testing all locally manufactured LED lighting products. In addition, UNDP's CCIT project plans to enhance the capacity of MOIT staff both at the national and provincial levels on survey, monitoring and evaluation of implementation of climate change related actions and policies. To catalyze these baseline efforts, *incremental GEF assistance is required for the following activities:*
 - Identification of new QUATEST equipment required to meet new testing protocols for LEDs (from Output 1.2)³⁶. This may include the use of "accelerated lifetime testing system LATS-90", which would compress the testing of "10,000 hour service life" of the LED to a shorter period;
 - Conduct of training on new testing protocols for LEDs involving 15 officers from QUATEST and various other testing centers that are public and private sector in Viet Nam. The training will likely span the entire Project period as it is expected that testing protocols will change with new LED products entering the market;
 - Capacity building for an enforcement regime with MoIT that requires LED suppliers to meet minimum testing requirements for LED lighting products (including standards LM79-08 and LM 80-08). The new enforcement regime under MoIT oversight will provide testing certification for declared lifetimes of LED products to be sold on the Vietnamese market;
- Output 1.4: Labeled and certified LED lighting products. The baseline project by the EECO aspiring to *label LED lighting products under their Viet Nam Energy Star mechanism under Component 3 of VNEEP II will be catalyzed by incremental GEF assistance through the following activities:*
 - Preparation of plans to implement the certification and labeling of LED lamps that as a minimum provides minimum energy performance standards for each LED product. As such, this would include a listing of LED lighting products for compulsory labeling. This activity will utilize the ESL knowledge products from the GEF-supported BRESL Project;
 - Preparation of updated circulars on the latest LED lighting products to fall under certification and labeling regime;
 - Training of Market Management Department field officers for spot market inspections of LED lamp suppliers for labeled products for compliance to new standards.
- Output 1.5: Updated building codes that includes the use of LED lighting products. To assist in VNEEP II efforts under Component 3 to comply with MoC's Construction Standard on Energy Efficiency Building Code (EEBC), incremental GEF assistance is required to specify the use of LED lamps to comply with new LED lamp standards developed in Output 1.2, and regulations on public lighting, guaranteeing economical and efficient use of energy³⁷. The development and promulgation of one TCVN technical code on lighting by the MoC will involve defining technical specifications on how and where LED lighting products are used, their energy efficiencies and savings, and service life. In

³⁶ There is now capacity in Viet Nam to test LEDs for IES LM-79.

³⁷ From Provision 18 under the Law on Energy Efficiency and Conservation (EE&C) was approved by Viet Nam National Assembly at Decision No 50/2010/QH12 dated June 17, 2010.

addition, the use of LED lamps will be carried out to assist in the compliance to the revised “Energy Efficient Building Code” through a close working relationship with the UNDP-GEF project on “Energy Efficiency in High Rise Residential and Commercial Buildings”;

- Output 1.6: Completed capacity building program to strengthen LED R&D facilities. The local LED manufacturers have made modest investments into their own R&D facilities, staffed with local lighting experts. Their current research and development includes design of new LED lighting devices for various indoor and outdoor usages that meet new national standards and are cost-competitive. As part of UNDP’s CCIT project, training packages on development and implementation of climate change mitigation plans for manufacturing enterprises and energy audits will be developed. These baseline activities will be complemented and scope expanded through the following *incremental GEF assistance on R&D lighting technology professionals of Ralaco, DQ and other participating LED manufacturing companies*:
 - Enabling them to design LED based lighting products for general lighting use within the regulatory framework designed by the Project in Outputs 1.1 and 1.4. These training programs will also include lighting engineers, environmental engineers, climate change professionals, electricians, contractors, and suppliers to design, develop and implement training programs specifically tailored for LED lamp manufacturing activities;
 - Facilitating dialogue between themselves and national R&D centers of LED lighting products to ensure that R&D concepts are disseminated to the production level, and properly researched for design and possible pilot production for testing;

- Output 1.7: Engineering and construction designs for improved LED lighting production in Viet Nam. To strengthen ongoing efforts by Vietnamese-based LED manufacturers³⁸ to secure international technical assistance for scaled-up LED lamp manufacturing processes, *GEF assistance will be required to source international expertise on advanced knowledge on LED lamp manufacturing*³⁹, and for the delivery of this knowledge on the following specific topics to local LED manufacturers:
 - LED lamp product design (includes investment in software for LED lamp design). Details of the software for LED lamp design can be found in Annex III;
 - Driver design for high powered outdoor LED lighting products in tropical areas;
 - LED package manufacturing (for LED replacement lamps from processed wafers);
 - Review of raw material standards⁴⁰ and testing methods;
 - Identification of required equipment for improved LED lamp manufacturing process⁴¹;
 - International standards and certification for LED lighting products (includes accelerated age testing);

³⁸ Technical support to Ralaco and Dien Quang will likely be for indoor LED luminaires (8-40 W) and outdoor LED luminaires (35-160 W).

³⁹ Sourcing international expertise will be a difficult process given the ties of these experts to patented LED technologies and their limitations in disseminating all LED knowledge. It is possible that more than one LED expert may need to visit a certain LED lamp manufacturer to determine the optimum LED lamp manufacturing process for the company.

⁴⁰ This may include the minimization of the use of various metals that deemed hazardous waste under existing laws. Where these laws may be absent in Viet Nam, other legal jurisdictions such as US federal laws can be used.

⁴¹ This may include: (i) the use of surface-mount technology (SMT) manufacturing equipment to mount one or more LED packages onto a printed circuit board (PCB) to create the light source. SMT is a key element of the LED-based luminaire assembly process; and (ii) special lathe machine for fabrication Al heat sink, currently not available in Vietnam. This service could be outsourced to other factories that produce aluminium windows or frames.

- Anti-electrostatic assemble lines; and,
- Product testing, assessment and supply.

The direct technical support to these manufacturers will be through international consultants for a specific LED lamp manufacturer who will have specific technical issues on how to improve their LED lamp production lines and product quality. Technical assistance on the aforementioned topics will target the production line operators on process of fabrication of the LED package equipment. The TA will also result in informing local LED lamp manufacturers on the required equipment purchases that will upgrade their LED production line to produce more cost-competitive LED lamps in Viet Nam during Year 2 of the Project.

Delivery of these 7 outputs (along with support for LED lamp demonstrations under Component 2) will improve the supply side of the LED market that will facilitate market transformation of the LED lighting market in Viet Nam.

51. Component 2: Demonstration of cost-effective local commercial production of LED lighting devices – This component addresses barriers related to low public awareness about LED lighting product benefits. This will be achieved through demonstrations on the use of high quality LED lighting products manufactured in Viet Nam in a variety of applications from outdoor street and industrial lighting to indoor lighting for commercial and residential applications. With the ongoing efforts of VAST to identify planned lighting upgrades through its network of stakeholders, demonstrations to be implemented under this component will lead to an outcome of increased use and deployment of locally-produced high-quality LED lighting technologies. This outcome will be achieved through assisting VAST's current activities under Component 2 (Capacity building) and Component 5 (Public awareness) of VNEEP II with the delivery of the following outputs:

- Output 2.1: Completed feasibility studies of indoor and outdoor LED lighting demonstrations. VAST has plans to demonstrate the use of quality and locally manufactured LEDs in various indoor and outdoor applications. When the production of quality locally manufactured LED lamps commences, feasibility studies will need to be prepared for these demonstrations. This output involves the preparation and completion of feasibility studies for (i) a demonstration for over 4,000 locally produced LED lamps for indoor lighting at 3 locations (i.e. residential, commercial and industrial); (ii) a demonstration for over 400 locally produced LED lamps for outdoor lighting at 3 locations (i.e. street and alley lighting); and (iii) assistance to other property owners who want to convert their lighting systems, indoor or outdoor, to LED lamps. The studies will cover the current lighting devices and their energy consumption, the proposed LED lighting replacements, the compliance of the LED lamps to the regulatory framework developed under Component 1, the effort required to replace these lights and installation of control systems, the means of monitoring energy savings from the LED lamp replacements, estimates of expected energy savings and reductions of operational costs, and expected impact of the demonstrations to LED lamp sales in Viet Nam. GEF assistance is required for the necessary technical assistance in the finalization of the feasibility studies.
- Output 2.2: Completed LED lighting application demonstrations. On the basis of the details in the feasibility studies prepared by VAST in Output 2.1, the delivery of this output involves assistance in the setting up of demonstrations of locally produced LEDs

for various applications. With significant co-financing expected from local LED lamp manufacturers in the form of LED lamps that meet international standards, the LED lighting products that will be used in each demo will be installed. Specific demonstrations proposed for feasibility studies include:

- 2,049 LED lamps⁴² in the VAST residential complex in Hanoi where locally produced LEDs for indoor usage are to be procured from Dien Quang;
- 2,026 LED lamps⁴³ in the Nha Be garment factory located in HCMC where locally produced LED lamps for indoor industrial usage are procured from Dien Quang;
- 100 LED high bay lamps (150W) in Nha Anh Garment Company located in Hanoi with locally produced LEDs for indoor usage procured from Ralaco;
- 100 LED street lights (35W) along selected alleys in Hanoi and Da Nang with locally produced LEDs procured from Ralaco;
- 100 LED street lights (150W) in along a road approach in Quang Ninh province with locally produced LEDs for outdoor usage procured from VN Schreder;
- 200 LED street lights (100W) along streets at Hoa Lac High Tech Park in Hanoi with locally produced LEDs procured from VN Schreder.

GEF support is required to ensure quality controls during the procurement, set up and overall demonstration of LED lighting application.

- Output 2.3: Approved system for monitoring and evaluation of LED lighting systems. The MoIT is currently responsible for evaluating the capacities of various organizations to EE, and delegating lead roles to those organizations qualified for M&E roles for EE initiatives. In addition, it is formulating detailed plan for the collection of data on end-use energy usage from the residential sector. *To support the baseline efforts by MoIT to setup and utilize MRV systems under Component 6 of VNEEP II, incremental GEF support is required for the necessary TA to setup the assessment of energy savings and CO₂ emission reductions of demonstration systems as well as the estimating and reporting the benefits of LED lighting systems on improving lighting quality.* During the assessment, GHG data collection framework and quantification methodologies planned under the CCIT project will be utilized. Besides MRV needs assessments and training packages on assessment of GHG emissions, MRV and energy audits will contribute towards the delivery of this output. The information obtained from this assessment will be used for information and dissemination purposes. Activities to achieve this output include:
 - For public sector LED installations, Provincial-level People's Committees shall conduct the management and monitoring of energy savings in line with regulations on power saving in public lighting. Companies supplying LEDs for the demonstrations (such as Ralaco, Dien Quang and VN Schreder) will provide the necessary support for the monitoring and evaluation of energy consumption of these LED lamp demonstrations;
 - Setting up of GHG reduction reports for LED lamp deployment within the framework of EE&C Law (Chapter VIII)⁴⁴ and Decision No. 1775/QD-TTg dated November 21, 2012 of the Prime Minister approval of project on GHG emission

⁴² These would consist of LED tubelights: 33 – (2x18W), 196 – (3x9W), 17 – (2x12W); 288 – 8W square LED lamps; 170 – 5W LED downlights; 373 – 12W panel LED lamps; and 972 – 8W panel LED lamps.

⁴³ These would consist of 2,026 – (2x18W-T8) LED tubelights.

⁴⁴ MoIT is the focal point and will use these reports to inform the LED Awareness Raising Program under Output 2.4.

management, and management of carbon credit business activities to the world market⁴⁵;

- Conduct of LED lamp sales, consumer attitudes towards LED lamps, assessment of the LED lighting products manufacturer capacity, market development, and energy savings and GHG reductions resulting from LED lamp demonstrations from Output 2.2 and LED lamp sales. Two surveys will be done throughout the period of the Project⁴⁶ with the aim of sustaining this activity once every two years after the EOP;
 - Conduct of capacity building for a relevant NGO (such as the Viet Nam Lighting Association) to setup and conduct marketing surveys for LED lamp sales throughout Viet Nam in close collaboration with the EE Office of MoIT. This would include a survey at the EOP on the willingness of urban and rural households to purchase LEDs over other lighting products;
- Output 2.4: Completed LED lighting product applications awareness raising program.
This delivery of the output will entail the following activities:
 - Discussions on the effective dissemination of consumer information on LED lamp benefits that may include roles for ESCOs and service providers who are involved with LED lighting system installations;
 - Design of consumer messaging on LED lamp benefits that will include user benefits (i.e. reduced electricity bills, improved lighting quality, reduced power outages), national benefits (reduced dependence on imported fossil fuels) and global benefits (reduced GHG emissions and reduced risk of severe climate change);
 - Preparation of updated public awareness messages including websites, TV and radio spots and newspapers to promote and replicate LED lamp uptake.

GEF support is required for the necessary technical assistance to support EECO for the delivery of the awareness raising programme.

- Output 2.5: Completed workshops for disseminating lessons learned from LED lighting product application demonstrations. Incremental GEF assistance will be required to assist VAST in conducting national workshops with all relevant stakeholders to share the findings and lessons learned from the LED lamp demonstrations. The results of the demonstration can be used to:
 - Propose further actions to change policies, standards and regulations as well as target dates for the national LED roadmap;
 - Identify where capacity efforts should be made to increase LED lamp market penetration;
 - Propose new LED lighting product lines that will boost LED sales and provide further national energy savings; and,
 - Assist other building owners and municipal managers on procurement and installation of LED lamps⁴⁷.

52. Without these planned interventions, LED lamp market penetration will not be significant resulting in higher GHG emissions related to electricity consumption for meeting lighting

⁴⁵ MoNRE is the focal point of this Decision

⁴⁶ Once in Year 1 to obtain baseline data of LED usage, and once in Year 4 to evaluate the impact of the Project in transforming the LED lighting market.

⁴⁷ This will lead to direct post-project emission reductions. TA may be provided to other residential complexes similar to the VAST residential complex and factories and commercial establishments such as the Nha Be garment factory.

demands for Viet Nam. Figure 6 is a flowchart of how the Project will be implemented. Figure 7 is an indicative implementation schedule.

Figure 6: Project Flowchart

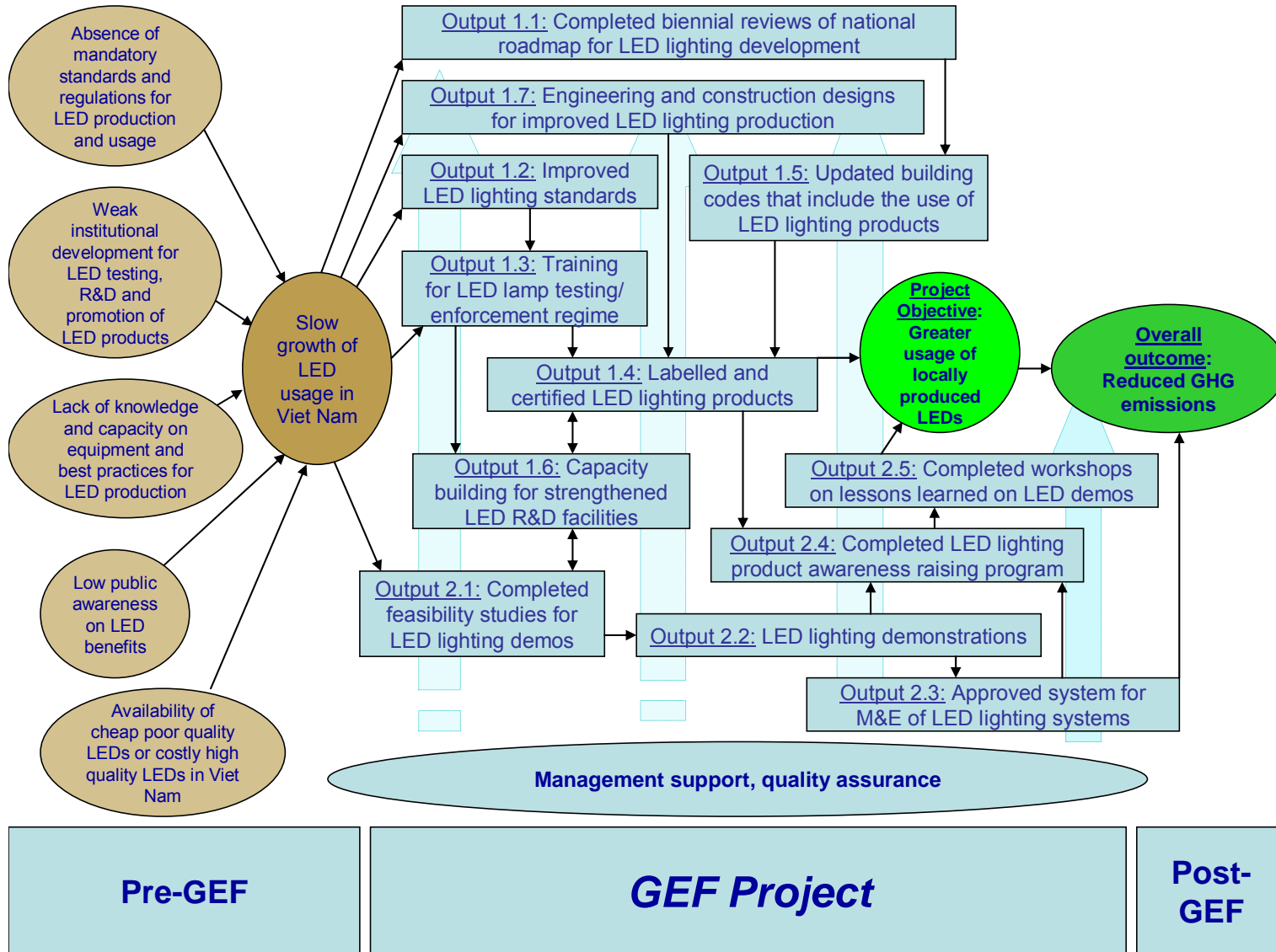
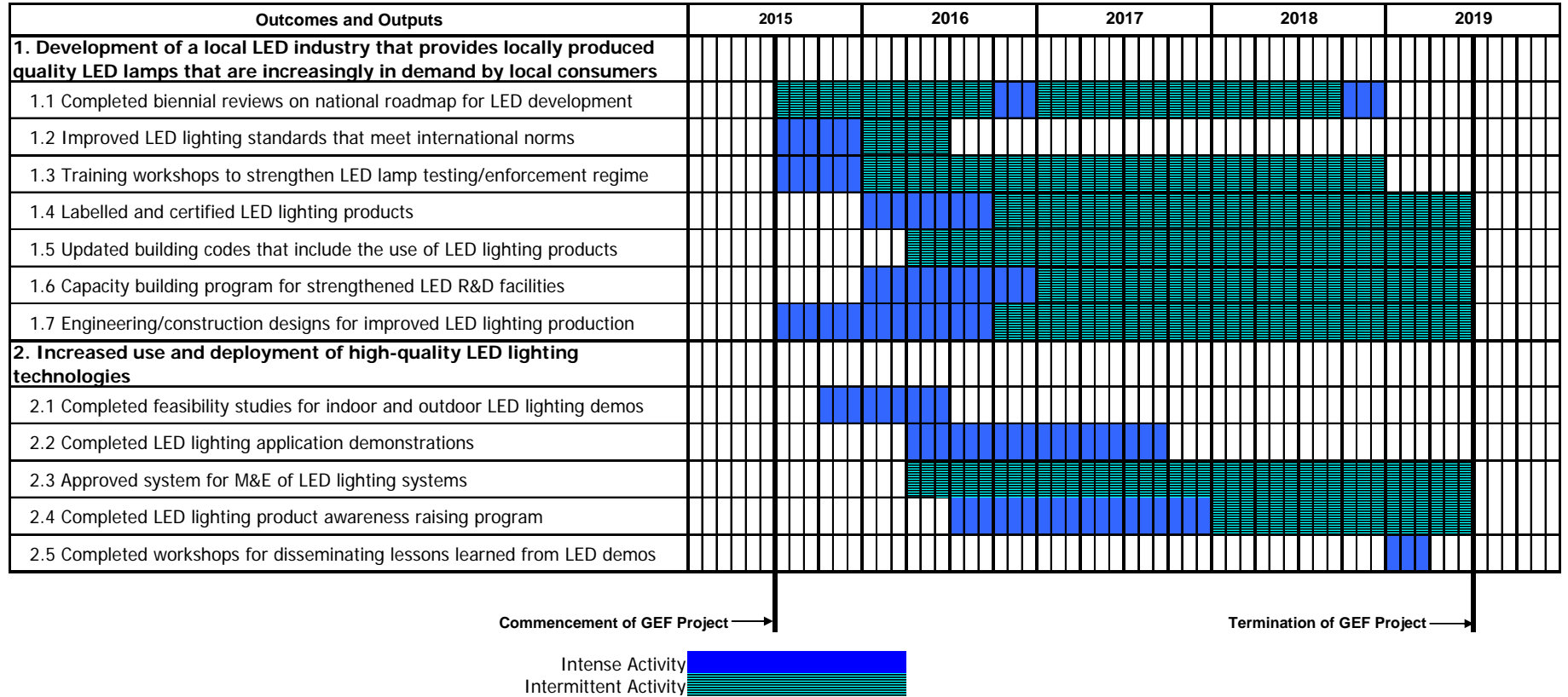


Figure 7: Indicative Implementation LED Project Schedule



Key Indicators, Risks and Assumptions

Indicators

53. The most direct impact of the proposed Project as it relates to core GEF objectives is the reduction in CO₂ emissions from the reduced electricity consumption from the increased use of LED lamps for indoor and outdoor lighting. The Project activities will result in energy savings and CO₂ emission reductions from development of a local LED lamp industry that provides locally produced quality LED lamps that are increasingly in demand by local consumers, and the increased use and deployment of locally-produced high-quality LED lighting technologies, compared to the baseline scenario where there is negligible growth in LED lamps. Based on the grid emission factor and an anticipated rate of deployment of LED lamps, the activities of the Project will result in:

- Direct cumulative CO_{2eq} emission reductions of 623 tonnes CO₂ from the demonstrations setup under Output 2.2;
- Cumulative direct post-project of 69.38 ktonnes CO₂ from LED lighting product applications that received technical assistance from the Project during the Project duration but implemented only after the EOP; and
- Indirect emission reductions of between 6 ktonnes CO_{2eq} (bottom-up)⁴⁸ and 5,154 ktonnes CO_{2eq} (top-down)⁴⁹ between 2019 and 2028, 10 years after the completion of the Project. Bottom-up indirect emission reductions will also be estimated from the results of the LED lamp marketing survey on increased sales of LED lamps prior to the EOP as a part of Output 2.3.

54. GEF support will be instrumental in transferring LED lamps manufacturing technology to Viet Nam and in developing a local LED lamps industry, which is currently limited to a few manufacturers that lack the required technical skills and expertise. GEF incremental activities are critical to lower the market barriers for the deployment of high-quality LED lighting products in the country. By putting in place quality standards and enabling policies, the Project will catalyze significantly enhanced product quality and greater consumer confidence, thus transforming the nascent LED lamps market in Viet Nam. Importantly, technical support will be provided to key market players including local manufacturers; their skills and capacities will be developed to sustain Project outcomes in the future. Finally, through the demonstration investments, the consumers awareness of the many advantages of LED lamps will be enhanced that would most importantly include energy savings and long service life. Without GEF support, it is unlikely that the introduction of high-quality LED lighting technology would happen in the short to medium term in Viet Nam.

Risks

55. Risks identified in the implementation of the Project are summarized in Table 3. Risks and countermeasures to identified risks are analyzed in detail in Annex I.

Assumptions

56. The main assumptions for this Project are the:

⁴⁸ Assumes a replication factor of 10 of which a replication factor of 3 is assumed during the Project period, and a factor of 7 for the period 10 years after EOP. The indirect ERs during the Project period will be measured by the market survey of Output 2.3

⁴⁹ Assumes a causality factor of 40%

- Economic recovery of Viet Nam continues that would ensure the capability of most households to afford the purchase of LED lighting devices;
- Continued strong government support for strengthening the current LED legal framework, regulations, standards and codes as well as providing an enabling environment for local lighting manufacturers to develop local LED lamp manufacturing facilities; and
- Willingness of local lighting manufacturers to fully invest in new LED lamp manufacturing equipment and to sell most LED lamps to the Vietnamese market to recover their investment.

Table 3: Summary of Project Risks

| Risk Description | Mitigation Measure | Level of Risk |
|--|--|----------------------|
| Political Risk | | |
| The government may shift program priorities unexpectedly, leading to a lack of committed resources for the development and implementation of LED lighting projects. This may include discontinued government support for strengthening the current LED legal framework, regulations, standards and codes as well as providing an enabling environment for local lighting manufacturers to develop local LED manufacturing facilities | This risk will be mitigated by engagement of government and other stakeholders to facilitate actions such as standards and labelling and testing programmes. Their commitment will be established and confirmed during project preparation and the inception phase. | Low |
| Technical Risk | | |
| Given support on technology transfer, the local manufacturers may still not be able to develop products that meet quality and performance levels set by local and international markets. This may result from a change of mind by local lighting manufacturers to fully invest in new LED lamp manufacturing equipment and/or to sell most LED lamps to the Vietnamese market to recover their investment | This risk will be managed by applying an integrated approach in technology transfer and exposing the largest Vietnamese lighting manufacturers to the latest technological developments and training local professionals in technology and quality assurance. | Medium |
| Market Risk | | |
| Market demand for LED lighting technology may be low, mainly due to high initial costs compared to conventional lighting technologies in addition to market distortions due to the presence of substandard products in the market and the reluctance of foreign technology | This risk will be managed by locally producing LED lighting lamps with the largest lighting manufacturers in Viet Nam who will meet international quality standards, while reducing the production costs and the price of LED lamps. Enhancing consumer awareness of the benefits of LEDs as well as the long-term financial benefits will help to boost the confidence of consumers in LED lighting products. | Medium |

| Risk Description | Mitigation Measure | Level of Risk |
|---|---|---------------|
| suppliers to enter a market where there may be issues with IPR infringement. | In addition, the largest lighting manufacturers have already expressed a willingness to pay or have paid for licensing fees for the use of patented LED technologies, and have the production capacity that would bring LED prices down. The Project, however, will <u>not</u> be assisting in human resource capacity building to improve IPR enforcement oversight. | |
| Social Risk | | |
| Poor and marginal income households may not benefit from increased access to LED lighting due to higher prices and the possibility that there is not a continued economic recovery in Viet Nam (that would ensure the capability of most households to afford the purchase of LED lighting devices) | This risk can be mitigated through the continued promotion of locally-produced LEDs, continued production of quality LEDs and maximizing the reduction of LED prices through increasing scales of economy of quality LED production | Low |

Cost Effectiveness

57. The direct GHG reductions expected from this Project are 70,005 tonnes CO_{2eq} cumulative to 2028, 10 years after Project completion. The cost of emission reductions resulting from this Project are USD 21.68 per tonne of CO₂ reduced.

Sustainability, Replicability and Impacts

Sustainability

58. The LED Project will ensure sustainability of LED market transformation through strong support to both the supply and demand side of LEDs. By creating favorable market conditions for the demand for LEDs and a sustained supply of quality LEDs at competitive prices for Vietnamese households, end-user and consumer confidence in LEDs will be sustained as a result of the Project activities. Moreover, with the demonstration of LED lights in several indoor and outdoor applications, conversion of all lighting systems in Viet Nam will be promoted and maximize the likelihood of sustained Project results.

Replicability

59. The demonstration component of this Project (Component 2) is designed in a manner to ensure replication of LED installation efforts. As such, the Project will demonstrate the cost and ease of LED installation followed by close monitoring of the energy and operational savings of LED lighting systems. Information of these demonstrations and their benefits will be disseminated and shared amongst a wide spectrum of stakeholders, maximizing the

potential for replication of the demonstrations.

Innovativeness and Impacts

60. This Project is innovative as it will provide specialized technical assistance to Viet Nam's primary lighting product manufacturers in the production of LED lighting products that are not widely available domestically. This will facilitate supply of locally-produced and cost-competitive LED lighting products to the Viet Nam lighting market. When used, such product will bring about energy savings of up to 50% of that consumed by a comparable lighting device. The project will also include the dissemination of useful information on the social and environmental benefits of LED lighting usage, which will eventually lead to increased demand for such lighting products.
61. The social and environmental impacts of achieving market transformation of the Vietnamese LED lighting market include:
- Reduced electricity costs to households, commercial and industrial establishments, and public agencies;
 - Increased availability of money from electricity savings from increased LED usage;
 - Improved quality of lighting in urban areas that has impacts on safety for local residents in public areas;
 - Possible increased difficulties to access to LED lighting experienced by marginal income sector of the population. However, for this population segment, LED lights do offer the possibility of having light sources powered from solar PV with minimal requirements for battery storage, thus providing a means of energy independence.
62. From a gender perspective, this Project will benefit the citizenry, particularly women and children given that LED lights have a longer and more reliable service life and higher lighting output compared to lighting products that are based on current lighting technologies in use, thereby creating safer conditions in public areas. These benefits can also be extended to indoor lighting where the women who spend most their time indoors will have access to reliable lighting sources and lower energy costs to the household. In addition, women will also indirectly contribute to the generation of GHG reductions from this Project through their employment in LED manufacturing facilities for example at Ralaco and Dien Quang, which are leading lighting product manufacturers producing more than 90% of all current LED lighting sales in Viet Nam. More than 50% of the employees of these companies are female.
63. The economic impacts of achieving market transformation of the Vietnamese LED lighting market include:
- Reduced electricity and operational costs to commercial and industrial establishments and public agencies;
 - Provides short-term relief to looming power shortages resulting from less electricity demand from the national grid;
 - Improved retail sales and commercial activities in the short-term resulting from lessened occurrences of power failures.

PROJECT RESULTS FRAMEWORK

| |
|--|
| Primary applicable Key Environment and Sustainable Development Key Result Area (same as that on the cover page, circle one): 1. Mainstreaming environment and energy OR 2. Catalyzing environmental finance OR 3. Promote climate change adaptation OR 4. Expanding access to environmental and energy services for the poor. |
| Applicable GEF Strategic Objective and Program: GEF-5 CCM Strategic Program SP1: Promote the demonstration, deployment, and transfer of innovative low-carbon technologies |
| Applicable GEF Expected Outcomes: Technologies successfully demonstrated, deployed, and transferred; enabling policy environment and mechanisms created for technology transfer; and GHG emissions avoided |
| Applicable GEF Outcome Indicators: Percentage of technology demonstrations reaching its planned goals; extent to which policies and mechanisms are adopted for technology transfer; and tonnes of CO ₂ equivalent avoided |

| Outcomes | Indicator | Baseline | Targets | Means of Verification | Critical Assumptions |
|--|--|---|--|--|---|
| Project Objective: ⁵⁰ Mitigation of GHG emissions through transformation of the lighting market towards greater usage of locally-produced LED lighting products in Viet Nam | <ul style="list-style-type: none"> ▪ Cumulative direct and indirect CO₂ emission reductions resulting by EOP, tonnes CO₂ ▪ Cumulative direct and indirect energy saving (MWh) by EOP ▪ % urban households and commercial establishments with reduced electricity bills from the use of LED lamps by EOP | <ul style="list-style-type: none"> ▪ negligible⁵¹ ▪ negligible⁵² ▪ negligible⁵³ | <ul style="list-style-type: none"> ▪ 623 ⁵⁴ ▪ 69,382 ⁵⁵ ▪ 1,000 ⁵⁶ ▪ 3,000 ⁵⁷ ▪ 5 | <ul style="list-style-type: none"> ▪ Project final report as well as annual surveys of LED energy consumption ▪ Project final report as well as annual surveys of energy consumption & reductions for LED usage ▪ EOP market surveys of LED usage and electricity bills segregated into residential and commercial establishments | <ul style="list-style-type: none"> ▪ Economic recovery of the country will continue that would enhance the ability of most households to afford the purchase of LED lighting devices |

⁵⁰ Objective (Atlas output) monitored quarterly ERBM and annually in APR/PIR

⁵¹ Negligible due to poor quality LEDs resulting in few if any emission reductions

⁵² Ibid 52

⁵³ Ibid 52

⁵⁴ Direct ERs from direct investments and generated during the Project period

⁵⁵ Post-project direct ERs (cumulative 10 yrs after EOP) from direct investments + ERs (cumulative 10 yrs after EOP) from locally manufactured LED lamps installed after EOP that received TA during Project period in Yrs 3 and 4

⁵⁶ Includes direct energy savings of 705 MWh from indoor demos and 293 MWh from outdoor demos

⁵⁷ Assumes a replication factor of 3 to be realized during the Project duration

| Outcomes | Indicator | Baseline | Targets | Means of Verification | Critical Assumptions |
|--|--|---|---|---|--|
| Outcome 1: ⁵⁸ Development of a local LED industry that provides locally produced quality LED lamps that are increasingly in demand by local consumers | <ul style="list-style-type: none"> Number of LED lamp manufacturing plants that have advanced manufacturing to produce LED lamps that meet new VN standards for LED lamps by EOP Number of retailers that sell locally labeled LED lighting products by EOP Number of LED lighting products that are standardized by Year 3 and EOP Number of new LED lighting products that are labeled by Year 3 | <ul style="list-style-type: none"> 0 0 0 0 | <ul style="list-style-type: none"> 3 200 6⁵⁹ 4 | <ul style="list-style-type: none"> Official documentation on LED lighting policies Official study that overviews the current LED manufacturing operations and required actions to improve LED production with new LED manufacturing technology Official monitoring and evaluation document on new LED manufacturing facilities Data from LED manufacturers on sales of LEDs to retailing outlets Training assessments and feedback from participants | <ul style="list-style-type: none"> Continued government support for strengthening current LED legal framework as well as regulations, standards and codes Sustained efforts by Government to enforce new standards that would result in the reduced availability of imported sub-standard and less costly LEDs in Viet Nam |
| Outcome 2: Increased use and deployment of locally-produced high-quality LED lighting technologies. | <ul style="list-style-type: none"> % rural and urban households and commercial establishments that have purchased locally produced LED lamps by EOP Annual number of sold LED lamps that are locally | <ul style="list-style-type: none"> <1 1.3 million⁶⁰ | <ul style="list-style-type: none"> 10⁶¹ 15 million⁶² | <ul style="list-style-type: none"> Demonstration project reports LED market survey reports Monitoring reports on energy consumption and | <ul style="list-style-type: none"> Willingness of existing lighting manufacturers to embrace new LED manufacturing technologies is assured Households and commercial establishments provide information on numbers of |

⁵⁸ All outcomes monitored annually in the APR/PIR.

⁵⁹ 4 indoor lamps and 2 outdoor lamps

⁶⁰ Estimated based on data from Ralaco in 2013

⁶¹ To be determined through completion of a statistical survey as a part of Output 1.1

⁶² This is the annual sales of LED lamps in Year 4. See Annex IV for annual targets for the duration of the Project

| Outcomes | Indicator | Baseline | Targets | Means of Verification | Critical Assumptions |
|----------|--|---|---|-----------------------|--|
| | <p>produced and certified LED lights in Viet Nam by EOP for the local lighting market</p> <ul style="list-style-type: none"> • % of market share of locally produced LED lamps in the Vietnamese lighting market by EOP | <ul style="list-style-type: none"> • <1 | <ul style="list-style-type: none"> • 7 | <p>energy savings</p> | <p>LEDs purchased</p> <ul style="list-style-type: none"> • Willingness of local LED manufacturers to disclose sales LED sales information |

TOTAL BUDGET AND WORK PLAN

| | | | |
|-----------------------------|---|-----------------------|----------|
| Award ID: | 00084024 | Project ID(s): | 00092227 |
| Award Title: | Local Development and Promotion of LED Technologies for Advanced General Lighting | | |
| Business Unit: | VNM10 | | |
| Project Title: | Local Development and Promotion of LED Technologies for Advanced General Lighting | | |
| PIMS no. | 5193 | | |
| Implementing Partner | Viet Nam Academy of Science and Technology (VAST) | | |

| GEF Outcome/Atlas Activity | Responsible Party/ Implementing Agent | Fund ID | Donor Name | Atlas Budgetary Account Code | ATLAS Budget Description | Amount (USD) Year 1 2015-6 | Amount (USD) Year 2 2016-7 | Amount (USD) Year 3 2017-8 | Amount (USD) Year 4 2018-9 | Total (USD) | Notes |
|--|---------------------------------------|--------------|------------|------------------------------|---------------------------|----------------------------|----------------------------|----------------------------|----------------------------|------------------|------------------|
| Outcome 1: Development of a local LED industry that provides locally produced quality LED lamps that are increasingly in demand by local consumers | VAST, UNDP | 62000 | GEF | 71200 | International Consultants | 184,000 | 200,000 | 32,000 | 0 | 416,000 | See Note 1 |
| | VAST | | | 71300 | Local Consultants | 134,450 | 148,600 | 60,550 | 13,200 | 356,800 | See Note 2 |
| | | | | 72100 | Contractual Services | 2,500 | 2,400 | | | 4,900 | See Note 3 |
| | | | | 71600 | Travel | 5,000 | 5,000 | 5,000 | 5,000 | 20,000 | See Note 4 |
| | | | | 72600 | Grants | 90,000 | | | | 90,000 | See Note 5 |
| | | | | 75700 | Training Workshops | 30,000 | 60,000 | 20,000 | 21,750 | 131,750 | See Note 6 |
| | Total GEF Outcome 1 | | | | | | 445,950 | 416,000 | 117,550 | 39,950 | 1,019,450 |
| Total Outcome 1 | | | | | | 445,950 | 416,000 | 117,550 | 39,950 | 1,019,450 | |
| Outcome 2: Increased use and deployment of locally-produced high-quality LED lighting technologies | VAST, UNDP | 62000 | GEF | 71200 | International Consultants | 8,000 | 0 | 24,000 | 16,000 | 48,000 | See Note 7 |
| | VAST | | | 71300 | Local Consultants | 0 | 21,100 | 80,400 | 66,000 | 167,500 | See Note 8 |
| | | | | 72100 | Contractual Services | 35,000 | | 10,000 | 55,000 | 100,000 | See Note 9 |
| | | | | 71600 | Travel | | | 5,000 | 3,400 | 8,400 | See Note 4 |
| | | | | 72605 | Grants | | 20,000 | 20,000 | | 40,000 | See Note 10 |

| GEF Outcome/Atlas Activity | Responsible Party/Implementing Agent | Fund ID | Donor Name | Atlas Budgetary Account Code | ATLAS Budget Description | Amount (USD) Year 1 2015-6 | Amount (USD) Year 2 2016-7 | Amount (USD) Year 3 2017-8 | Amount (USD) Year 4 2018-9 | Total (USD) | Notes |
|---|--------------------------------------|--------------|------------|------------------------------|-----------------------------------|----------------------------|----------------------------|----------------------------|----------------------------|------------------|-------------|
| | | | | 75700 | Training Workshops | | | 26,000 | 36,000 | 62,000 | See Note 11 |
| | Total GEF Outcome 2 | | | | | 43,000 | 41,100 | 165,400 | 176,400 | 425,900 | |
| | Total Outcome 2 | | | | | 43,000 | 41,100 | 165,400 | 176,400 | 425,900 | |
| PROJECT MANAGEMENT (including M&E) | VAST, UNDP | 62000 | GEF | 71200 | International Consultants | 0 | 0 | 0 | 16,000 | 16,000 | See Note 12 |
| | VAST | | | 71300 | Local Consultants and Local Staff | 3,150 | 3,700 | 5,200 | 5,200 | 17,250 | See Note 13 |
| | | | | 72200 | Equipment | 2,000 | 2,000 | 3,000 | | 7,000 | See Note 14 |
| | | | | 72400 | Communications | 500 | 500 | 500 | 300 | 1,800 | See Note 15 |
| | | | | 72500 | Office Supplies | 1,000 | 1,000 | 500 | 500 | 3,000 | See Note 16 |
| | | | | 74100 | Professional Services (Audit) | 3,000 | 3,000 | 3,000 | 3,000 | 12,000 | See Note 17 |
| | UNDP | | | 74500 | UNDP Cost Recovery Charges | 4,000 | 4,000 | 3,500 | 3,500 | 15,000 | See Note 18 |
| | Total GEF Project Management | | | | | 13,650 | 14,200 | 15,700 | 28,500 | 72,050 | |
| Total Project Management | | | | | 13,650 | 14,200 | 15,700 | 28,500 | 72,050 | | |
| GEF Total | | | | | | 502,600 | 471,300 | 298,650 | 244,850 | 1,517,400 | |
| Grand Total | | | | | | 502,600 | 471,300 | 298,650 | 244,850 | 1,517,400 | |

Summary of Funds:

| | Amount Year 1 | Amount Year 2 | Amount Year 3 | Amount Year 4 | Total |
|----------------------|------------------|------------------|------------------|------------------|------------------|
| GEF | 502,600 | 471,300 | 298,650 | 244,850 | 1,517,400 |
| Co-financing: | 1,307,400 | 3,703,000 | 1,506,994 | 112,000 | 6,629,394 |
| UNDP | 20,000 | 30,000 | 30,000 | 20,000 | 100,000 |
| MoIT | 50,000 | 40,000 | 40,000 | 20,000 | 150,000 |
| QUATEST 1 (MoST) | 10,000 | 40,000 | 40,000 | 10,000 | 100,000 |
| Ralaco | 500,000 | 1,200,000 | 511,300 | 25,000 | 2,236,300 |
| Dien Quang | 500,000 | 2,150,000 | 747,694 | 0 | 3,397,694 |
| VN Schreder | 190,400 | 165,000 | 100,000 | 0 | 455,400 |
| VAST | 37,000 | 38,000 | 38,000 | 37,000 | 150,000 |
| CHTD | | 40,000 | | | 40,000 |
| Total | 1,810,000 | 4,174,300 | 1,805,644 | 356,850 | 8,146,794 |

Notes:

1. This includes professional time for the following international consultants to be in Viet Nam, all at USD 4,000 per week (includes travel and per diem costs): International Project Implementation Advisor (IPIA) for 2 weeks during Yr. 1; LED Lighting Product Standards (ILPS) for 4 wks in Yr 1; LED Lighting Product Testing and S&L (ILPT) for 4 wks in both Yrs 1 and 2; Technology Support to Local Manufacturers (ITS) for 24 wks in Yr 1, 28 wks in Yr 2, and 8 wks in Yr.3; LED Lighting Technology Trainer (ILTT) for 8 wks in both Yrs 1 and 2; Senior Technical Specialist (ISTS) for 4 wk in Yr 1 and 6 wks in Yr 2; Evaluation Specialist (IES) for 4 wks in Yr 2.
2. This includes professional time for the following national staff and consultants: National Project Manager (NPM) (@ USD 550/wk) for 49, 38, 10 and 10 wks during Yrs 1, 2, 3, and 4 respectively; one Technology Support Consultant to Local Manufacturers (NTS) (@USD 300/wk) for 50 weeks for Yrs 1 and 2, and 17 wks for Yr 3; LED Lighting Product Testing (NLPT) (@USD350/wk) for 30, 40, 15 wks during Yrs 1, 2, and 3 respectively; Technical Consultant (NPTC) (@USD600/wk) for 52 and 26 wks in Yrs 1 and 2; National LED Lighting Roadmap (NLR) (@USD300/wk) 26 wks for both Yrs 1 and 2; LED Lighting Product Standards (NLPS) (@USD550/wk) for 18, 26 and 20 wks in Yrs 1, 2 and 3 respectively; LED Labeling and Certification (NLC) (@USD300/wk) for 18, 52 and 30 wks for Yrs 1, 2 and 3 respectively; Codes and Regulations for LED Use (NCR) (@USD450/wk) for 18, 52 and 26 wks for Yrs 1, 2 and 3 respectively; R&D Training (NRDT) (@USD250/wk) for 26 wks for Yrs 1, 2 and 3 each; National Awareness Raising (NAR) (@USD200/wk) for 8, 20, 20 and 26 wks for Yrs 1, 2, 3 and 4 respectively; Project Admin Accountant Officer (ACC) (@USD250/wk) for 46, 46, 10 and 10 wks for Yrs 1, 2, 3 and 4 respectively;
3. For translation services
4. For travel to various workshops and consultations on roadmap, regulatory changes, demonstration projects, information dissemination in Hanoi and HCMC
5. Assumes 4 sets of lighting design software: Oxy Tech's Litestar 4D Software @ USD 30,000, Lamda's Trace Pro Software @ USD 20,000, ANSYS ICEPAK software @ USD 25,000, and Mentor Graphics FLoTHERM software @ USD 15,000. For details, see Annex III
6. Includes several workshops and seminars delivered to each company separately on specialized LED manufacturing topics as well as general Project workshops including one Inception Workshop in Yr 1 (USD 10,000); two workshops to review LED roadmap Output 1.1) in Yrs 1 and 3 (USD 12,000); one workshop to review new LED standards (Output 1.2) in Yr 1 (USD 10,000); two training workshops for Quatest and testing staff on new testing protocols

(Output 1.3) in Yrs 2 and 3 (USD 14,000); one workshop on market inspections (Output 1.4) in Yr 2 (USD 8,000); two training workshops on LED product R&D (Output 1.6) in Yrs 2 and 3 (USD10,000);

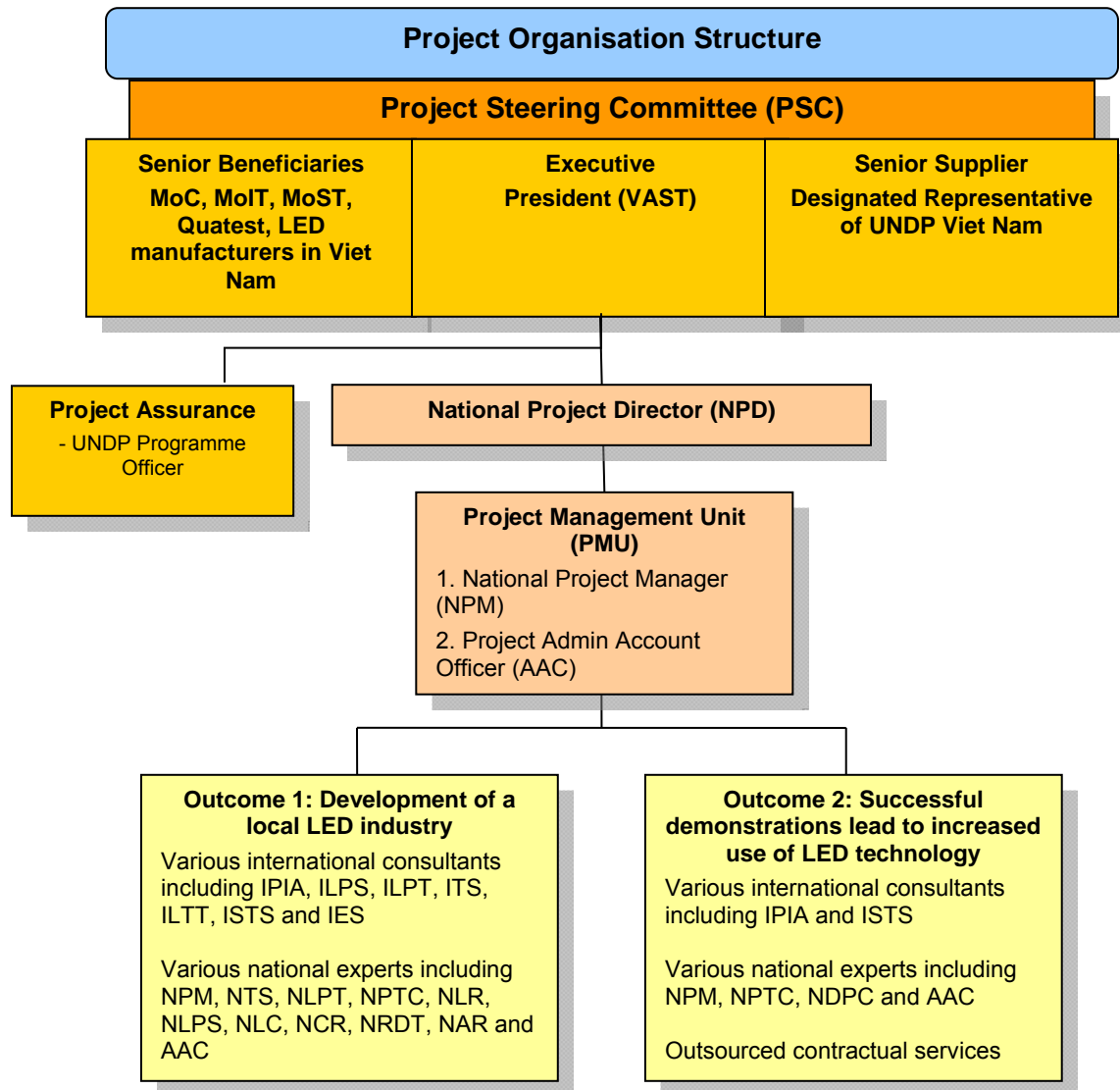
7. This includes professional time for the following international consultants to be in Viet Nam, all at USD 4,000 per week (includes travel and per diem costs): IPIA for 2 weeks for both Yrs 1 and 3; ISTS for 4 wks for both Yrs 3 and 4;
8. This includes professional time for the following national consultants: NPM @ USD 550/wk for 10, 38 and 38 wks during Yrs 2, 3, and 4 respectively; NPTC @USD600/wk for 26, 52 and 28 wks in Yrs 2, 3 and 4; LED Project Demo Coordinators (NDPC) (@USD400/wk) full time for Yrs 3 and 4; and the AAC @USD250/wk for 30 and 30 wks for Yrs 3 and 4 respectively;
9. For two marketing surveys under Output 2.3: USD 35,000 in Year 1 to obtain baseline data of LED usage, and USD 45,000 in Year 4 to evaluate the impact of the Project in transforming the LED lighting market. Awareness raising program for USD 20,000 over Years 3 and 4;
10. Covers installation costs of installing locally made LEDs at demo sites;
11. For supporting national workshops in Output 2.5 on advancement of LED market as well as workshops to assist other property and building owners to procure and install LEDs;
12. Includes resources for Final Evaluation by IES for 4 wks in Yr 4
13. This includes professional time for the following national consultants: NPM @ USD 550/wk for 3, 4, 4 and 4 wks during Yrs 1, 2, 3, and 4 respectively; and the AAC @USD250/wk for 6, 6, 12 and 12 wks for Yrs 1, 2, 3 and 4 respectively
14. For office equipment;
15. For mobile phone communications
16. Budget set up for office supplies used in PMU
17. Budget set up for project audit
18. Budget set up for DPC

MANAGEMENT ARRANGEMENTS

Project Organization Structure

64. The Project is co-financed with funding from the GEF and UNDP acts as the *GEF Implementing Agency*. The Project will be implemented by VAST, UNDP's *Implementing Partner*, and the Center for High Technology Development (CHTD) under VAST, which will assume the overall responsibility for the achievement of project results as the Project's *Implementing Entity*. This IE will be subject to the micro assessment as per Harmonized Approach to Cash Transfers to Implementing Partners (HACT) framework. The micro assessment will also define subsequent quality assurance activities and the most suitable resource transfer modality and procedures. UNDP will provide overall management and guidance from its Country Office in Hanoi and the Bangkok Regional Hub (BRH) in Bangkok, and will be responsible for monitoring and evaluation of the project as per normal GEF and UNDP requirements. CHTD will designate a senior official as the *National Project Director (NPD)* for the project. The NPD will be responsible for overall guidance to project management, including adherence to the Annual Work Plan (AWP) and achievement of planned results as outlined in the ProDoc, and for the use of UNDP funds through effective management and well established project review and oversight mechanisms. The NPD also will ensure coordination with various ministries and agencies provide guidance to the project team to coordinate with UNDP, review reports and look after administrative arrangements as required by the Government of Viet Nam and UNDP. The project will be executed according to UNDP's National Implementation Modality (NIM), as per the NIM project management implementation guidelines agreed by UNDP and the Government of Viet Nam. The Project organization structure is shown on Figure 8.
65. The Project Steering Committee (PSC) will have oversight of the Project Management Unit (PMU). The PSC will consist of a Chairperson (VAST President); with PSC members from MoC, MoIT, MoST, UNDP Viet Nam, VAST, and a LED manufacturer representative. The primary functions of the PSC will be to provide the necessary direction that allows the Project to function and achieve its policy and technical objectives, and to approve the annual Project plans and M&E reports.
66. The PMU (under CHTD) will report to VAST. The PMU will be responsible to VAST, the PSC and UNDP for implementing the Project, planning activities and budgets, recruiting specialists, conducting training workshops and other activities to ensure the Project is executed as per approved work plans.
67. As a GEF implementing agency, UNDP also has a role of project assurance. This role will be exercised by the UNDP Programme Officer responsible for the project, based in the UNDP Country Office (CO).
68. Both the PMU and the NPD will implement mechanisms to ensure ongoing stakeholder participation and effectiveness with the commencement of the Project by conducting regular stakeholder meetings, issuing a regular project electronic newsletter, conducting feedback surveys, implementing strong project management practices, and having close involvement with UNDP Viet Nam as the GEF implementing agency.

Figure 8: Project Organization Structure⁶³



There are a number of other stakeholders that will be involved in the promotion, development and implementation of this LED Project including the following who are also co-financiers of the Project, namely those named on Table 4, a summary of co-financing from stakeholders.

Table 4: Co-Financing Details

| Co-Financer | Amount (USD) | General Description of Co-Financed Activities |
|---|-------------------|---|
| Viet Nam Academy of Science and Technology (VAST) | 150,000 (in-kind) | <ul style="list-style-type: none"> Project management (in-kind): Office space and various administrative support for the Project. Chairing of the Project Steering Committee. |

⁶³ For acronyms of the various international consultants and national experts, please refer to Notes 1, 2, 5 and 6 under the “Budget and Work Plan”. For detailed Terms of Reference of international consultants and national experts, please refer to Annex VI.

| | | |
|--|---|---|
| Center for High Technology Development (CHTD) under the VAST | 40,000 (Investment) | <ul style="list-style-type: none"> • <i>Purchase of LEDs for demonstration under Output 2.2 for VAST residential complex in Hanoi</i> |
| Ministry of Industry And Trade (MoIT) | 150,000 (in-kind) | <ul style="list-style-type: none"> • Component 1 including review and recommendations on roadmap to encourage the development of LED lighting to replace traditional lighting (Output 1.1), review and coordination with MoST on improved lighting standards and LED testing regime, and coordination with MoC on LED compliance with the Energy Efficiency Building Code; • Component 2: Policy development in raising program of LED lighting as financially viable |
| Quality Assurance and Testing Center 1 (QUATEST) under the Ministry of Science and Technology (MoST) | 100,000 (Investment) | <ul style="list-style-type: none"> • LED testing equipment under Output 1.3 |
| Private Sector Investors: Ralaco (indoor and outdoor demos) Dien Quang (indoor demo only) VN Schreder (outdoor demo only) | 2,236,300 (Investment) 3,397,694 (Investment) 455,400 (Investment) | <p>⇒ <u>Under Component 1</u>, these firms will provide investments in labor, technology transfer, capacity development, input materials, advanced LED testing equipment, the LED production process equipment all that meets best international practices that will lead to:</p> <ul style="list-style-type: none"> ▪ LED lamp product design including software for LED lamp design; ▪ driver design for high powered outdoor LED products in tropical areas; ▪ LED package manufacturing (for LED replacement lamps from processed wafers); ▪ review of raw material standards and testing methods; ▪ required equipment for improved LED manufacturing process; ▪ international standards and certification for LED products (includes accelerated age testing); ▪ anti-static assemble lines; and ▪ products testing, assessment and supply; <p>⇒ <u>Under Component 2</u>, these firms will:</p> <ul style="list-style-type: none"> ▪ supply and installation of outdoor and street lighting LED lamps, and setting up the measure to monitor the energy consumption of the installed LED lamps (3 demo sites with 400 sets); ▪ supply and installation of indoor commercial and residential lighting LED lamps, and setting up measures to monitor energy consumption of the installed LED lamps (3 demo sites with 4,175 sets); <ul style="list-style-type: none"> • support for the preparation and organization of two workshops on promotion of LED lighting application using lessons learned from the installation and use of LEDs in the demo projects |
| UNDP | 100,000 | <p>UNDP's co-financing is mainly through its support to the UNDP funded project "<i>Strengthening Capacity on Climate Change Initiatives in the Industry and Trade Sectors</i>", which include activities that have been subsumed into the proposed GEF project as baseline activities.</p> <ul style="list-style-type: none"> • Quantification of GHG emission reduction potentials and energy savings from identified CCM actions such as the use of energy efficient lamps particularly LED lighting devices in the industry and trade sectors • Development of data collection framework and methodologies for estimating GHG emission reductions for specific climate change options (e.g., utilization of EE lighting devices) that will be piloted in |

| | | |
|---------------|------------------|---|
| | | <p>specific industry sectors but are also applicable to other industry sub-sectors such as the lighting products manufacturing industry.</p> <ul style="list-style-type: none"> • Development of policies and institutional mechanisms for the promotion of market reform to enable involvement of the private sector and service providers into the industry's low carbon development • Capacity development of Ministry of Trade and Industry's national and provincial staff, industrial associations, energy efficiency conservation centers, auditors and enterprise managers through development and delivery of training packages on related climate change mitigation interventions such as development, implementation and monitoring of climate change policies, development and implementation of mitigation action plans, GHG emission reduction potential assessment, energy audits and MRV. |
| Total: | 6,629,394 | |

General

UNDP support service

69. VAST will enter into an agreement with UNDP for support services in the form of procurement of goods and services during the project implementation process. In such a case, appropriate cost recovery will be charged as per UNDP rules and regulations. The support services will be outlined in the form of Letter of Agreement signed between VAST and UNDP.

Collaborative Arrangements with Related Projects

70. This Project complements a number of former and ongoing initiatives that have been developed and implemented in Viet Nam in the field of energy efficiency. The lessons from the completed UNDP/GEF Viet Nam Energy Efficiency in Public Lighting (VEEPL) program, which aimed at improving energy efficiency in the public lighting sector, has been incorporated in this proposed Project. One of the recommendations of the VEEPL terminal evaluation report was to involve a commercially oriented organization in the activities of a potential follow-on project on promoting LED lamps that has been done for the proposed Project. Furthermore, the Project will establish close coordination with the ongoing UNEP/GEF funded project on Phasing out Incandescent Lamps through Lighting Market Transformation in Viet Nam that aims to eliminate and replace energy inefficient lighting products with high quality energy efficient lamps focusing on CFLs. The experience and success of the UNEP/GEF project in transforming the CFL market has been useful in informing the design of this project.

71. The National Energy Efficiency Program (Phase 2) forms one of the key baseline projects for this proposed initiative, the details of which can be found in Para 22. This proposed Project, which will be managed by the same implementing partner, will maintain this close coordination with VNEEP, especially in the development of minimum energy performance standards for LED lamps in Output 1.2 and labelling activities of Output 1.4.

72. MoST is also executing a 5-year WB-loan project “Fostering Innovation through Research, Science and Technology (FIRST)” from 2014 to 2019⁶⁴ that will support higher productivity, competitiveness, and quality of Viet Nam's economic growth through improving scientific research performance, developing and applying technologies, and promoting innovation in enterprises with a view to increase the added value of domestic economy. Specifically, the FIRST project will support science and technology (S&T) and promote innovation via i) designing and piloting new policies to improve the national policy framework for S&T; ii) capacity building for government research institutes towards further linkages with enterprises and market demands; and iii) promoting technology innovation in enterprises, and encouraging the establishment and development of S&T enterprises. The FIRST Project proposes work with Ralaco on the activity for “fostering of a technology innovation association between manufacturers and science – technology community” that will support for Ralaco’s new indoor LED lamp products.

73. VAST will ensure co-finance and cooperation from the other programs, some of which are funded by other donor agencies. Co-financing details are provided on Table 5.

Prior Obligations and Prerequisites

74. There are no prior obligations and prerequisites.

Audit Arrangements

75. The Government will provide the UNDP Resident Representative with certified periodic financial statements. An annual audit of the financial statements relating to the status of UNDP (including GEF) funds will be conducted according to UNDP financial regulations, rules and audit policies by the legally recognized auditor or by a commercial auditor engaged by the UNDP.

Agreement on Intellectual Property Rights and Use of Logo on Project Deliverables

76. To accord proper acknowledgement to GEF for providing funding, a GEF logo should appear on all relevant GEF-supported Project publications, including among others, Project hardware, if any, purchased with GEF funds. Any citation on publications regarding Projects funded by GEF should also accord proper acknowledgement to GEF. Alongside GEF and UNDP logo, a VAST logo may also feature as the Implementing Partner of the proposed Project.

⁶⁴ Project financing includes USD100 million of loan from the World Bank and USD 10 million from the Viet Nam Government

MONITORING FRAMEWORK AND EVALUATION

77. The project team and the UNDP Office in Hanoi supported by the UNDP-GEF Regional Coordination Unit in Bangkok will be responsible for project monitoring and evaluation conducted in accordance with established UNDP and GEF procedures. The Project Results Framework provides performance and impact indicators for project implementation along with their corresponding means of verification. The GEF CC Tracking Tool will also be used to monitor progress in reducing GHG emissions. The M&E plan includes: inception workshop and report, project implementation reviews, quarterly and annual review reports, independent mid-term evaluation, and independent final evaluation. The following sections outline the principle components of the Monitoring and Evaluation Plan and indicative cost estimates related to M&E activities. The M&E budget is provided on Table 5.
78. Project start: A Project Inception Workshop will be held within the first 4 months of the project starting with those with assigned roles in the project organization structure, UNDP country office and where appropriate/feasible regional technical policy and program advisors as well as other stakeholders will be invited. The Inception Workshop is crucial to building ownership for the project results and to plan the first year annual work plan. The Inception Workshop would address a number of key issues including:
- a) Assisting all partners to fully understand and take ownership of the project;
 - b) Detailing the roles, support services and complementary responsibilities of UNDP CO and the UNDP-GEF RCU staff vis-à-vis the project team;
 - c) Discussing the roles, functions, and responsibilities within the Project's decision-making structure including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference of project staff will be discussed again as required;
 - d) Finalization of the first annual work plan based on the project results framework and the relevant GEF Tracking Tool if appropriate. A review and agreement on the indicators, targets and their means of verification will be required as well as a re-check of assumptions and risks;
 - e) Providing a detailed overview and reach consensus on reporting, monitoring and evaluation (M&E) requirements, the M&E work plan and budget;
 - f) Discussion of financial reporting procedures and obligations, and arrangements for annual audit;
 - g) Planning and scheduling Project Board meetings; and,
 - h) Clarification of roles and responsibilities of all project organization structures as well as planned dates of meetings where the first PSC meeting should be held within the first 12 months following the inception workshop.
79. An Inception Workshop report is a key reference document and must be prepared and shared with participants to formalize various agreements and plans decided during the meeting.
80. Quarterly Progress Report: Contents of the QPR include:
- Progress made as reported in the Standard Progress Report (SPR) and monitored in the UNDP Enhanced Results Based Management Platform;
 - Based on the initial risk analysis submitted, the risk log shall be regularly updated in ATLAS (if applicable otherwise outside ATLAS). Risks become critical when the impact and probability are high;

Table 5: M&E Work Plan and Budget

| Type of M&E activity | Responsible Parties | Budget US\$ <i>Excluding project team staff time</i> | Time Frame |
|--|--|--|---|
| Inception Workshop and Report | <ul style="list-style-type: none"> ▪ Project Manager ▪ UNDP CO, UNDP GEF | Indicative cost: 10,000 | Within first four months of project start up |
| Measurement of Means of Verification of project results. | <ul style="list-style-type: none"> ▪ UNDP GEF RTA/Project Manager will oversee the hiring of specific studies and institutions, and delegate responsibilities to relevant team members. | To be finalized in Inception Phase and Workshop. | Start, mid and end of project (during evaluation cycle) and annually when required. |
| Measurement of Means of Verification for Project Progress on <i>output and implementation</i> | <ul style="list-style-type: none"> ▪ Oversight by technical specialist with support from the Project Manager ▪ Project team | To be determined as part of the Annual Work Plan's preparation. | Annually prior to ARR/PIR and to the definition of annual work plans |
| ARR/PIR | <ul style="list-style-type: none"> ▪ Project manager and team ▪ UNDP CO ▪ UNDP RTA ▪ UNDP EEG | Indicative cost: 5,000 for the first year for the completion and update of the GEF CCM Tracking Tool | Annually by July |
| Project Steering Committee meetings | Project Manager | 3,000 x 4 years | Following IW and annually thereafter. |
| Periodic status/ progress reports | <ul style="list-style-type: none"> ▪ Project manager and team | None | Quarterly |
| Mid-term Review | <ul style="list-style-type: none"> ▪ Project manager and team ▪ UNDP CO ▪ UNDP RCU ▪ External Consultants (i.e. evaluation/Review team) | Indicative cost: 25,000 | At the mid-point of project implementation. |
| Final Evaluation | <ul style="list-style-type: none"> ▪ Project manager and team, ▪ UNDP CO ▪ UNDP RCU ▪ External Consultants (i.e. evaluation team) | Indicative cost: 30,000 | At least three months before the end of project implementation |
| Project Terminal Report | <ul style="list-style-type: none"> ▪ Project manager and team ▪ UNDP CO | 0 | At least three months before the end of the project |
| Audit | <ul style="list-style-type: none"> ▪ UNDP CO ▪ Project manager and team | Indicative cost per year: 3,000 x 4 years | Yearly |
| Scheduled audits and spot check | <ul style="list-style-type: none"> ▪ UNDP CO ▪ Project manager and team | Indicative cost per year: 3,000 x 4 years | To be decided based on risk assessment from the micro-assessments |
| Visits to field sites (UNDP staff travel costs to be charged to IA fees) | <ul style="list-style-type: none"> ▪ UNDP CO ▪ UNDP RCU (as appropriate) ▪ Government representatives (MoNRE, MPI) | 4,000 x 4 years | Yearly |
| TOTAL indicative COST Excluding project team staff time and UNDP staff and travel expenses | | 122,000 (+/- 5% of total budget) | |

- Project Progress Reports (PPR) as generated in the Executive Snapshot and based on the information recorded in Atlas; and,
- Other ATLAS logs that are used to monitor issues and lessons learned. The use of these functions is a key indicator in the UNDP Executive Balanced Scorecard.

81. Annual Project Review /Project Implementation Reports (APR/PIR): APRs/PIRs are key reports prepared to monitor progress since project start and in particular for the previous reporting period (30 June to 1 July). The APR/PIR combines both UNDP and GEF reporting requirements, and includes, but is not limited to, reporting on the following:
- Progress made toward project objective and project outcomes, each with indicators, baseline data and end-of-project targets (cumulative);
 - Project outputs delivered per project outcome (annual);
 - Lesson learned/good practice;
 - AWP and other expenditure reports;
 - Risk and adaptive management;
 - ATLAS QPR; and,
 - Portfolio level indicators (i.e. GEF focal area tracking tools) that are used by most focal areas on an annual basis.
82. Periodic Monitoring through site visits: UNDP CO and the UNDP RCU staff will conduct visits to project sites based on the agreed schedule in the project's Inception Report/Annual Work Plan to assess first hand project progress. Other members of the Project Board may also join these visits. A Field Visit Report/BTOR will be prepared by the CO and UNDP RCU and will be circulated no less than one month after the visit to the project team and Project Board members.
83. Mid-term of project cycle: The project will undergo an independent Mid-Term Review at the mid-point of project implementation. The Mid-Term Review will determine progress being made toward the achievement of outcomes and will identify course correction if needed. It will focus on the effectiveness, efficiency and timeliness of project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. Findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term. The organization, terms of reference and timing of the mid-term evaluation will be decided after consultation between the parties to the project document. The Terms of Reference for this Mid-term Review will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF. The management response and the evaluation will be uploaded to UNDP corporate systems, in particular the [UNDP Evaluation Office Evaluation Resource Center \(ERC\)](#). The relevant GEF Focal Area Tracking Tools will also be completed during the mid-term evaluation cycle.
84. End of Project: An independent Final/Terminal Evaluation will take place three months prior to the final Project Board meeting and will be undertaken in accordance with UNDP and GEF guidance. The final evaluation will focus on the delivery of the project's results as initially planned (and as corrected after the mid-term evaluation, if any such correction took place). The final evaluation will look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefits/goals. The Terms of Reference for this evaluation will be prepared by the UNDP CO based on guidance from the Regional Coordinating Unit and UNDP-GEF.
85. The Final Evaluation should also provide recommendations for follow-up activities and requires a management response which should be uploaded to PIMS and to the [UNDP Evaluation Office Evaluation Resource Center \(ERC\)](#). The relevant GEF Focal Area Tracking Tools will also be completed during the final evaluation. During the last three months, the project team will prepare the Project Terminal Report. This comprehensive

report will summarize the results achieved (objectives, outcomes, outputs), lessons learned, problems met and areas where results may not have been achieved. It will also lay out recommendations for any further steps that may need to be taken to ensure sustainability and replicability of the project's results.

86. Learning and knowledge sharing: Results from the project will be disseminated within and beyond the Project intervention zone through a number of existing information sharing networks and forums. In addition:
- The Project will participate, as relevant and appropriate, in UNDP/GEF sponsored networks, organized for senior personnel working on projects that share common characteristics;
 - The Project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation through lessons learned;
 - The Project will identify, analyze, and share lessons learned that might be beneficial in the design and implementation of similar future projects. Identifying and analyzing lessons learned is an on-going process and the need to communicate such lessons as one of the project's central contributions is a requirement to be delivered not less frequently than once every 12 months. UNDP/GEF shall provide a format and assist the project team in categorizing, documenting and reporting the lessons learned. To this end a percentage of project resources will also need to be allocated for these activities;
 - This GEF-funded Project will endeavor to compile and share its development results within a monitoring framework that is designed to meet the goals of the UN One Plan outcomes.

LEGAL CONTEXT

87. This Project Document shall be the instrument referred to as such in Article I of the Standard Basic Assistance Agreement between the Government of Viet Nam and the United Nations Development Program, signed by the parties on 21 March 1978. The host country-implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the government co-operating agency described in that Agreement.
88. Consistent with the Article III of the SBAA, the responsibility for the safety and security of the implementing partner and its personnel and property, and of UNDP's property in the implementing partner's custody, rests with the implementing partner. The implementing partner shall:
- Put in place an appropriate security plan and maintain the security plan, taking into account the security situation in the country where the project is being carried;
 - Assume all risks and liabilities related to the implementing partner's security, and the full implementation of the security plan.
89. UNDP reserves the right to verify whether such a plan is in place, and to suggest modifications to the plan when necessary. Failure to maintain and implement an appropriate security plan as required hereunder shall be deemed a breach of this agreement.
90. The implementing partner agrees to undertake all reasonable efforts to ensure that none of the UNDP funds received pursuant to the Project Document are used to provide support to

individuals or entities associated with terrorism and that the recipients of any amounts provided by UNDP hereunder do not appear on the list maintained by the Security Council Committee established pursuant to resolution 1267 (1999). The list can be accessed via: <http://www.un.org/Docs/sc/committees/1267/1267ListEng.htm>. This provision must be included in all sub-contracts or sub-agreements entered into under this Project Document.

ANNEXURES

Annex I: Risk Analysis

OFFLINE RISK LOG

| | | |
|---|--------------------|--------------|
| Project Title: Local Development and Promotion of LED Technologies for Advanced General Lighting | Project ID: | Date: |
|---|--------------------|--------------|

| # | Description | Date Identified | Type | Impact & Probability | Countermeasures / Management Response | Owner | Submitted, updated by | Last Update | Status (compared with previous evaluation) |
|---|---|-----------------|-------------------------|----------------------|---|-----------------|--|-------------|--|
| 1 | Unexpected government shift in priorities away from committed resources for the development and implementation of LED lighting projects | | Political | P = 1 I = 4 | Government and private sector manufacturers are committed to this Project and the forestalling of new power plant construction. More importantly, the Project will facilitate important Government actions (such as setting of standards and labeling programs, testing programs and codes government and regulating the use of LEDs in various applications) that will improve the confidence of private LED manufacturers to invest in advanced LED manufacturing equipment that will reduce the price of locally sold LEDs | Project manager | Submitted by Project Proponent, updated by Project Manager | | |
| 2 | Local manufacturers are unable to produce LED products that meet quality and performance levels set by local and international markets | | Financial | P = 3 I = 5 | Project will support strengthened and integrated approaches for technology transfer for the largest Vietnamese lighting manufacturers with training of local lighting professionals in advanced LED technology and quality assurances | Project manager | Submitted by Project Proponent, updated by Project Manager | | |
| 3 | Market demand for LED lighting technology may be low, mainly due to high initial costs compared to conventional lighting | | Technical and financial | P = 3 I = 5 | This risk will be managed by locally producing LED lighting lamps that meet international quality standards, while reducing the production costs and the price of LED lamps. In addition, | Project manager | Project Manager | | |

| # | Description | Date Identified | Type | Impact & Probability | Countermeasures / Management Response | Owner | Submitted, updated by | Last Update | Status (compared with previous evaluation) |
|---|--|-----------------|--------|----------------------|---|-------|-----------------------|-------------|--|
| | technologies in addition to market distortions due to the presence of substandard products in the market and the reluctance of foreign technology suppliers to enter a market where there may be issues with IPR infringement. | | | | <p>enhancing consumer awareness of the benefits of LEDs as well as the long-term financial benefits will help to boost the confidence of consumers in LED lighting products.</p> <p>In addition, the largest lighting manufacturers have already expressed a willingness to pay or have paid for licensing fees for the use of patented LED technologies, and have the production capacity that would bring LED prices down. The Project, however, will <u>not</u> assist in human resource capacity building to improve IPR enforcement oversight.</p> | | | | |
| 4 | Poor and marginal income households may not benefit from increased access to LED lighting due to higher prices. | | Social | P = 1 I = 3 | This risk can be mitigated through the continued and sustained promotion of locally-produced LEDs, continued production of quality LEDs and maximizing the reduction of LED prices through increasing scales of economy of LED production | | | | |

Annex II: Detailed CO₂ Calculations and Assumptions

A. Purpose of Annex

This annex provides an analysis of the energy saved and GHG emissions reduced through a shift from the traditional means of lighting in Viet Nam to light emitting diode (LED) lighting technologies. The GHG emission reductions that are attributed to the project include:

- Direct CO₂ reductions from the indoor and outdoor LED lamp demonstrations by Ralaco, Dien Quang and VN Schreder; and
- Indirect CO₂ reductions resulting from bottom-up replications and top-down replications using GEF guidelines⁶⁵ and inputs from the PPG team on the timing of the investments for these LED lighting product applications and the resulting CO₂ emission reductions.

A summary of the emission reductions presented in this Annex is shown in Table II-1. A summary of the derivation of the baseline scenario of lighting in Viet Nam and the calculation of the “top-down” GHG emissions is provided in Section B, C and D.

Table II-1: Summary of GHG Reductions from LED Project Activities

| | Emissions reduction (ktonnes CO₂) | Comments |
|--|---|---|
| Direct emission reductions | 0.623 | See Tables II-7 and II-8 for indoor and outdoor demo direct GHG reductions that are summarized on Table II-10 |
| Indirect top-down emission reductions | 5,153.74 | See Table II-9 for P10 (or 10-year market potential). Causality factor of 40% was considered on 10-year potential as shown on Table II-10 |
| Indirect bottom-up emission reductions | 6.23 | Assumed replication factor of 10.0 times direct emission reductions. See Table II-11 for details |

B. Baseline Scenario

The lighting market for indoor general lighting: The current stock of indoor lighting lamps in Viet Nam is estimated at around 200 million. It is further estimated that of all the indoor lighting lamps installed, 50 million are incandescent, 80 million fluorescent tube lights (FTL), 60 million CFLs and the balance is some other special types.

The annual sale of lighting lamps is estimated at 140 million lamps, with 40 million incandescent, 60 million FTL, 40 million CFL. Other than a number of small manufacturers of various types of lighting products, Ralaco in the North and Dien Quang in the South are the major producers of indoor lighting lamps in Viet Nam. Together they produce around 140 million incandescent, FTL and CFLs annually.

⁶⁵ http://www.thegef.org/gef/sites/thegef.org/files/documents/C.33.Inf_.18%20Climate%20Manual.pdf

The total consumption of CFLs of all wattages in 2010 is about 40 million. As reported by Dien Quang and Ralaco manufacturers, among them the biggest amount is the CFL 18W occupying 50% (about 20 million), CFLs 14W occupying 33% of total (about 13 million), the rest 17% (about 7 million) is the CFL 25-30W.

The total consumption of FTLs of all kinds in 2010 is about 60 million. Also as reported by the same manufacturers, the biggest amount (70% of total) is FTLs T8-36W (about 42 million), and FTLs T8-18W is about 30% (18 million). The annual sales trends show that the sales of CFLs and T8 lamps have consistently been growing and they are replacing incandescent and T10 lamps. The national phasing out of incandescent lamps >= 60W is scheduled to be completed by 2014. It is estimated that by 2017 incandescent and T10 lamps would be phased out on global level.

The lighting market for outdoor general lighting: Currently the operating stock of outdoor lighting is estimated at around 600,000 lamps in Viet Nam, most of which are used for illuminating highways, roads, street, and alleys. As an impact of GEF funded VEEPL project by 2013-2014 all street lighting would be using energy efficient lamps and control technologies.

Assumptions

Under the baseline scenario it is assumed that lighting sector in Viet Nam will continue to follow the trends observed over recent years. The annual growth rate of lamps of all kinds is at 2%. Power transmission losses are about 10%. The use time for: (i) residential area: 5 hours; (ii) streets and construction sites: 11 hours; and commercial establishments and offices: 8 hours. The main types and quantity of lamps in the baseline scenario is in the Table 1 below.

Table II-2: Main types and quantity of lamps for baseline scenario calculation

| Year | Number of lamps to be used (mill. pieces) | | | | | | | | | |
|-------------------------------|---|------|------|------|------|----------|----------|------|------|-------------|
| | Incandescent | | CFL | | | FTL | | HPS | | Total lamps |
| | 100W | 75W | 30W | 18W | 14W | T8 - 36W | T8 - 18W | 250W | 150W | |
| Annual growth rate: 2% | | | | | | | | | | |
| 2010 | 10.0 | 30.0 | 7.0 | 20.0 | 13.0 | 42.0 | 18.0 | 0.4 | 0.2 | 140.6 |
| 2011 | 5.0 | 25.0 | 12.1 | 25.4 | 13.3 | 42.8 | 18.4 | 0.4 | 0.2 | 142.6 |
| 2012 | - | 20.0 | 17.4 | 30.9 | 13.5 | 43.7 | 18.7 | 0.4 | 0.2 | 144.8 |
| 2013 | - | 10.0 | 17.7 | 41.5 | 13.8 | 44.6 | 19.1 | 0.4 | 0.2 | 147.3 |
| 2014 | - | - | 18.1 | 52.4 | 14.1 | 45.5 | 19.5 | 0.4 | 0.2 | 150.1 |

C. Project Scenario

For the project scenario some assumptions for the calculation are as follow;

- 1) The annual growth rate of lamps of all kinds is at 2%.

- 2) The national phasing out of incandescent lamps $\geq 60\text{W}$ scheduled to be completed by 2014. From 2014, all incandescent lamps $\geq 60\text{W}$ to be replaced by relevant CFLs.
- 3) The total consumption of CFLs of all wattages in 2010 is about 40 million. As reported by Dien Quang and Ralaco manufacturers, among them the biggest amount is the CFL 18W occupying 50% (about 20 million), CFLs 14W occupying 33% of total (about 13 million), the rest 17% (about 7 million) is the CFL 25-30W.
- 4) The total consumption of FTLs of all kinds in 2010 is about 60 million. Also as reported by the same manufacturers, the biggest amount (70% of total) is FTLs T8-36W (about 42 million), and FTLs T8-18W is about 30% (18 million).
- 5) The annual growth rate of lamps of all kinds is at 2%.
- 6) LED replacement rate suggested to be 1.6% for 2017, and from 2018 onwards it will be at 10% for each year.
- 7) Power transmission losses are about 10%.
- 8) The use time for: (i) residential area: 5 hours; (ii) streets and construction sites: 11 hours; and commercial establishments and offices: 8 hours.

Under the project scenario, with GEF support, the aforementioned barriers in Paras 11 to 20 will be lowered. Quality standards for LED general lighting applications will be approved and enforced. There will be a transfer of skills, knowledge and technology to local manufacturers, enabling them to design, assemble and produce high quality LED lamps following an integrated design approach. As the local manufacturing base for high quality LED lamps develops, consumer confidence and demand for LED products will increase. Eventually, the cost of LED lighting products will come down, further stimulating growth in the market. By 2017, it is expected that LED lighting products will replace 1.6% of conventional lighting sources (equivalent to 2.5 million units) and by 2028, i.e., after 10 years of project end, the replacement will reach around 31.4% (about 62.2 million units). This market share would translate into avoided annual GHG emissions of at least 1.63 million tons of CO_2 compared to the baseline scenario. The main types and quantity of LED lamps to be replaced in the project scenario are depicted in the Table II-3.

CO₂ emission factor to be used:

In 2013, based on MoIT calculation results, MoNRE issued a new CO_2 emission factor of 0.6244 kg/kWh at Decision No 513/KTTVBDKH dated 28 May 2013. And from that day this emission factor must be applied for all CDM projects in Viet Nam.

D. Project Impact Analysis and “Top-Down” Calculation

The indirect impact calculation is based on the top-down methodology together with aforementioned assumptions. The results of the indirect calculation of projected electricity consumption and energy savings in lighting sector are briefed in the Table II-3.

For the calculation of CO_2 emission and CO_2 emission reduction of lighting sector two values of CO_2 emission factor have been used including (i) VEEPL's value: 0.43kg CO_2/kWh ; and (ii) MONRE's value: 0.6244kg CO_2/kWh . The calculation results are described in the Tables II-4 and II-5.

Table II-3: Projected Electricity Consumption in the Lighting Sector

| Year | Energy Usage (GWh) | | Energy Savings (GWh) | |
|------|--------------------|--------------|----------------------|------------|
| | Baseline Case | Project Case | Annual | Cumulative |
| 2015 | 11,586.8 | - | - | - |
| 2016 | 11,818.6 | - | - | - |
| 2017 | 12,055.0 | 11,965.0 | 90.0 | 90.0 |
| 2018 | 12,296.1 | 12,002.2 | 293.8 | 383.8 |
| 2019 | 12,542.0 | 12,019.4 | 522.6 | 906.4 |
| 2020 | 12,792.8 | 12,013.6 | 779.2 | 1,685.6 |
| 2021 | 13,048.7 | 11,981.5 | 1,067.1 | 2,752.7 |
| 2022 | 13,309.6 | 11,937.7 | 1,372.0 | 4,124.7 |
| 2023 | 13,575.8 | 11,861.8 | 1,714.0 | 5,838.7 |
| 2024 | 13,847.4 | 11,749.6 | 2,097.7 | 7,936.5 |
| 2025 | 14,124.3 | 11,607.2 | 2,517.1 | 10,453.6 |
| 2026 | 14,406.8 | 11,395.4 | 3,011.4 | 13,465.0 |
| 2027 | 14,694.9 | 11,316.1 | 3,378.8 | 16,843.8 |
| 2028 | 14,988.8 | 11,197.8 | 3,791.0 | 20,634.8 |

**Table II-4: Projected CO₂ Emissions from Lighting Sector
(Assuming VEEPL's emission factor of 0.43 kg/kWh)**

| Year | CO ₂ Emission (Ktons) | | CO ₂ Emission Reduction (Ktons) | |
|------|----------------------------------|--------------|--|------------|
| | Baseline Case | Project Case | Annual | Cumulative |
| 2015 | 4,982.3 | - | - | - |
| 2016 | 5,082.0 | - | - | - |
| 2017 | 5,183.6 | 5,144.9 | 38.7 | 38.7 |
| 2018 | 5,287.3 | 5,161.0 | 126.4 | 165.0 |
| 2019 | 5,393.0 | 5,168.3 | 224.7 | 389.8 |
| 2020 | 5,500.9 | 5,165.9 | 335.1 | 724.8 |
| 2021 | 5,610.9 | 5,152.1 | 458.9 | 1,183.7 |
| 2022 | 5,723.1 | 5,133.2 | 589.9 | 1,773.6 |
| 2023 | 5,837.6 | 5,100.6 | 737.0 | 2,510.7 |
| 2024 | 5,954.4 | 5,052.3 | 902.0 | 3,412.7 |
| 2025 | 6,073.4 | 4,991.1 | 1,082.4 | 4,495.0 |
| 2026 | 6,194.9 | 4,900.0 | 1,294.9 | 5,789.9 |
| 2027 | 6,318.8 | 4,865.9 | 1,452.9 | 7,242.8 |
| 2028 | 6,445.2 | 4,815.1 | 1,630.1 | 8,873.0 |

**Table II-5: Projected CO₂ Emissions from Lighting Sector
(Assuming MoNRE's emission factor of 0.6244 kg/kWh)**

| Year | CO2 Emission (Ktons) | | CO2 Emission Reduction (Ktons) | |
|------|----------------------|--------------|--------------------------------|------------|
| | Baseline Case | Project Case | Annual | Cumulative |
| 2015 | 7,234.8 | - | - | - |
| 2016 | 7,379.5 | - | - | - |
| 2017 | 7,527.1 | 7,470.9 | 56.2 | 56.2 |
| 2018 | 7,677.7 | 7,494.2 | 183.5 | 239.7 |
| 2019 | 7,831.2 | 7,504.9 | 326.3 | 566.0 |
| 2020 | 7,987.8 | 7,501.3 | 486.5 | 1,052.5 |
| 2021 | 8,147.6 | 7,481.3 | 666.3 | 1,718.8 |
| 2022 | 8,310.5 | 7,453.9 | 856.7 | 2,575.5 |
| 2023 | 8,476.8 | 7,406.5 | 1,070.2 | 3,645.7 |
| 2024 | 8,646.3 | 7,336.5 | 1,309.8 | 4,955.5 |
| 2025 | 8,819.2 | 7,247.5 | 1,571.7 | 6,527.2 |
| 2026 | 8,995.6 | 7,115.3 | 1,880.3 | 8,407.5 |
| 2027 | 9,175.5 | 7,065.8 | 2,109.7 | 10,517.2 |
| 2028 | 9,359.0 | 6,991.9 | 2,367.1 | 12,884.4 |

Summaries of the calculations of GHG reductions and energy savings from the indoor and outdoor demonstrations are provided on Tables II-6 and II-7 respectively.

Table II-8 provides the calculation of the potential cumulative CO₂ emissions reductions for the period of 10 years after the EOP (or P₁₀) that is used to calculate the “top-down” indirect emission reductions. The P₁₀ used is 12,884 ktons of CO₂. The detailed calculation spreadsheet for the indirect GHG potential for the top-down calculation is provided on Table II-8.

Table II-9 provides a summary of the direct and indirect GHG emission reductions as well as calculations of the lifetime energy saved (through to 10 years after EOP).

Table II-10 is a summary of the “bottom-up” (or replication) emission reductions of 6.3 kilotons of CO₂ based on the direct emission reductions.

Table II-11 is a summary of the “top-down” emission reductions of 5,154 kilotons CO₂ for the Project based on the 10-year market value of potential cumulative ERs (P₁₀) of 12,884 kilotons CO₂ and causality factor of 40%.

Table II-6: Summary of Indoor GHG Reductions from LED Project Activities

Baseline: Indoor Lights

| Detail | Unit | Value | |
|--------------------------------|----------------|-------|----------------------------------|
| Grid emissions factor Viet Nam | tonnes CO2/MWh | 0.62 | |
| Average power of FTLs and CFLs | watt | 23.06 | Total for all VAST indoor lights |
| Daily operation | hours | 8 | Includes lights for common areas |
| Annual operation | hours | 2920 | 365 days assumed |
| FTLs 2x36W | watt | 90 | Garment factory in |
| Daily operation | hours | 10 | Operational hours of the factory |
| Annual operation | hours | 3000 | 300 days assumed |

Project Intervention: Indoor Lights

| | | | |
|--|------|-------|------------------------|
| Dien Quang average power of LED Replacements @VAST | watt | 10.88 | Total for all VAST LED |
| Dien Quang 2x18W LEDs | watt | 44 | Replaces 2x36W lamp |

| | Unit | Value | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 | Year 13 | Year 14 | Total |
|---|-------------------------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
| | | | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 | 2024-25 | 2025-26 | 2026-27 | 2027-28 | |
| Direct GHG Emissions from Demo Replacements | | | | | | | | | | | | | | | | | | |
| VAST Residential Complex | | | | | | | | | | | | | | | | | | |
| 10.88W (weighted average) replacement from 23.06W | LED Lamps | | | | | 2,049 | 2,049 | 2,049 | 2,049 | 2,049 | 2,049 | 2,049 | 2,049 | 2,049 | 2,049 | 2,049 | 2,049 | 2,049 |
| Energy saved | MWh | | | | | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 |
| GHG Reduction | tonnes CO _{2e} | | | | | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 |
| Nha Be Garment Factory | | | | | | | | | | | | | | | | | | |
| 2x18W LED replacements | LED Lamps | | | | | 2,026 | 2,026 | 2,026 | 2,026 | 2,026 | 2,026 | 2,026 | 2,026 | 2,026 | 2,026 | 2,026 | 2,026 | 2,026 |
| Energy saved | MWh | | | | | 280 | 280 | 280 | 280 | 280 | 280 | 280 | 280 | 280 | 280 | 280 | 280 | 280 |
| GHG Reduction | tonnes CO _{2e} | | | | | 175 | 175 | 175 | 175 | 175 | 175 | 175 | 175 | 175 | 175 | 175 | 175 | 175 |
| Total direct + post-project direct (demo) GHG reductions | tonnes CO _{2e} | | | 0 | 0 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 | 220 |
| Direct post-project emissions from other outdoor applications (which received TA in Years 3 and 4 from Output 2.4) | | | | | | | | | | | | | | | | | | |
| Residential complexes - similar LED replacements as VAST | LED Lamps | | | | | | | 0 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 |
| Energy saved | MWh | | | | | | | | 2,133 | 2,133 | 2,133 | 2,133 | 2,133 | 2,133 | 2,133 | 2,133 | 2,133 | 2,133 |
| GHG Reduction | tonnes CO _{2e} | | | | | | | | 1,332 | 1,332 | 1,332 | 1,332 | 1,332 | 1,332 | 1,332 | 1,332 | 1,332 | 1,332 |
| Other factory & commercial facilities similar to Nha Be Factory | LED Lamps | | | | | | | 0 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 |
| Energy saved | MWh | | | | | | | | 8,280 | 8,280 | 8,280 | 8,280 | 8,280 | 8,280 | 8,280 | 8,280 | 8,280 | 8,280 |
| GHG Reduction | tonnes CO _{2e} | | | | | | | 0 | 5,170 | 5,170 | 5,170 | 5,170 | 5,170 | 5,170 | 5,170 | 5,170 | 5,170 | 5,170 |
| | LED Lamps | | | | | | | | | | | | | | | | | |
| | MWh | | | | | | | | | | | | | | | | | |
| | tonnes CO _{2e} | | | | | | | | | | | | | | | | | |
| | LED Lamps | | | | | | | | | | | | | | | | | |
| | MWh | | | | | | | | | | | | | | | | | |
| | tonnes CO _{2e} | | | | | | | | | | | | | | | | | |
| Total post-project direct GHG reductions (receiving TA) | tonnes CO _{2e} | | | 0 | 0 | 0 | 0 | 0 | 6,502 | 6,502 | 6,502 | 6,502 | 6,502 | 6,502 | 6,502 | 6,502 | 6,502 | 65,021 |
| Total GHG reductions | tonnes CO _{2e} | | | 0 | 0 | 220 | 220 | 220 | 6,722 | 6,722 | 6,722 | 6,722 | 6,722 | 6,722 | 6,722 | 6,722 | 6,722 | 67,662 |

Start of GEF Project → End of GEF Project →

Summary of Results for Indoor Demo on Table II-6

| | | | | | | | | | |
|---|-------------------------|-----------|---|--|--|--|--|--|--|
| Direct emission reductions | tonnes CO _{2e} | 623 | emission reductions from demos during Project duration | | | | | | |
| Direct post-project emission reductions: | tonnes CO _{2e} | 69,382 | emission reductions from LEDs installed at facilities where owners or managers received TA during Project | | | | | | |
| Indirect emission reductions (top-down): | tonnes CO _{2e} | 5,153,741 | Includes outdoor lights | | | | | | |
| Indirect emission reductions (bottom-up): | tonnes CO _{2e} | 6,228 | Includes outdoor lights | | | | | | |
| Total emission reductions: | tonnes CO _{2e} | 5,229,973 | | | | | | | |
| Total direct energy saved for indoor demos during Project | | 705 MWh | | | | | | | |

P10 or 10-year market potential for GHG reductions:

| | | |
|---|--------|------------------------|
| Estimated % of total power consumption from indoor lighting in 2012 | 25.3% | EVN 2012 Annual Report |
| Grid emissions factor for 2008 | 0.5764 | tCO ₂ /MWh |
| Assumed grid emissions factor after 2013 | 0.6244 | tCO ₂ /MWh |

Lifetime energy saved:

| | | |
|--|-------------|------------------|
| Annual savings for LED demos | 400 | MWh |
| | 1,438,351 | MJ |
| Annual saving for LEDs receiving TA during the Project | 10,613 | MWh |
| | 38,206,796 | MJ |
| Life time for LED lights | 15 | years |
| Lifetime energy saved: | 573,101,938 | MJ |
| Life time direct emission reductions | 3,742 | tCO ₂ |
| Lifetime direct post-project emissions reduced | 99,401 | tCO ₂ |
| Life time indirect emission reductions (bottom-up) | 9,342 | tCO ₂ |
| Lifetime indirect emission reductions (top-down) | 7,730,611 | tCO ₂ |

Table II-7: Summary of Outdoor GHG Reductions from LED Project Activities

Baseline: Outdoor Lights

| Detail | Unit | Value | |
|--|----------------|-------|--|
| Grid emissions factor Viet Nam | tonnes CO2/MWh | 0.62 | |
| High Pressure Sodium Lamps (HPS lamps) | watt | 275 | Street lights in Da Nang, and bridge to Hai Phong City |
| HPS lamps | watt | 80 | Street lights in HCMC |
| Daily operation | hours | 11 | for streetlights |
| Annual operation | hours | 4015 | 365 days assumed |
| High Pressure Sodium Lamps (HPS lamps) | watt | 275 | Industrial site in Hanoi |
| HPS lamps | watt | 0 | Industrial |
| Daily operation | hours | 10 | Industrial site |
| Annual operation | hours | 3000 | 300 days assumed |
| High Pressure Sodium Lamps (HPS lamps) | watt | 165 | Hoa Lac High Tech |
| HPS lamps | watt | 0 | Industrial |
| Daily operation | hours | 11 | Industrial site |
| Annual operation | hours | 4015 | 365 days assumed |
| Metal Halide Lamps | watt | 125 | Construction Site in Hanoi |
| Metal Halide Lamps | watt | 0 | Construction Site |
| Daily operation | hours | 10 | Construction Site |
| Annual operation | hours | 1500 | 150 days assumed |

Project Intervention: Outdoor Lights

| | | | |
|------------------------------------|------|-----|------------------------|
| Ralaco and Schreder LED 150W Lamps | watt | 158 | Replaces 275 W lamp |
| Ralaco LED 35W Lamps | watt | 40 | Replaces 80 W lamp |
| Ralaco LED 70W Lamps | watt | 80 | Replaces 125W MH lamp |
| Schreder 100W Lamps | watt | 100 | Replaces 165W HPS lamp |

| | Unit | Value | Year 0 2014-15 | Year 1 2015-16 | Year 2 2016-17 | Year 3 2017-18 | Year 4 2018-19 | Year 5 2019-20 | Year 6 2019-20 | Year 7 2020-21 | Year 8 2021-22 | Year 9 2022-23 | Year 10 2023-24 | Year 11 2024-25 | Year 12 2025-26 | Year 13 2026-27 | Year 14 2027-28 | Total | |
|---|--------------------|-------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|--------------------|--------------------|--------------------|--------------------|-------|-------|
| Direct GHG Emissions from Demo Replacements | | | | | | | | | | | | | | | | | | | |
| Ralaco LED Street Lights | | | | | | | | | | | | | | | | | | | |
| 150W LED replacements | LED Lamps | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Energy saved | MWh | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GHG Reduction | tonnes CO2e | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Ralaco LED Street Lights | | | | | | | | | | | | | | | | | | | |
| 35W LED replacements | LED Lamps | | | | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | |
| Energy saved | MWh | | | | | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| GHG Reduction | tonnes CO2e | | | | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | |
| Ralaco Industrial LEDs | | | | | | | | | | | | | | | | | | | |
| 150W LED replacements | LED Lamps | | | | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | |
| Energy saved | MWh | | | | | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | |
| GHG Reduction | tonnes CO2e | | | | | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | |
| Ralaco Construction Site LEDs | | | | | | | | | | | | | | | | | | | |
| 80W LED Floodlight replacements | LED Lamps | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Energy saved | MWh | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| GHG Reduction | tonnes CO2e | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Schreder LED Street Light Demo 1 | | | | | | | | | | | | | | | | | | | |
| 150W LED replacements | LED Lamps | | | | | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | |
| Energy saved | MWh | | | | | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | |
| GHG Reduction | tonnes CO2e | | | | | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | |
| Schreder LED Street Light Demo 2 (bridge to Hai Phong City) | | | | | | | | | | | | | | | | | | | |
| 100W LED Streetlight replacements | LED Lamps | | | | | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | |
| Energy saved | MWh | | | | | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | |
| GHG Reduction | tonnes CO2e | | | | | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | |
| Total direct + post-project direct (demo) GHG reductions | tonnes CO2e | | | | | 0 | 0 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 1,096 |
| Direct post-project emissions from other outdoor applications (which received TA in Years 3 and 4 from Output 2.4) | | | | | | | | | | | | | | | | | | | |
| 150W LEDs (street lighting applications) | LED Lamps | | | | | | | 0 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | |
| Energy saved | MWh | | | | | | | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 | |
| GHG Reduction | tonnes CO2e | | | | | | | 0 | 59 | 59 | 59 | 59 | 59 | 59 | 59 | 59 | 59 | 59 | |
| 150W LEDs (industrial lighting applications) | LED Lamps | | | | | | | 0 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | |
| Energy saved | MWh | | | | | | | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | |
| GHG Reduction | tonnes CO2e | | | | | | | 0 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | |
| 35W LED replacements (Street lighting applications) | LED Lamps | | | | | | | 0 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | |
| Energy saved | MWh | | | | | | | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | |
| GHG Reduction | tonnes CO2e | | | | | | | 0 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | |
| 80W LEDs (construction site applications) | LED Lamps | | | | | | | 0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | |
| Energy saved | MWh | | | | | | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | |
| GHG Reduction | tonnes CO2e | | | | | | | 0 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | |
| Total post-project direct GHG reductions (receiving TA) | tonnes CO2e | | | | | 0 | 0 | 0 | 0 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 1,247 | |
| Total GHG reductions | tonnes CO2e | | | | | 0 | 0 | 91 | 91 | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 216 | 2,343 | |

Start of GEF Project → End of GEF Project →

Summary of Results for Outdoor Demo on Table II-7

| | | | | | | | | | | | | |
|--|-------------------------|-------|--|--|--|--|--|--|--|--|--|--|
| Direct emission reductions | tonnes CO _{2e} | 183 | emission reductions from demos during Project duration | | | | | | | | | |
| Direct post-project emission reductions: | tonnes CO _{2e} | 2,160 | emission reductions from LEDs installed at facilities where owners or managers received TA during Project | | | | | | | | | |
| Indirect emission reductions (top-down): | tonnes CO _{2e} | | Due to the small estimate of 600,000 outdoor lights in Viet Nam (see Para 7), these emission reductions have been included with the indoor lighting calculations | | | | | | | | | |
| Indirect emission reductions (bottom-up): | tonnes CO _{2e} | 0 | Included in the ERs for indoor Demos | | | | | | | | | |
| Total emission reductions: | tonnes CO _{2e} | 2,343 | | | | | | | | | | |
| Total direct energy saved during Project | | 293 | MWh | | | | | | | | | |

Table II-9: Summary of Emission Reductions and Lifetime Energy Saved by LED Project Activities

| | | | | | | | | | |
|---|-------------------------|-----------|---|--|--|--|--|--|--|
| Direct emission reductions | tonnes CO _{2e} | 623 | emission reductions from demos during Project duration | | | | | | |
| Direct post-project emission reductions: | tonnes CO _{2e} | 69,382 | emission reductions from LEDs installed at facilities where owners or managers received TA during Project | | | | | | |
| Indirect emission reductions (top-down): | tonnes CO _{2e} | 5,153,741 | Includes outdoor lights | | | | | | |
| Indirect emission reductions (bottom-up): | tonnes CO _{2e} | 6,228 | Includes outdoor lights | | | | | | |
| Total emission reductions: | tonnes CO _{2e} | 5,229,973 | | | | | | | |
| Total direct energy saved for indoor demos during Project | | 705 | MWh | | | | | | |

P10 or 10-year market potential for GHG reductions:

| | | |
|---|--------|------------------------|
| Estimated % of total power consumption from indoor lighting in 2012 | 25.3% | EVN 2012 Annual Report |
| Grid emissions factor for 2008 | 0.5764 | tCO ₂ /MWh |
| Assumed grid emissions factor after 2013 | 0.6244 | tCO ₂ /MWh |

Lifetime energy saved:

| | | |
|--|-------------|------------------|
| Annual savings for LED demos | 400 | MWh |
| | 1,438,351 | MJ |
| Annual saving for LEDs receiving TA during the Project | 10,613 | MWh |
| | 38,206,796 | MJ |
| Life time for LED lights | 15 | years |
| Lifetime energy saved: | 573,101,938 | MJ |
| Life time direct emission reductions | 3,742 | tCO ₂ |
| Lifetime direct post-project emissions reduced | 99,401 | tCO ₂ |
| Life time indirect emission reductions (bottom-up) | 9,342 | tCO ₂ |
| Lifetime indirect emission reductions (top-down) | 7,730,611 | tCO ₂ |

Table II-10: Summary of “Bottom-Up” Emission Reductions

| | | | |
|---------------------------------|--|--|--|
| Step 15 | Enter Replication Factor. Please refer to section 2 (e) in the Manual for further guidance. Also see table below for standardized suggestions. Not all projects will fit these suggestions, if using a different replication factor explain rational in the assumptions box. | 15) Replication Factor | 10 |
| Notes: | Project will create market transformative environment along with demonstrations of LED technologies and effective awareness programmes | | |
| Assumptions: | Replication factor based on the assumption that private sector entities will want to replicate LED installations for cost savings and compliance with national decrees on EE lighting. | Direct Emissions Reductions | 623 |
| Standardized Suggestions | | | |
| | Project Type | Suggested Replication Factor | |
| | Solar Home Systems | 2 | |
| | ESCO | 2 | |
| | Market transformation and demonstration capital | 3 | |
| | Credit and guarantee facilities | 4 | |
| Step 16 | Sense check automatic results | 16) Results: Indirect bottom up-emissions | 6,227.92 Tons CO2 e 6.23 KT CO2 e 0.01 MT CO2 e |

Table II-11: Summary of “Top-Down” Emission Reductions

| | | | |
|---------------------------------|--|---|---|
| Indirect Top Down | | | |
| Step 17 | Enter 10 year market potential | 17) Enter P10 (Tons CO2 e) | 12,884,352 |
| Notes: | Based on analysis of lighting market | | |
| Assumptions: | Based on availability of quality LEDs in Viet Nam that are competitively priced coupled with effective awareness programmes on the benefits of LED installations. The Government has not yet set any national targets for market penetration of LED lighting | | |
| Step 18 | Enter GEF Causality Factor. Please refer to section 2 (e) in the Manual for further guidance. Also see table below for standardized suggestions. | 18) Enter Causality Factor (%) | 40 |
| Notes: | The Project will setup an enabling environment for investment into local LED manufacturing which includes LED standards and enforcement | | |
| Assumptions: | Demand for LEDs will increase due to reduction of LED prices in Viet Nam and strong awareness programmes on the benefits of LEDs. | | |
| Standardized Suggestions | | | |
| | Pick Causality Factor | % | |
| | Level 5 - "Critical" | 100 | |
| | Level 4 - "dominating" | 80 | |
| | Level 3 - "substantial but modest" | 60 | |
| | Level 2 - "modest" | 40 | |
| | Level 1 - "weak" | 20 | |
| Step 19 | Sense check automatic results | 19) Results: Indirect top-down emissions | 5,153,741 Tons CO2 e 5,153.74 KT CO2 e 5.15 MT CO2 e |

Annex III: Overview of LED Software

a) **Comsol Multiphysics Software with Two Modules of Heat Transfer and CFD (Comsol producer) (~US\$30,000)**

The Comsol Multiphysics software is the simulation tool for Electrical, Mechanical, Fluid Flow, and Chemical applications. Comsol Multiphysics is a multipurpose software platform for finite element analysis and solver. Its Heat Transfer module is capable to analyze/calculate heat transfer phenomenon in bulk materials; meanwhile the CFD module allows us to analyze/calculate the heat transfer phenomenon by air convection. The combination of these two modules supports strongly lighting system design by pre-determining the thermal distribution of operating lighting systems – one of the key issues directly affecting the lifetime and the reliability of the systems.

Detail description of two modules is as follows:

• **CFD Module - Simulation Software for All Fluid Flow Applications**

The CFD Module is the platform for simulating devices and systems that involve sophisticated fluid flow models. As is the case with all modules in the COMSOL Product Suite, the CFD Module provides ready-made physics interfaces that are configured to receive model inputs via the graphical user interface (GUI), and to use these inputs to formulate model equations. The particular physics interfaces that the CFD Module is equipped with enable you to model most aspects of fluid flow, including descriptions of compressible, non-isothermal, non-Newtonian, two-phase, and porous media flows – all in the laminar and turbulent flow regimes. The CFD Module can be used as a standard tool for simulating computational fluid dynamics (CFD), or in collaboration with the other modules in the COMSOL Product Suite for multiphysics simulations where fluid flow is important.

The CFD Module GUI grants you full access to all steps in the modeling process. This includes the following steps:

- Selecting the appropriate description of the flow, for example single-phase or two-phase, laminar or turbulent flows, etc.
- Creating or importing the model geometry;
- Defining the fluid properties;
- Adding source and sink terms, or editing the underlying equations of the fluid model, if required;
- Selecting mesh elements and controlling the density of the mesh at different positions;
- Selecting solvers and tuning them, if required.

• **The Heat Transfer Module**

The Heat Transfer Module helps investigate the effects of heating and cooling in devices, components, or processes. The module furnishes you with simulation tools to study the mechanisms of heat transfer – conduction, convection, and radiation – often in collaboration with other physics, such as structural mechanics, fluid dynamics, electromagnetics, and chemical reactions. In this context, the Heat Transfer Module acts as a platform for all possible industries and applications where the creation, consumption, or transfer of heat or energy is the focus of, or contributes significantly to, the studied process.

The Heat Transfer Module comes stocked with an internal material database containing the material properties of a number of common fluids and gases that includes many of the thermodynamic data required for accurate analysis. This includes thermal conductivity, heat capacities, and densities. The Material Library is also a source for material properties, with

either the data or algebraic relations of over 2,500 solid materials, where many of their properties, such as Young's Modulus and electrical conductivity, are temperature-dependent. The Heat Transfer Module also supports the import of thermodynamic and other material data from Excel® and MATLAB®, and for connecting with external thermodynamic databases through the CAPE-OPEN interfacing standard.

The COMSOL Group provides software solutions for multiphysics modeling. It is a fast growing high tech engineering software company with a proven track record and a vision as a leader of the industry. The company was founded in July 1986 in Stockholm, Sweden. It has grown to include offices in Brazil, China, Denmark, Finland, France, Germany, the Netherlands, Norway, India, Italy, Switzerland, the United Kingdom, and the U.S.A.

The corporate culture, like its products, is innovative, vibrant, and cutting edge. It is committed to encouraging creativity through an exciting, challenging environment in which individuals excel and grow. Talented employees and an active learning environment are the keys to its success. This has allowed them to grow to a staff of 350 people.

In 1998, the company released the first version of its flagship product, COMSOL Multiphysics. In subsequent years, its product line has expanded to include a suite of discipline-specific add-on modules for Structural Mechanics, High and Low Frequency Electromagnetics, Fluid Flow, Heat Transfer, Chemical Reactions, MEMS, Acoustics, and more. It has added LiveLink products for CAD software, MATLAB®, and Excel® that deliver a seamless integration between COMSOL Multiphysics simulations and CAD packages, MATLAB and Excel. Multipurpose tools are also available and boost the functionality of our simulation platform to provide the CAE market with the best-in-class solution for verifying and optimizing your designs. Its mission is to:

- Develop easy-to-use software for modeling and simulation of real world multiphysics systems;
- Assist the users in getting the most out of its products;
- Sustain and reinforce COMSOL's position as a leading provider and developer of technical computing software; and,
- Make its technology the primary tool for engineers, researchers and lecturers in the education and hi-tech product design fields.

b) TRACE PRO software (LAMBDA producer) (~US\$20,000)

TRACE PRO is a supplemental software to the LITESTAR software. It is opto-mechanical software used for design, analysis, and optimization of optical and illumination systems. With its intuitive CAD interface and powerful features like interactive optimizers, TRACE PRO offers users a sophisticated and powerful optical design environment.

TRACE PRO streamlines the prototype to manufacturing process by combining an intuitive 3D CAD interface, advanced utilities, and seamless interoperability with other mechanical design programs.

Lambda Research Corporation, a privately-held company founded in 1992, is an industry leader in optical analysis, illumination system design and analysis, and custom software development. Lambda Research Corporation publishes TRACE PRO, an award-winning opto-mechanical design software used for designing and analyzing illumination and optical systems.

www.lambdares.com

Conclusion:

Both LITESTAR 4D and the TRACE PRO software will be used for all types of lamps for indoor and outdoor lighting including the LED indoor height bay & outdoor alley lamps to be manufactured by RALACO and demonstrated by the Project.

c) ANSYS ICEPAK Software (ANSYS producer) (US\$25,000)

ANSYS ICEPAK software provides robust and powerful computational fluid dynamics (CFD) for electronics thermal management. Based on the renowned ANSYS FLUENT solver, ANSYS ICEPAK combines advanced solver technology with robust meshing options designed to provide fast and accurate thermal results for electronics cooling applications.

Figure III-1: Fluid streamlines and temperature contours for 1U network server

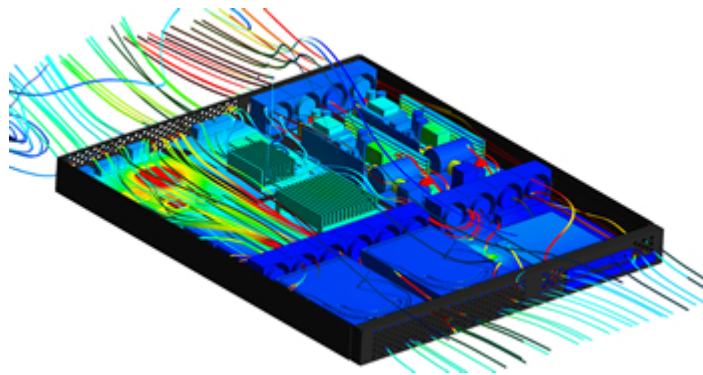
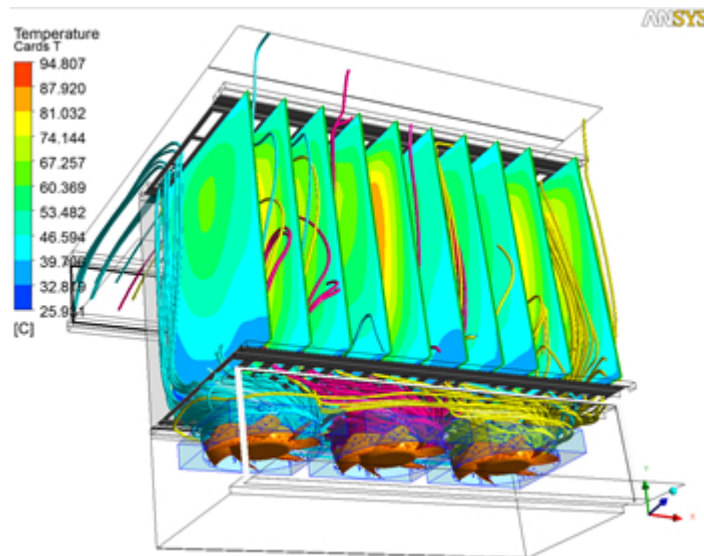


Figure III-2: Velocity streamlines colored by fan for a card array in a VME format box cooled by 3 axial fans, image created using ANSYS CFD-Post



For more than a decade, companies around the world have relied on ANSYS ICEPAK to carry out rapid heat transfer and fluid flow analysis of IC packages, printed circuit boards and complete electronic system as well as to perform easy validation of design modifications before building any physical prototypes. Founded in 1970, ANSYS employs about 2,600 professionals, and many of them are engineering experts in fields such as finite element analysis, computational fluid dynamics, electronics and electromagnetics, and design optimization. The ANSYS's staff includes more master's and Ph.D.-level engineers than any other simulation provider.

ANSYS is passionate about pushing the limits of world-class technology, all so our customers can turn their design concepts into successful, innovative products. The company has been [recognized as one of the world's most innovative and fastest –growing companies](#) by prestigious organizations including BusinessWeek and FORTUNE magazines. Over the years, the ANSYS's steady growth and financial strength reflects its commitment to innovation and R&D. The Company reinvest 15 percent of its revenues each year into research to continually refine its software. It is listed on the NASDAQ stock exchange.

d) FLoTHERM Software (MENTOR GRAPHICS producer) (US\$15,000)

FLoTHERM is a supplemental software to above ANSYS ICEPAK software.

FLoTHERM software performs thermal analysis, create virtual models, and test design modifications of electronic equipment before physical prototyping.

FLoTHERM uses advanced CFD techniques to predict airflow, temperature, and heat transfer in components, boards, and complete systems, including racks and data centers. It's also the industry's best solution for integration with MCAD and EDA software.

FLoTHERM is the undisputed world leader for electronics thermal analysis, with a 98 percent user recommendation rating. It supports more users, application examples, libraries and published technical papers than any competing product.

FLoTHERM is a key component of the simulation-based design decisions strategy, ensuring that the thermal design goals are met.

FLoTHERM is the market-leading electronics cooling simulation software with more installed seats than all other electronics cooling CFD software. For over 25 years FLoTHERM has been used by a huge customer base, including almost all the major blue-chip electronics companies in the world. FLoTHERM supports chip, package, board and system design, and even extends out to data centers. It is designed as a vertically-specialized solution for the electronics thermal market through its innovative SmartPart technology, extensive libraries, tailored and stable solution technology, state-of-the art compact thermal modelling techniques and parametric analysis & optimization functionality. FLoTHERM features advanced interfacing technologies for working with EDA data from Mentor Graphics, Cadence and Zuken and is backed by a family of ancillary solutions for PCB (FLoTHERM PCB) and package modelling (FLoTHERM PACK and FLoTHERM IC).

Mentor Graphics, Inc is a [US-based multinational corporation](#) dealing in [electronic design automation](#) (EDA) for [electrical engineering](#) and [electronics](#). In 2004 it was ranked third in the EDA industry it helped create. Founded in 1981, the company is headquartered in [Wilsonville, Oregon](#) and employs roughly 4,400 people worldwide with annual revenues of around \$1 billion.

Conclusion: The ANSYS ICEPAK and FLoTHERM software will be used for all types of lamps for indoor and outdoor lighting including the LED indoor lamps to be manufactured by Dien Quang Company and demonstrated by the Project.

Annex IV: Overview of Other LED Manufacturing Equipment for Viet Nam

For these local LED manufacturers, implementing these investments to scale up LED lamp production has been difficult without foreign strategic alliances to provide the design and technical assistance on the equipment configurations for scaled-up LED lamp production. *Despite numerous attempts to secure foreign technical assistance related to LED lamp manufacturing, these manufacturers are still experiencing difficulties in securing their services to advise them on how to approach these investments* that may include the processes within the red enclosure on Figure IV-1 including:

- LED driver production technology which the manufacturers can design and assemble themselves;
- Design and control of spare parts such as the PCB and heat sink for which the manufacturers need a guideline on heat management design for LED lamps produced by their facilities;
- LED packaging manufacturing that is dominated by G7 countries as well as Taiwan, Korea and China and comprises 65% of the manufacturing costs of an LED light. One of the large lighting manufacturers in Viet Nam has expressed interest in an investment and technology transfer for this equipment in Viet Nam to be supplied from either the Nihon Garter or JIU Company of Japan.

Other LED equipment required for Vietnamese-based lighting device manufacturers includes Surface Mount Technology (SMT) technology and its components known as Surface Mount Device (SMD). SMT technology can be used in the manufacture of LED packages. The advantages of SMT and SMD components include smaller size of the resulting circuit and compression devices; increased quality and production speed through automation; no drilling operations; and cleaner production than previous generations of semiconductor manufacturing. This technology requires clean operation and a regulated environment.

As an example, Essemtec, a Swiss manufacturer of production systems, has a production line consisting of a large-format printing system, multiple pick-and-place machines and a curing or reflow system⁶⁶. The line can produce all lengths of LED tube lamps up to 180 cm. The inline screen and stencil printer, invented by Essemtec, has a printable area of 180 cm x 50 cm that allows a panel for multiple 180 cm tubes that can be printed in one run. The machine loads and prints PCBs fully automatically and forwards them to the pick-and-place system. The inline conveyor system is designed to transport heavy aluminum-based PCB commonly used for LED products.

An LED lighting production line based on SMT technology includes: (i) Stencil Printer Machine; (ii) Pick & Place Machine; (iii) Reflow Oven; (iv) Automatic Optical Inspection (AOI); and (v) supporting equipment (Conveyors, Feeders). Until recently, fully automated manufacturing of LED lamps was not possible because of limitations of the available inline printing systems. One or more pick-and-place machines are installed in-line to mount LEDs and other electronic components onto the PCB. The number of machines only depends on the desired line throughput. The Management Information System (MIS) software developed by Essemtec, automatically balances the work load over multiple machines to get maximum line output. The MIS also serves other functions such as quality assurance, consumption and stock management, and the storage of production data for traceability.

For curing and soldering of the components onto the PCB, a high-performance reflow or curing system is installed inline. The oven is optimized for the unique needs of large and heavy boards and provides constant process conditions at every position. For example, it can be completed with handling and inspection modules. For ESD or moisture-sensitive components, it is recommended to use the “tower” automatic preservation system. Figure 5 depicts the detailed composition of SMT pick

⁶⁶ <http://www.essemtec.com>

and place lines designed for the operation. Component SMT lines are mostly modular but can be used to attach other necessary equipment.

Figure IV-1: LED Manufacturing Process

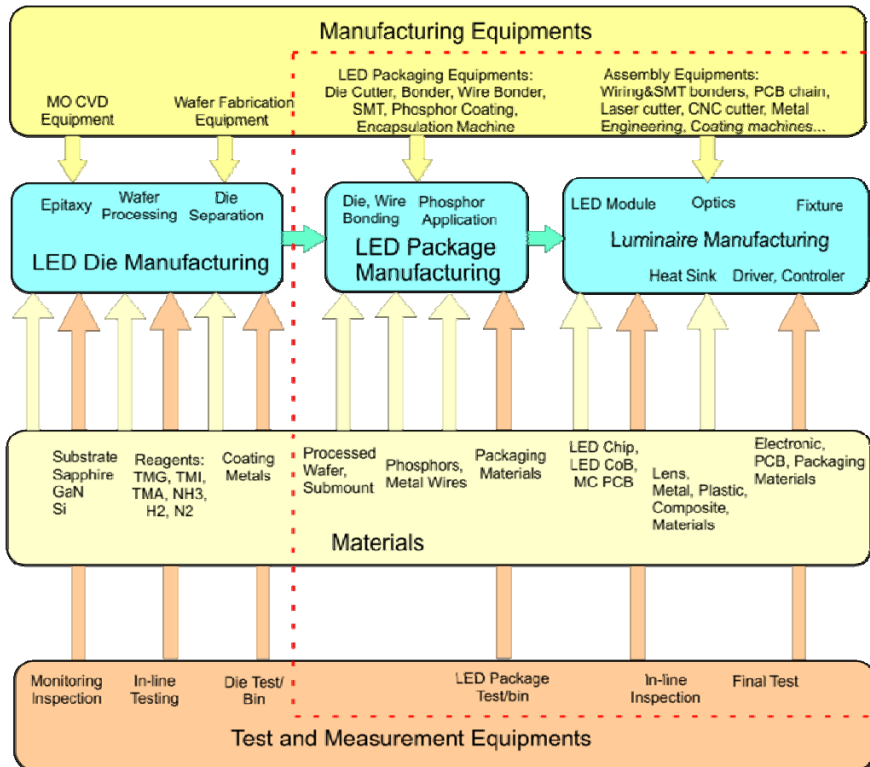
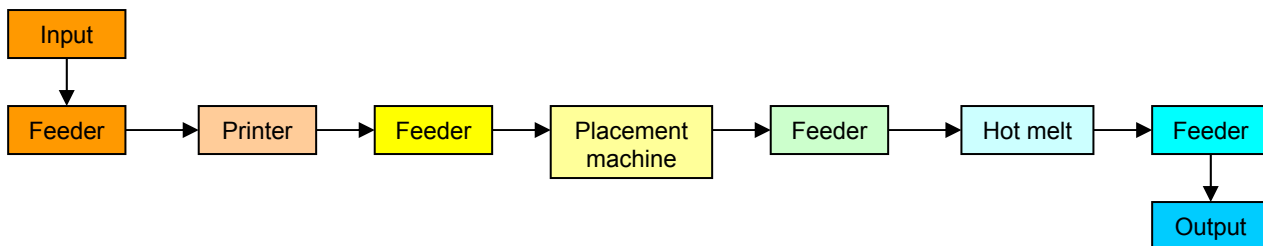


Figure IV-2: Diagram of SMT lines designed for the entry



Annex V: Annual Targets

| Strategy | Objectively Verifiable Indicator | | | Year 1 | Year 2 | Year 3 | Year 4 |
|--|--|-------------|------------------------------------|-------------|-------------|------------------------------|------------------------------------|
| | Indicator Description | Baseline | Target | | | | |
| Objective: | Cumulative direct and indirect CO ₂ emission reductions by EOP, tonnes CO ₂ . | negligible | 623 (direct) | 0 | 0 | 311 | 623 |
| | Cumulative direct and indirect energy saving (MWh) by EOP | negligible | 1,000 (direct) 3,000 (indirect) | 0 | 0 | 450 (direct) 0 (Indirect) | 1,000 (direct) 3,000 (indirect) |
| Outcome 1: Development of a local LED industry that provides locally produced quality LED lamps that are increasingly in demand by local consumers | Number of LED manufacturing plants that have advanced manufacturing to produce LEDs that meet new VN standards for LEDs by EOP | 0 | 3 | 0 | 3 | 3 | 3 |
| | Number of retailers that sell locally labeled LED lighting products by EOP | 0 | 200 | 0 | 0 | 0 | 200 |
| | Number of new LED lighting products that are standardized by Year 3 | 0 | 6 | 0 | 0 | 6 | 6 |
| | Number of new LED products that are labeled by Year 3 | 0 | 4 | 0 | 0 | 4 | 4 |
| Outcome 2: Increased use and deployment of locally-produced high-quality LED lighting technologies. | % rural and urban households and commercial establishments that have purchased locally produced LED lamps by EOP | <1 | 10 | 0 | 0 | 5 | 10 |
| | % of market share of locally produced LED lamps in the Vietnamese lighting market by EOP | <1 | 7 | <1 | <1 | 3 | 7 |
| | Annual number of sold LED lamps that are locally produced and certified LED lights in Viet Nam by EOP | 1.3 million | 15 million | 1.3 million | 1.3 million | 6 million | 15 million |

Annex VI: Agreements on Implementation Support Service

STANDARD LETTER OF AGREEMENT BETWEEN UNDP AND THE GOVERNMENT OF VIET NAM FOR THE PROVISION OF SUPPORT SERVICES

Dear Mr. Nguyen Van Thao,

1. Reference is made to consultations between officials of the Viet Nam Academy of Science and Technology (hereinafter referred to as “the Academy”) and officials of UNDP with respect to the provision of support services by the UNDP Viet Nam country office for nationally managed project “*Local Development and Promotion of LED Technologies for Advanced General Lighting in Viet Nam (LED)*”. UNDP and the Academy hereby agree that the UNDP country office may provide such support services at the request of the Academy through its institution designated in the relevant project document, as described below.
2. The UNDP country office may provide support services for assistance with reporting requirements and direct payment. In providing such support services, the UNDP country office shall ensure that the capacity of the Academy-designated institution is strengthened to enable it to carry out such activities directly. The costs incurred by the UNDP country office in providing such support services shall be recovered from the administrative budget of the office.
3. The UNDP country office may provide, at the request of the designated institution, the following support services for the activities of the project:
 - a) Identification and/or recruitment of project personnel;
 - b) Identification and facilitation of training activities;
 - c) Procurement of goods and services;
4. The procurement of goods and services and the recruitment of project personnel by the UNDP country office shall be in accordance with the UNDP regulations, rules, policies and procedures. Support services described in paragraph 3 above shall be detailed in an annex to project document, in the form provided in the Attachment hereto. If the requirements for support services by the country office change during the life of a project, the annex to the programme support document or project document is revised with the mutual agreement of the UNDP resident representative and the designated institution.
5. The relevant provisions of the Standard Basic Assistance Agreement between the Government of Viet Nam and the United Nations Development Program, signed by the parties on 21 March 1978 (the “SBAA”), including the provisions on liability and privileges and immunities, shall apply to the provision of such support services. The Academy shall retain overall responsibility for the nationally managed project through its designated institution. The responsibility of the UNDP country office for the provision of the support services described herein shall be limited to the provision of such support services detailed in the annex to the programme support document or project document.
6. Any claim or dispute arising under or in connection with the provision of support services by the UNDP country office in accordance with this letter shall be handled pursuant to the relevant provisions of the SBAA.



A handwritten signature in blue ink is located at the bottom right of the page.

7. The manner and method of cost-recovery by the UNDP country office in providing the support services described in paragraph 3 above shall be specified in the annex to the project document.
8. The UNDP country office shall submit progress reports on the support services provided and shall report on the costs reimbursed in providing such services, as may be required.
9. Any modification of the present arrangements shall be effected by mutual written agreement of the parties hereto.
10. If you are in agreement with the provisions set forth above, please sign and return to this office two signed copies of this letter. Upon your signature, this letter shall constitute an agreement between your Academy and UNDP on the terms and conditions for the provision of support services by the UNDP country office for nationally managed programmes and projects.

Yours sincerely,



Signed on behalf of UNDP

Bakhodir Burkhanov
Deputy Country Director

Date: 19/8/2014



For the Viet Nam Academy of Science and Technology

Mr. Nguyen Van Thao
Director, Centre for High Technology Development

Date: 20/8/2014



Attachment

DESCRIPTION OF UNDP COUNTRY OFFICE SUPPORT SERVICES

1. Reference is made to consultations between the Viet Nam Academy of Science and Technology (VAST), the institution designated by the Government of Viet Nam and officials of UNDP with respect to the provision of support services by the UNDP country office for the nationally managed project “Local Development and Promotion of LED Technologies for Advanced General Lighting in Viet Nam (LED)”.
2. In accordance with the provisions of the letter of agreement signed on [*insert date of agreement*] and the project document, the UNDP country office shall provide support services for the Project as described below.
3. Support services to be provided:

| Support services (insert description) | Schedule for the provision of the support services | Cost to UNDP of providing such support services (where appropriate) (*) | Amount and method of reimbursement of UNDP (where appropriate) (**) |
|---|--|--|---|
| 1. Identification and recruitment of project personnel (International Technical Specialist) | At the start of the project | US\$ 1,830 | US\$ 1,830 |
| 2. Procurement of goods and services (for project inception, evaluation and technical inputs) | During the tenure of project | US\$ 525/ each procurement case (estimated 5 cases) | US\$ 2,625 |
| 3. Direct payments/ Financial support (i.e. vendor creation, voucher, issue check, EFT process, F10 settlement, spot check) | During the tenure of the project | US\$ 1,645 @ 4 years | US\$ 6,585 |
| 4. Admin. and Support services (management of event, visa request, outgoing mail, travel authorization, ticket request) | During the tenure of the project | US\$ 990 @ 4 years | US\$ 3,960 |
| Total (Estimated) | | | US\$15,000 |

(*) Cost to UNDP of providing support service will be charged on transactional basis and based on the UNDP Viet Nam price list effective at the time of transaction.

(**) Amount will be charged at the end of each quarter based on transactions which occur during the quarter.

4. Description of functions and responsibilities of the parties involved:

- The National Project Director (at VAST): make request of the services as needed
- UNDP Programme Officer, Programme Associate and HR staff, procurement staff, finance and common service staff are responsible for implementing of the above

Annex VII: Terms of Reference for Project Staff and Consultants

1. National Project Manager (NPM)

Duty Station: Hanoi with national travel as required.
Duration of assignment: 12 month with possible extension (full-time).
Direct Supervisor: National Project Director

Responsibilities and Duties:

The primary task of the **NPM** is to plan, organize and implement the LED project under the direction of the NPD. He/she will be responsible for in management of input mobilization and day-to-day project operations including timely resolution of issues, problems or bottlenecks. He/she will report directly to the NPD, representing the VAST. He/she will manage the technical and administrative staff under the PMU with multidisciplinary capabilities in EC&EE policy and institutional support development, communication and awareness; technical capacity development; energy efficiency services provision support; financing; and demonstration. To assume this overall responsibility, the specific tasks of the NPM are as follows:

1. Prepare, update, and submit the required work plan and reports to NPD and UNDP CO for clearance timely and with satisfactory quality, including: Annual work plan, quarterly work plan, Annual Project Reports, GEF Project Implementation Review Report, the Quarterly Progress Reports, and the Final Project Reports as scheduled;
2. Finalize detailed ToRs for key outputs (i.e. personnel, sub-contractors, training, and procurements), within assistance from the International and National Senior Technical Advisers, and submit to NDP and UNDP CO for clearance and approval;
3. Take responsibility for monitoring the overall progress and use of the resources of all outputs and initiative corrective actions if necessary;
4. Assume direct responsibility for managing the project budget on behalf of the NPD, ensuring that:
 - o Project funds are made available when needed, and are disbursed properly;
 - o Accounting records and supporting documents are kept;
 - o Required financial reports are prepared;
 - o Financial operations are transparent and financial procedures/regulations for NIM project are applied;
 - o PM is ready to stand up audit at any time.
5. Assume direct responsibility for managing the physical resources (e.g. vehicles, office, equipment, furniture, stationary...) provided to the project by UNDP;
6. Keep record and update the Project issues and risks and recommend necessary actions to NPD to effectively cope with identified risks, and coordinate the implementation of the approved risk mitigation actions;
7. Liaison and coordinate the implementation of all project partnership agreements to ensure that partners implement the project components in a collaborative manner with the Project quarterly and annual work plan;
8. Liaison with UNDP CO or designated quality assurance personnel on the project quality management issues;
9. Supervise the project staff and local or international experts/consultants working for the project;
10. Provide back-stopping support for administrative work of the Project Management Unit if necessary; and
11. Organize the Inception Workshop, APR and SPC meetings as well as evaluation missions in coordination with UNDP.

Qualifications:

- Minimum of Master's Degree in management, administration, economics, or any other relevant fields with engineering background.
- At least 5 years of proven track record on national or international project management experience, and at least three years of experience in energy project;
- Track record of, or proven experience in successful contract management, supervision and reporting skills;
- Excellent English proficiency, both in written and spoken,
- Knowledgeable about Viet Nam's energy policies, lighting industries and administrative structures;
- Familiar with technical assistance projects and GEF/UNDP projects in Viet Nam; and
- Highly self-motivated, with good leadership skills.

2. Project Admin and Accountant (AAC)

Duty Station: Hanoi with national travel as required.
Duration of Assignment: 12 month with possible extension (full-time).
Direct Supervisor: Project Manager

Responsibilities and Duties:

The Project accountant cum Administration shall be responsible for (i) the accurate and appropriate recording of disbursements of Project funds; maintaining the set of books required according to UNDP accounting procedures, classifying and summarizing financial transactions of the project and the generation of required financial reports. He/She will also be responsible in updating all other books of accounts such as subsidiary ledgers and special registers; (ii) administrative support to the operations of PMU, supervising administrative staff and ensuring the smooth functioning of administrative systems under the project. Specifically, he/she will be responsible for the following tasks:

1. Installation and implementation of a GEF financial system that records transactions that utilize GEF Funds in accordance with UNDP's existing guidelines on national execution;
2. Orientation of staff on the use of the project's financial systems and procedures;
3. Proper recording of financial transactions and submit a regular report on the project's financial status;
4. Certifying correctness of journals, vouchers, bills, statement of accounts, trial balance, budget estimates and other financial statement and records;
5. Preparation of certification of the availability of funds and/or allotment of expenses, vouchers and requisition for supplies, materials, etc.;
6. Preparation of annual and quarterly budgets including the necessary budget revisions based on the corresponding line-item-budgets approved by VAST;
7. Establishment of a project account and ensure appropriateness and proper record keeping of transactions;
8. Supervision of the preparation of payroll and general voucher of salaries, and other documentary requirements for disbursements;
9. Preparation of updated reports on disbursements made by the project, and advise the Project Team on the overall financial status of the project; and
10. Preparation of a system of accounts those records all the in-cash and in-kind contributions of co-financing entities to the Project.

Administration tasks:

1. Establishes the administrative system and procedures consistent with UNDP's national execution mode, in the form of a Manual, for the guidance of project staff, consultants and subcontractors;
2. Establishes a record of management system for the project both in paper and electronic;
3. Maintains files of all personnel, consultants and subcontractors actively engaged in the project;
4. Prepares and arranges travel plans and procurement plans for the project;
5. Supervises the procurement of equipment, supplies and sundries as may be needed in the Project, in accordance with UNDP guidelines;
6. Maintains an updated inventory of all supplies and equipment and prepares guidelines for the proper use and maintenance of office equipment and properties;
7. Supervises the overall administrative activities related to project implementation;
8. Prepares annual and quarterly work plan of activities for approval by PMU; and
9. Secretariat support to workshops, seminars and trainings.

Qualification and Experience:

- Bachelors Degree in accounting or financing, preferably Masters Degree in the same or any other relevant field;
- At least 5 years experience as accountant, administration, preferably with UNDP/GEF project;
- Proven track record in project management such as in meeting deadlines, timely submission of acceptable deliverables, etc.;
- Excellent English communication skills, both written and verbal;
- Knowledge of the Atlas or any systems similar to PeopleSoft;
- With satisfactory skills on the use of office software packages such as MS Word, Excel and Power Point; and
- Good interpersonal skills.

Project Consultants and other staff

3. International Expert on LED Lighting Product Standards (ILPS)

Duty Station: Hanoi with domestic travel as required.
 Duration of Assignment: One month output-based contract spread out during Year 1
 Direct Supervisor: UNDP and National Project Director

Duties and Responsibilities:

The ILPS will assist in the work on the development of TCVN National Standards for LED Lighting Products. The specific tasks of the ILPS are as follows:

- Review relevant current Vietnamese product EE lighting standards focusing on LED lighting standards with Vietnamese counterparts;
- Compile relevant international standards, review these and provide copies to Vietnamese counterparts;
- Work with Vietnamese counterparts in the review and analysis of data on current Vietnamese LED lighting products;
- Advise and assist Vietnamese counterparts in developing draft LED lighting product standards for some main kinds of LED lighting lamps;
- Attend meetings with Vietnamese LED lighting product manufacturers and experts to discuss each proposed standard;
- Assist Vietnamese counterparts in preparing revised draft standards; and
- Answer other questions about the standard and standard development process posed by Vietnamese counterparts and other Vietnamese officials and experts.

Deliverables:

- Report on International Product LED Lighting Standard Development experience;
- Report on the technical assistance and capacity building provided; and
- Mission reports.

Qualification and Experience:

- Bachelors or Masters degree in engineering, marketing, or applied sciences;
- At least ten years of diverse experience in the field of LED lighting products application and manufacturing;
- Extensive experience with EE (LED) lighting equipment standards, testing, certification, labelling in several regions of the world;
- Familiarity with training, education, and promotion activities;
- Ability to function effectively in an international, multi-cultural environment; and
- Fluency in English, both spoken and written.

4. International Expert on LED Lighting Product Testing, Certification & Labelling (ILPT)

Duty Station: Hanoi with domestic travel as required.
Duration of Assignment: Two month spread out during Years 1 and 2.
Direct Supervisor: UNDP and National Project Director

Duties and Responsibilities:

The International Expert on LED Lighting Product Testing, Certification and Labelling will provide technical assistance in the upgrading of national lighting product testing, certification and labelling capabilities. The specific tasks of the expert are as follows:

- Reassess LED lighting product quality testing, certification and labelling capability of the local lighting testing laboratories, and determine gaps as compared to international practice;
- Provide advice and technical assistance to the selected local lighting testing laboratories in defining effective solutions on improvement their capacities;
- Provide advice and technical assistance to the selected local lighting testing laboratories in the process of improving their capacities; and
- Provide advice and technical assistance in implementation process M&E.

Deliverables:

- Evaluation report on local lighting product testing, certification and labelling capacity focusing on LED lighting products;
- Report on the technical assistance and capacity building provided; and
- Mission reports.

Qualification and Experience:

- Bachelors or Masters degree in engineering, marketing, or applied sciences;
- At least ten years of diverse experience in the field of EE (LED) lighting products application and manufacturing;
- Extensive experience with EE (LED) lighting equipment standards, testing, certification, labelling in several regions of the world;
- Familiarity with training, education, and promotion activities;

- Ability to function effectively in an international, multi-cultural environment; and
- Fluency in English, both spoken and written.

5. International Experts on LED Lighting Technology Supporting to Local Lighting Manufacturers (ITS)

Duty Station: Hanoi with domestic travel as required.
 Duration of Assignments: Up to 3 experts as required with a total of 15 months available during Years 1, 2 and 3
 Direct Supervisor: UNDP and National Project Director

Duties and Responsibilities:

Up to 3 ITSs will provide technical assistance to local lighting product manufacturers in the upgrading of the R&D, design and production line of LED lighting products. The specific tasks of these experts are to:

- Review current Vietnamese LED lighting products quality and reassess the manufacturers' capacity in R&D, design and production, find the gaps;
- Recommend international LED lighting technologies that are more applicable and suitable to Viet Nam manufacturers to implement;
- Provide advice and technical assistance in defining effective solutions for improving their LED products quality and outputs;
- Provide advice and technical assistance to the manufacturers in the process of upgrading the R&D, design and production lines; and
- Provide advice and technical assistance in implementation process M&E.

Deliverables:

- Evaluation report on local LED lighting products manufacturing capabilities and performance;
- Report on the technical assistance and capacity building provided; and
- Mission reports.

Qualification and Experience:

- Bachelors or Masters degree in engineering, marketing, or applied sciences;
- At least ten years of diverse experience in the field of LED lighting products application and manufacturing;
- Extensive experience with LED lighting equipment standards, testing, certification, labelling in several regions of the world;
- Familiarity with training, education, and promotion activities;
- Ability to function effectively in an international, multi-cultural environment; and
- Fluency in English, both spoken and written.

6. International Expert on LED Lighting Technology Training (ILTT)

Duty Station: Hanoi with domestic travel as required.
 Duration of Assignment: 4 months spread out during the Year 1 to Year 2.
 Direct Supervisor: UNDP and National Project Director

Duties and Responsibilities:

The ILTT will provide technical assistance in the development and implementation of Training Program on LED lighting R&D including products design technology of LED lighting. The specific tasks of the ILTT are as follows:

- Work with the relevant subcontractor to develop teaching materials for the following areas:
 - Awareness of benefits of LED lighting technology and systems application;
 - International experiences in the areas of R&D, products design technology of LED lighting;
 - International key studies on LED lighting products designs.
- Support the subcontractor for the Development and Implementation of LED Lighting R&D Training Program in designing the program and review their works; and
- Provide some training lectures for trainees.

Deliverables:

- Final version of training program with training materials;
- Report on lectures delivered in training courses for trainees; and
- Mission report.

Qualification and Experience:

- PhD degree related to energy efficiency technology, particularly on LED Lighting;
- Five (5) years of professional experience in EE lighting systems;
- Practical experience of working with EC&EE programs, preferably in the ASEAN Region on EC&EE technical capacity building;
- Ability to function effectively in an international, multi-cultural environment; and
- Fluency in English, both spoken and written.

7. International Senior Technical Specialist (ISTS)

Duty Station: Hanoi with domestic travel as required.
Duration of Assignment: Full time for the first year and part-time for the following years
Direct Supervisor: UNDP and National Project Director

Duties and Responsibilities:

The overall responsibility of the ISTS is to provide technical advice and substantive support to the UNDP and NPD and NPM on overall implementation and in particular on the project quality issues. Specific responsibilities and tasks of the Consultant include:

- Provision of technical inputs for key project outputs :
 - a) Provide technical guidance to the sub-contractors to develop LED lighting regulations (under Component 1 including international best practice and experience in development and implementation of LED lighting roadmaps, LED lighting codes, LED lighting design practices, R&D international practices, monitoring and evaluation of outputs, reports submitted by sub-contractors and experts;
 - b) Provide advice and technical assistance in completion of LED lighting basic designs for demo sites (under component 2);

- c) Provide advice and technical assistance in completion of comprehensive technical and economic feasibility evaluation (under component 2);
 - d) Provide advice and technical assistance in completion of detailed engineering designs (under component 2); and
 - e) Provide advice and technical assistance in completion of installation, operation, monitoring and evaluation of LED lighting systems (under component 2).
- Project Quality Monitoring and Evaluation ensuring that the effective implementation of the quality management plan throughout the project period by undertaking the following tasks:
 - a) Formulate and facilitate the implementation of the Project Monitoring and Evaluation Plan that links to project outcome indicators, progress indicators and the Logical Framework;
 - b) Formulate a quality management plan for key outputs, in consultation with PMU, UNDP CO for approval of NPD. Essentially, the quality plan should include output quality criteria, guidelines and procedures for quality control, responsibility of PMU personnel, and schedules;
 - c) Review the products of sub-contracts and consultants as directed by NPD, and provide advice to NPD and NPM on the quality of the final products.
 - Assist NPM in implementing risk management plan by:
 - a) Identifying critical issues, barriers, or risks (external risks in particular);
 - b) Advise NPD and UNDP CO on solutions to effectively manage risks and other emerging barrier; and
 - c) Facilitating the implementation of risk management plan approved by NPD.

Qualification and Experience:

- Master Degree in business administration, economics, public administration, engineering; preferably with PhD. Degree in the same or any other relevant field;
- At least 10 years of experience in the field of energy efficiency including specialized experience in industrial energy efficiency, policy development, and institutional capacity building;
- Excellent communication skills, full proficiency in English both written and verbal. Skilled presenter of ideas in one on one situations and in symposia;
- Experienced in initiating project development, implementation, monitoring and evaluation;
- Proven experience in resource mobilization from governments, non-government organizations and the private sector;
- Multidisciplinary professional experience preferred; and
- With good appreciation of, and strong links with relevant international organizations.

8. National Consultant providing Technical Support to Local Manufacturers (NTS)

Task Location: Hanoi with domestic travel as required.
 Duration of Assignment: One consultant for about 30 months
 Direct Supervisor: National Project Director

Duties and Responsibilities

The tasks of the National Expert on Technical Assistance to Local Manufacturers are the provision of technical assistance to the Local Lighting Manufacturers in upgrading their existing design and production of LED lighting products of all kinds and in improving their quality to meet Vietnamese and regional standards with reduced costs.

Scope of Work:

- Evaluate the current production situation of the LED lighting products of the selected local manufacturers;
- Provide recommendations for improving the LED lighting products quality and outputs;
- Provide technical advice on designs and production lines for LED lighting products;
- Test the quality of LED lighting products pursuant to International and National Standards;
- Enhance the capacity of technical staff of the selected local LED lighting product manufacturers;
- Conduct an evaluation workshop on upgraded LED lighting products and manufacturing processes; and
- Prepare annual and final report on implementation results.

Deliverables:

- Inception Report – one (1) month after issuance of Notice to Proceed and disbursement of mobilization fee;
- Progress reports – 2 months after submission of Inception Report and every 3 months thereafter;
- Situation and solutions for improving the lighting products quality and outputs submitted/approved by TWG;
- Designs and production lines for these products upgraded, tested pursuant to the International and National Standards;
- Monitoring and evaluation system to be submitted and presented to the TWG for approval; and
- Final report for upgrading implementation accepted by the TWG.

All communications and reporting must be in Vietnamese and English language.

Qualification and Experience:

Minimum requirements for the experts are as follows:

- Knowledgeable and familiar with international and national EE lighting system standards and label including LED;
- At least a degree in Engineering, Business Management, or related fields; and
- Previous experience(s) in lighting product designs, manufacture, and production.

9. National Consulting Support on Strengthening of LED Lighting Products Testing (NLPT)

Task Location: Hanoi with domestic travel as required.
Duration of Assignment: Twenty one (21) months spread out in Years 1, 2 and 3.
Direct Supervisor: National Project Director

Duties and Responsibilities:

The task of the NLPT is the development of the capacity of local lighting laboratories for comprehensive testing of LED lighting equipment. These improved lighting laboratories, in their turn, will provide lighting product testing and research services to local lighting product manufacturers and/or importers in product quality testing.

Scope of Work:

- Review the current situation of the lighting product quality testing capabilities of the existing local lighting testing laboratories;
- Provide useful recommendations and solutions for improving the LED lighting product quality testing capabilities of the existing local testing laboratories;
- Improve LED lighting product quality testing capabilities;
- Test the quality of the LED lighting products made by local manufacturers and sold in the local markets pursuant to the International and National Standards; and
- Conduct a summary and evaluation workshop on implementation results.

Deliverables:

- Evaluation reports on situation of the labs;
- Proposals on improving the lab capabilities; and
- Quarterly reports on lighting product testing results of the improved labs.

All communications and reporting must be in Vietnamese and English.

Qualification and Experience:

- Knowledgeable and familiar with the lighting product testing procedures and equipment;
- At least a degree in Engineering, Lighting Technology, Electronic Measurements, Information Technology, Public Administration, Business Management, or related fields; and
- Previous experience(s) in developing Vietnamese software, in training and consultative services, preferably for use in the lighting industry.

10. Project Technical Consultant (NPTC)

Duty Station: Hanoi with national travel as required.
Duration of Assignment: Full-time for Year 1, 2 and 3 and half time in Year 4.
Direct Supervisor: National Project Director.

Duties and Responsibilities:

The NPTC will provide advice to the NPD and NPM on issues related to project execution including participatory design, legal and regulatory frameworks, policy development, technical and institutional capacity development. The NPTC will ensure the effective transfer and adaptability of the international expertise, lessons and best practices to production of the quality project outputs. Specific tasks of the NPTC include:

1. Assist NPM to maintain the collaboration with MoC, MoST, MoIT and VAST to develop policies and policy tools on LED lighting and replicate demonstration results;
2. Appraise and develop efforts to mainstream LED project's components with other energy efficiency activities in the private and public sector in the country, particularly the National Energy Conservation Program (VNEEP);

3. Identify, assess and provide recommendations on how to integrate international programs/projects on EC&EE into the LED Lighting Project;
4. Verify and provide technical comments on reports prepared by national and international experts and subcontractors as required by NDP/NPM;
5. Assist NPM in finalizing ToRs and job descriptions for PMU staff, national and international consultants as well as subcontractors;
6. Review all reports required under the Monitoring and Evaluation Plan, give comments and recommendations;
7. Provide advice on quality control and technical inputs to all reports/products submitted by task expert and consultants, give comments and recommendations;
8. Review project training program including training courses, study tours, workshops, give comments and recommendations;
9. Attend the meetings of the Project Steering Committee as directed by PM;
10. Participate in a project recruitment panel, and TWG as directed by NPD; and
11. Participate/facilitate the project workshops, seminars, forums as required by NPD.
12. Provide strategic policy advice in the areas of programming, technical and financial planning and management;
13. Assist PM to take the responsibility of communication and coordination with other project partners to ensure their participation and co-financing for implementing all project activities as scheduled in the Project Work Plan;
14. Provide substantive inputs to all project implementation activities in close collaboration with ISTA and advice on the preparation of a detailed project work plan and the monitoring and evaluation plan.

Qualification and Experience:

- Minimum of Master Degree in engineering or business management; a PhD Degree in the same or any other relevant fields is an advantage;
- At least 10 years of experience in the energy research and development including specialized experience in energy efficient lighting, LED lighting technology, policy development, and institutional capacity building;
- Excellent communication skills, full proficiency in English both written and verbal;
- Experienced in initiating project development, implementation, monitoring and evaluation;
- Proven experience in resource mobilization from governments, non-government organizations and the private sector;
- Multidisciplinary professional experience preferred; and
- With good appreciation of, and strong links with relevant international organizations.

11. National Consultant for the Development and Review of a National LED Lighting Development Roadmap (NLR)

Task Location: Hanoi with domestic travel as required.

Duration of Assignment: Half-time for Years 1 and 2.

Direct Supervisor: National Project Director

Duties and Responsibilities:

The NLR will to assist MoIT in the setting up of the National roadmap of LED lighting development replacing of traditional lights. The proposed Roadmap will be commented by relevant institutions and after revising be submitted to MoIT and GoV for approval. The approved Roadmap will be reviewed over a two-year period. Other tasks include:

- Review and evaluate the existing Roadmaps relating to EE lighting development and IEE lighting phasing out (with comparison with those in other world and regional countries) and find the gaps;
- Put forwards a solution on developing the Roadmap relating to LED lighting development;
- Develop the Roadmap of LED lighting development to replace the traditional lights;
- Organize the workshop for reviewing the developed Roadmap;
- Submit the revised Roadmap to the MoIT for approval;
- After each two years conduct a review on the Roadmap implementation and recommend the improvement.
- Conduct review workshops on the revised Roadmap. The final revised Roadmap will be submitted to MoIT for approval.

Deliverables include:

- An evaluation report on the existing Roadmaps relating to EE lighting development and IEE lighting phasing out with recommendations on development of the new Roadmap; and
- Final proposal on the developed Roadmap of LED lighting development to replace the traditional lights submitted to MoIT.
- The revised Roadmap after each two years review submitted to MoIT.

All communications and reporting must be in Vietnamese and English

Qualification and Experience:

- Bachelors or Masters degree in economics, engineering or applied sciences;
- At least ten years of diverse experience in local government policy making and enforcement;
- Knowledgeable and familiar with the lighting technology, and the process of developing IRRs and guidelines in the lighting;
- Previous experience(s) in developing rules and regulations for lighting;
- Familiarity with lighting equipment testing standards, certification, labelling, training, education, and promotion activities;
- Ability to function effectively in an international, multi-cultural environment; and
- Fluency in English, both spoken and written.

12. National Consultant for the Development of National Standards for LED Lamps (NLPS)

Task Location: Hanoi with domestic travel as required.
 Duration of Assignment: Fifteen (15) months spread out during Years 1, 2 and 3.
 Direct Supervisor: National Project Director

Duties and Responsibilities:

The NLPS will provide technical assistance to VAST and MoST in formulating two new Viet Nam Standards TCVN on Testing Methods and one Viet Nam Standard TCVN on Energy Performance for LED Lamps. The targeted lighting products include LED lamps of all kinds. The standards development process is aimed at introducing standards including (i) IEC LM-79-2008: Approved Method for the Electrical and Photometric Testing of Solid State Lighting Devices, that provides a foundation for accurate comparisons of luminaire performance for solid state lighting (SSL) and all

other sources; (ii) IEC LM-80-2008: Approved Method for Measuring Lumen Depreciation of LED Light Sources, that defines a method of testing lamp depreciation; (iii) The energy performance standards (EPS) that will be tailor - made for Viet Nam conditions. The final developed standards will be submitted to MOST for approval. Other specific tasks of the NLPS include:

- Assist/work with the ILPS in the review and assessment of existing LED lighting product standards in the country to identify gaps and provide recommendations to update existing and develop new Viet Nam National Standards (VNS) on LED lamps considering the presently available and applicable LED lighting technologies and products;
- Consolidate LED Lighting Products Standards based on relevant codes/ standards in other countries and information gathered from consultations with the local lighting industry;
- Update existing VNS on LED lighting products and formulate three new ones, including EPS;
- Assist/facilitate the approval of the new proposed VNS for LED lamps; and
- Prepare a monitoring and evaluation system to track the progress of the standards compliance, as well as define difficulties encountered and assistance needed to be provided to the local lighting products manufacturers/distributors by the Project to assist them in meeting the EPS.

Deliverables include:

- Inception Report – one (1) month after issuance of Notice to Proceed and disbursement of mobilization fee;
- Progress report – Two months after submission of Inception Report and every three months thereafter;
- Updated and new VNS for LED lamps, including EPs submitted to MOST;
- Monitoring and evaluation system to be submitted and presented to the TWG for approval; and
- Draft final report for presentation subject to final acceptance by the TWG.

All communications and reporting must be in Vietnamese and English.

Qualification and Experience:

- Knowledgeable and familiar with the LED lighting industry and the process of formulating Viet Nam National Standards;
- Sub-contractor team that will be fielded must be composed of individuals with at least an education degree in Engineering, Bachelor of Laws, Public Administration, Business Management, or related fields; and
- Previous experience(s) in developing policies, institutional frameworks and energy efficiency standards, preferably lighting standards.

13. National Consultant for Support to LED Labelling and Certification (NLC)

Task Location: Hanoi with domestic travel as required.
Duration of Assignment: Twenty four (24) months spread over Years 1, 2 and 3.
Direct Supervisor: National Project Director

Duties and Responsibilities:

The NLC will provide technical assistance to MoIT in the formulation and administration of a Systematic Labelling and Certification Program for LED lighting products. Specific tasks of the NLC include:

- Review and assess the impact of labelling and certification programs for LED lighting products in other countries;
- In close cooperation with MOIT, formulate a labelling and certification program for LED lighting products;
- Organize and conduct workshop with relevant state agencies on the developed program; and
- Work with MOIT in facilitating the approvals of the labelling and certification program through consultations with stakeholders.

Deliverables include:

- Inception Report - one (1) month after issuance of Notice to Proceed and disbursement of mobilization fee;
- Progress report on the 3rd month and 5th month from issuance of Notice to Proceed; and
- Draft final report on Labelling and Certification Program.

All communications and reporting must be in Vietnamese and English.

Qualification and Experience:

- Knowledgeable and familiar with the EC&EE in lighting industry;
- Previous experience(s) in developing certifications/guidelines, institutional frameworks and energy efficiency standards; and
- Sub-contractor team to be fielded must be composed of individuals with at least a Bachelors Degree in Engineering, EE Lighting Technology, Law, Public Administration, Business Management, or any other relevant field.

14. National Consultant on Strengthening of Codes and Regulation on the use of LEDs (NCR)

Task Location: Hanoi with domestic travel as required.
 Duration of Assignment: Twenty-four (24) months spread over Years 1, 2 and 3.
 Direct Supervisor: National Project Director

Duties and Responsibilities:

The NCR will assist MoC in the setting up of the national mandatory technical codes and regulations on lighting and lighting product use including LED lighting products. The proposed Code will be commented on by relevant institutions and after revising to be submitted to MoC for approval. Specific tasks include:

- Review and evaluate the existing Codes relating to EE lighting and EE lighting products including LED (with comparison with those in other world and regional countries) and find the gaps;
- Put forwards a solution on developing the Code relating to LED lighting and products;
- Develop the Code to include LED lighting and LED lighting products;
- Organize the workshops for getting the comments on the developed Code; and
- Submit the revised Code to the MoC for approval.

Deliverables include:

- Inception Report - one (1) month after issuance of Notice to Proceed and disbursement of mobilization fee;
- Progress report on the 3rd month and 5th month from issuance of Notice to Proceed;
- An evaluation report on the existing Codes relating to EE lighting with recommendations on development of the new Code to include LED lighting and LED lighting products; and
- Final proposal of the developed Code submitted to MoC.

All communications and reporting must be in Vietnamese and English.

Qualification and Experience:

- Bachelors or Masters degree in economics, engineering or applied sciences;
- At least ten years of diverse experience in local government policy making and enforcement;
- Knowledgeable and familiar with the lighting technology, financial industry and the process of developing IRRs and guidelines in the public work;
- Previous experience(s) in developing rules and regulations for lighting
- Familiarity with lighting equipment testing standards, certification, labelling, training, education, and promotion activities;
- Ability to function effectively in an international, multi-cultural environment; and
- Fluency in English, both spoken and written.

15. National Consultant for Development and Implementation of LED Lighting R&D Training Program (NRDT)

Task Location: Hanoi with domestic travel as required.
 Duration of Assignment: Twelve (12) months spread over Years 1 to 3.
 Direct Supervisor: National Project Director

Duties and Responsibilities:

The NRDT will work towards the enhancement of the capacities of relevant national lighting R&D organizations as well as R&D centers of local manufacturers (lighting and environment engineers, lighting products designers professional staff in climate change, electricians, contractors, suppliers) to ensure the meeting of locally produced LED lighting products with the Vietnamese and regional standards and with reduced costs. Specific tasks will include:

- Review and assess training needs on LED lighting R&D by relevant public lighting stakeholders;
- Develop the training curriculum with International Expert's advice;
- Together with PMO conduct a training workshop and assess the results of the training workshop.

Deliverables will include:

- Inception Report - one (1) month after issuance of Notice to Proceed and disbursement of mobilization fee;
- Progress report on the 3rd month and 5th month from issuance of Notice to Proceed;
- Final version of curricula submitted, subject to acceptance by PMU; and
- Final report on the training workshop including a result assessment to be approved by PMU.

All communications and reporting must be in Vietnamese and English.

Qualification and Experience:

- Familiarity with EC&EE systems, in general, and EE lighting systems, in particular, and their applications;
- Broad experience in developing training modules and in conducting trainings on energy efficiency applications, in general, and LED lighting, in particular; and
- Sub-contractor team must be composed of individuals with at least a Bachelors Degree in Engineering, Lighting Technology, Communications, Education, or any other relevant fields.

16. National Consultant for the Development and Implementation of LED Lighting Awareness Raising Program (NAR)

Task Location: Hanoi with domestic travel as required.
Duration of Assignment: Eighteen (18) months spread over entire 4-year Project period.
Direct Supervisor: National Project Director

Duties and Responsibilities:

The NAR will develop and implement a campaign to raise the general awareness of LED lighting with policy makers, appropriate officials, the lighting industry, customers and the general public. Specific tasks include:

- Develop a communications and dissemination strategy;
- In coordination with the VNEEP set up work plan for dissemination of LED lighting to community through the network;
- In coordination with VNEEP design and circulate information dissemination packages comprising advertisements, newsletters, small-sized stickers, posters, and radio and TV programs.

Deliverables include:

- Inception Report - one (1) month after issuance of Notice to Proceed and disbursement of mobilization fee;
- Progress report on the 3rd month and 5th month from issuance of Notice to Proceed; and
- All produced information materials and Final report.

All communications and reporting must be in Vietnamese and English.

Qualification and Experience:

- Proven track record of experience (at least 5 years) in public relations and marketing related to energy conservation and energy efficiency (EC&EE) and lighting industry;
- Good working experience in designing, organizing and producing mass media campaign; and
- Sub-contractor team to be fielded must be composed of individuals with at least an education degree in Communication, Advertising Design, or related fields.

17. National Consultant for LED Demo Project Coordinator (NDPC)

Task Location: Hanoi with domestic travel as required.
Duration of Assignment: Eighteen (18) months starting the Quarter 2 of Year 2 to Quarter 3 of Year 3 of LED Lighting Project.
Direct Supervisor: Task Expert: Technology and Policy Coordinator.

Duties and Responsibilities:

The NDPC will undertake the implementation of the identified demonstration projects in each demo site including LED lamps installations and operations. Specific tasks include:

- Install LED lighting systems;
- Operate the demonstrated LED lighting systems at demo sites;
- Coordinate with PMU to conduct the promotional workshops; and
- Perform M&E functions for the PMU

Deliverables include:

- Inception Reports – one (1) month after issuance of Notice to Proceed and disbursement of mobilization fee;
- Progress reports – Two months after submission of Inception Report and every three months thereafter; and
- Reports on the implementation results of the demo LED lighting systems installation and operation.

All communications and reporting must be in Vietnamese and English.

Qualification and Experience:

- Knowledgeable and familiar with LED lighting technology, financing/banking industry, evaluating the techno-economic feasibility of EC&EE projects, and the development of feasible EC&EE projects;
- Sub-contractor team that will be fielded must be composed of senior experts with at least a master degree in technology, finance, economic, management, laws or related fields; and
- Previous experience(s) in demonstration projects for public works.

Annex VIII: UNDP-GEF Environmental and Social Screening Procedure (ESSP)

Annex VII-A: Environmental and Social Screening Checklist

QUESTION 1:

Has a combined environmental and social assessment/review that covers the proposed project already been completed by implementing partners or donor(s)?

Select answer below and follow instructions:

NO → **Continue to Question 2 (do not fill out Table 1.1)**

YES → No further environmental and social review is required if the existing documentation meets UNDP's quality assurance standards, and environmental and social management recommendations are integrated into the project. Therefore, you should undertake the following steps to complete the screening process:

1. Use Table 1.1 below to assess existing documentation. (It is recommended that this assessment be undertaken jointly by the Project Developer and other relevant Focal Points in the office or Bureau).
2. Ensure that the Project Document incorporates the recommendations made in the implementing partner's environmental and social review.
3. Summarize the relevant information contained in the implementing partner's environmental and social review in Annex A.2 of this Screening Template, selecting Category 1.
4. Submit Annex A to the PAC, along with other relevant documentation.

Note: Further guidance on the use of national systems for environmental and social assessment can be found in Annex B.

| TABLE 1.1: CHECKLIST FOR APPRAISING QUALITY ASSURANCE OF EXISTING ENVIRONMENTAL AND SOCIAL ASSESSMENT | Yes/No |
|--|---------------|
| 1. Does the assessment/review meet its terms of reference, both procedurally and substantively? | n/a |
| 2. Does the assessment/review provide a satisfactory assessment of the proposed project? | n/a |
| 3. Does the assessment/review contain the information required for decision-making? | n/a |
| 4. Does the assessment/review describe specific environmental and social management measures (e.g. mitigation, monitoring, advocacy, and capacity development measures)? | n/a |
| 5. Does the assessment/review identify capacity needs of the institutions responsible for implementing environmental and social management issues? | n/a |
| 6. Was the assessment/review developed through a consultative process with strong stakeholder engagement, including the view of men and women? | n/a |
| 7. Does the assessment/review assess the adequacy of the cost of and financing arrangements for environmental and social management issues? | n/a |

Table 1.1 (continued) For any “no” answers, describe below how the issue has been or will be resolved (e.g. amendments made or supplemental review conducted).

n/a

QUESTION 2:

Do all outputs and activities described in the Project Document fall within the following categories?

- Procurement (in which case UNDP’s [Procurement Ethics](#) and [Environmental Procurement Guide](#) need to be complied with)
- Report preparation
- Training
- Event/workshop/meeting/conference (refer to [Green Meeting Guide](#))
- Communication and dissemination of results

Select answer below and follow instructions:

NO → Continue to Question 3

- YES** → No further environmental and social review required. Complete Annex VII-2, selecting Category 1, and submit the completed template (Annex A) to the PAC.

QUESTION 3:

Does the proposed project include activities and outputs that support *upstream* planning processes that potentially pose environmental and social impacts or are vulnerable to environmental and social change (refer to Table 3.1 for examples)? (Note that *upstream* planning processes can occur at global, regional, national, local and sectoral levels)

Select the appropriate answer and follow instructions:

NO → Continue to Question 4.

YES → **Conduct the following steps to complete the screening process:**

1. Adjust the project design as needed to incorporate UNDP support to the country(ies), to ensure that environmental and social issues are appropriately considered during the upstream planning process. Refer to Section 7 of this Guidance for elaboration of environmental and social mainstreaming services, tools, guidance and approaches that may be used.
2. Summarize environmental and social mainstreaming support in Annex A.2, Section C of the Screening Template and select “Category 2”.
3. If the proposed project ONLY includes upstream planning processes then screening is complete, and you should submit the completed Environmental and Social Screening Template (Annex A) to the PAC. If downstream implementation activities are also included in the project then continue to Question 4.

| TABLE 3.1 EXAMPLES OF UPSTREAM PLANNING PROCESSES WITH POTENTIAL DOWNSTREAM ENVIRONMENTAL AND SOCIAL IMPACTS | Answer Yes/No/N.A |
|--|----------------------|
| <p>1. Support for the elaboration or revision of global-level strategies, policies, plans, and programmes.</p> <p><i>For example, capacity development and support related to international negotiations and agreements. Other examples might include a global water governance project or a global MDG project.</i></p> | No |
| <p>2. Support for the elaboration or revision of regional-level strategies, policies and plans, and programmes.</p> <p><i>For example, capacity development and support related to transboundary programmes and planning (river basin management, migration, international waters, energy development and access, climate change adaptation etc.).</i></p> | No |
| <p>3. Support for the elaboration or revision of national-level strategies, policies, plans and programmes.</p> <p><i>For example, capacity development and support related to national development policies, plans, strategies and budgets, MDG-based plans and strategies (e.g. PRS/PRSPs, NAMAs), sector plans.</i></p> | Yes |
| <p>4. Support for the elaboration or revision of sub-national/local-level strategies, policies, plans and programmes.</p> <p><i>For example, capacity development and support for district and local level development plans and regulatory frameworks, urban plans, land use development plans, sector plans, provincial development plans, provision of services, investment funds, technical guidelines and methods, stakeholder engagement.</i></p> | Yes |

QUESTION 4:

Does the proposed project include the implementation of *downstream* activities that potentially pose environmental and social impacts or are vulnerable to environmental and social change?

To answer this question, you should first complete Table 4.1 by selecting appropriate answers. If you answer “No” or “Not Applicable” to all questions in Table 4.1 then the answer to Question 4 is “NO.” If you answer “Yes” to any questions in Table 4.1 (even one “Yes” can indicated a significant issue that needs to be addressed through further review and management) then the answer to Question 4 is “YES”:

- NO** → No further environmental and social review and management required for downstream activities. Complete Annex VII-B by selecting “Category 1”, and submit the Environmental and Social Screening Template to the PAC.
- YES** → Conduct the following steps to complete the screening process:
 1. Consult Section 8 of this Guidance, to determine the extent of further environmental and social review and management that might be required for the project.
 2. Revise the Project Document to incorporate environmental and social management measures. Where further environmental and social review and management activity cannot be undertaken prior to the PAC, a plan for undertaking such review and management activity

within an acceptable period of time, post-PAC approval (e.g. as the first phase of the project) should be outlined in Annex A.2.

3. Select “Category 3” in Annex A.2, and submit the completed Environmental and Social Screening Template (Annex A) and relevant documentation to the PAC.

TABLE 4.1: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT

| 1. Biodiversity and <u>Natural</u> Resources | Answer (Yes/No/ Not Applicable) |
|--|--|
| 1.1 Would the proposed project result in the conversion or degradation of <u>modified habitat</u> , <u>natural habitat</u> or <u>critical habitat</u> ? | No |
| 1.2 Are any development activities proposed within a legally protected area (e.g. natural reserve, national park) for the protection or conservation of biodiversity? | No |
| 1.3 Would the proposed project pose a risk of introducing invasive alien species? | No |
| 1.4 Does the project involve natural forest harvesting or plantation development without an independent forest certification system for sustainable forest management (e.g. <i>PEFC, the Forest Stewardship Council certification systems, or processes established or accepted by the relevant National Environmental Authority</i>)? | No |
| 1.5 Does the project involve the production and harvesting of fish populations or other aquatic species without an accepted system of independent certification to ensure sustainability (e.g. <i>the Marine Stewardship Council certification system, or certifications, standards, or processes established or accepted by the relevant National Environmental Authority</i>)? | No |
| 1.6 Does the project involve significant extraction, diversion or containment of surface or ground water? <i>For example, construction of dams, reservoirs, river basin developments, groundwater extraction.</i> | No |
| 1.7 Does the project pose a risk of degrading soils? | No |
| 2. Pollution | |
| 2.1 Would the proposed project result in the release of pollutants to the environment due to routine or non-routine circumstances with the potential for adverse local, regional, and transboundary impacts? | No |
| 2.2 Would the proposed project result in the generation of waste that cannot be recovered, reused, or disposed of in an environmentally and socially sound manner? | No |
| 2.3 Will the proposed project involve the manufacture, trade, release, and/or use of chemicals and hazardous materials subject to international action bans or phase-outs? <i>For example, DDT, PCBs and other chemicals listed in international conventions such as the Stockholm Convention on Persistent Organic Pollutants, or the Montreal Protocol.</i> | No |

| TABLE 4.1: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT | |
|--|-----|
| 2.4 Is there a potential for the release, in the environment, of hazardous materials resulting from their production, transportation, handling, storage and use for project activities? | Yes |
| 2.5 Will the proposed project involve the application of pesticides that have a known negative effect on the environment or human health? | No |
| 3. Climate Change | |
| 3.1 Will the proposed project result in significant ⁶⁷ greenhouse gas emissions? <i>Annex E provides additional guidance for answering this question.</i> | No |
| 3.2 Is the proposed project likely to directly or indirectly increase environmental and social vulnerability to climate change now or in the future (also known as maladaptive practices)? You can refer to the additional guidance in Annex C to help you answer this question. <i>For example, a project that would involve indirectly removing mangroves from coastal zones or encouraging land use plans that would suggest building houses on floodplains could increase the surrounding population's vulnerability to climate change, specifically flooding.</i> | No |
| 4. Social Equity and Equality | |
| 4.1 Would the proposed project have environmental and social impacts that could affect indigenous people or other vulnerable groups? | No |
| 4.2 Is the project likely to significantly impact gender equality and women's empowerment ⁶⁸ ? | No |
| 4.3 Is the proposed project likely to directly or indirectly increase social inequalities now or in the future? | No |
| 4.4 Will the proposed project have variable impacts on women and men, different ethnic groups, social classes? | No |
| 4.5 Have there been challenges in engaging women and other certain key groups of stakeholders in the project design process? | No |
| 4.6 Will the project have specific human rights implications for vulnerable groups? | No |
| 5. Demographics | |
| 5.1 Is the project likely to result in a substantial influx of people into the affected community(ies)? | No |
| 5.2 Would the proposed project result in substantial voluntary or involuntary | No |

⁶⁷ Significant corresponds to CO₂ emissions greater than 100,000 tons per year (from both direct and indirect sources). Annex E provides additional guidance on calculating potential amounts of CO₂ emissions.

⁶⁸ Women are often more vulnerable than men to environmental degradation and resource scarcity. They typically have weaker and insecure rights to the resources they manage (especially land), and spend longer hours on collection of water, firewood, etc. (OECD, 2006). Women are also more often excluded from other social, economic, and political development processes.

| TABLE 4.1: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT | |
|---|----|
| resettlement of populations? <i>For example, projects with environmental and social benefits (e.g. protected areas, climate change adaptation) that impact human settlements, and certain disadvantaged groups within these settlements in particular.</i> | |
| 5.3 Would the proposed project lead to significant population density increase which could affect the environmental and social sustainability of the project? <i>For example, a project aiming at financing tourism infrastructure in a specific area (e.g. coastal zone, mountain) could lead to significant population density increase which could have serious environmental and social impacts (e.g. destruction of the area's ecology, noise pollution, waste management problems, greater work burden on women).</i> | No |
| 6. Culture | |
| 6.1 Is the project likely to significantly affect the cultural traditions of affected communities, including gender-based roles? | No |
| 6.2 Will the proposed project result in physical interventions (during construction or implementation) that would affect areas that have known physical or cultural significance to indigenous groups and other communities with settled recognized cultural claims? | No |
| 6.3 Would the proposed project produce a physical “splintering” of a community? <i>For example, through the construction of a road, power line, or dam that divides a community.</i> | No |
| 7. Health and Safety | |
| 7.1 Would the proposed project be susceptible to or lead to increased vulnerability to earthquakes, subsidence, landslides, and erosion, flooding or extreme climatic conditions? <i>For example, development projects located within a floodplain or landslide prone area.</i> | No |
| 7.2 Will the project result in increased health risks as a result of a change in living and working conditions? In particular, will it have the potential to lead to an increase in HIV/AIDS infection? | No |
| 7.3 Will the proposed project require additional health services including testing? | No |
| 8. Socio-Economics | |
| 8.1 Is the proposed project likely to have impacts that could affect women's and men's ability to use, develop and protect natural resources and other natural capital assets? <i>For example, activities that could lead to natural resources degradation or depletion in communities who depend on these resources for their development, livelihoods, and well-being?</i> | No |
| 8.2 Is the proposed project likely to significantly affect land tenure | No |

| TABLE 4.1: ADDITIONAL SCREENING QUESTIONS TO DETERMINE THE NEED AND POSSIBLE EXTENT OF FURTHER ENVIRONMENTAL AND SOCIAL REVIEW AND MANAGEMENT | |
|--|---|
| | arrangements and/or traditional cultural ownership patterns? |
| 8.3 | Is the proposed project likely to negatively affect the income levels or employment opportunities of vulnerable groups? No |
| 9. | Cumulative and/or Secondary Impacts |
| 9.1 | Is the proposed project location subject to currently approved land use plans (e.g. roads, settlements) which could affect the environmental and social sustainability of the project? <i>For example, future plans for urban growth, industrial development, transportation infrastructure, etc.</i> No |
| 9.2 | Would the proposed project result in secondary or consequential development which could lead to environmental and social effects, or would it have potential to generate cumulative impacts with other known existing or planned activities in the area? <i>For example, a new road through forested land will generate direct environmental and social impacts through the cutting of forest and earthworks associated with construction and potential relocation of inhabitants. These are direct impacts. In addition, however, the new road would likely also bring new commercial and domestic development (houses, shops, businesses). In turn, these will generate indirect impacts. (Sometimes these are termed "secondary" or "consequential" impacts). Or if there are similar developments planned in the same forested area then cumulative impacts need to be considered.</i> No |

ANNEX VII-B: ENVIRONMENTAL AND SOCIAL SCREENING SUMMARY
(To be filled in after Annex VII-A has been completed)

Name of Proposed Project: “Viet Nam: Local Development and Promotion of LED Technologies for Advanced General Lighting” (LED)

A. Environmental and Social Screening Outcome

Select from the following:

- Category 1.** No further action is needed
- Category 2.** Further review and management is needed. There are possible environmental and social benefits, impacts, and/or risks associated with the project (or specific project component), but these are predominantly indirect or very long-term and so extremely difficult or impossible to directly identify and assess.
- Category 3.** Further review and management is needed, and it is possible to identify these with a reasonable degree of certainty. If Category 3, select one or more of the following sub-categories:
 - Category 3a:** Impacts and risks are limited in scale and can be identified with a reasonable degree of certainty and can often be handled through application of standard best practice, but require some minimal or targeted further review and assessment to identify and evaluate whether there is a need for a full environmental and social assessment (in which case the project would move to Category 3b).
 - Category 3b:** Impacts and risks may well be significant, and so full environmental and social assessment is required. In these cases, a scoping exercise will need to be conducted to identify the level and approach of assessment that is most appropriate.

B. Environmental and Social Issues

Although LEDs are more energy-efficient than CFLs and incandescent bulbs, there is uncertainty about the potential environmental impacts of the various components LEDs and whether special provisions are required for their disposal at the end of their service life. A recent study⁶⁹ suggests that LED bulbs can be categorized as hazardous waste⁷⁰ due to excessive levels of lead (Pb) leachability (44 mg/L; regulatory limit: 5) and the high contents of copper (31,600 mg/kg; limit: 2500). The LEDs have high resource depletion and toxicity potentials due primarily to their high levels of aluminium, copper, gold, lead, silver, and zinc. The conclusion of the study is that LEDs do enhance energy efficiency, conservation and sustainability policies; however, manufacturing engineers should focus on the development of technologies that reduce the content of hazardous and rare metals in lighting products without compromising their performance and useful lifespan. Based on the uncertainty of environmental impacts of disposal of LEDs, studies need to be made on the how to mitigate this impact, either through minimization of the use of various metals in the manufacturing process that are deemed hazardous waste under existing laws, or study the impact of their disposal in landfills with the intention of proposing mitigation measures to reduce their impact using alternative disposal methods. Since typically CFLs contain small amounts of mercury, the project will encourage safe handling and disposal of waste CFLs replaced by the LED lamps. Therefore, replaced waste CFLs are not anticipated to lead to significant negative impacts on the environmental.

⁶⁹ Potential environmental impacts from the metals in incandescent, compact fluorescent lamp (CFL), and light-emitting diode (LED) bulbs, available on [Environmental Science and Technology](#), 2013 Jan 15;47(2):1040-7; doi: 10.1021/es302886m; abstract available on <http://www.ncbi.nlm.nih.gov/pubmed/23237340>

⁷⁰ According to hazardous waste definitions under existing U.S. federal and California state regulations and by applying life cycle impact-based and hazard-based assessment methods.

Insignificant social issues will arise with the mainstreaming of LEDs on the lighting market. While initially LEDs are expected too costly to lower income end users, the economies of scale with scaled-up production of LEDs will bring the LED prices to a level affordable by these vulnerable groups.

C. Next Steps (for projects requiring further environmental and social review and management):

During this Project, an analysis of where these metals are processed within the LED manufacturing process will be conducted. The possibility is strong that many of the LED components imported into Viet Nam will already contain these metals, reducing the environmental impact of LEDs from the manufacturing process in Viet Nam. Capacity building on the application of new techniques and practices in the manufacturing of LED lighting products, as well as in the proper disposal of waste CFLs replaced by the LED lamps, and the recovery and reuse of the mercury in waste CFLs, will be introduced and promoted under the Project. The Project will also examine best practices globally on environmentally responsible measures of LED disposal.

D. Sign Off



Project Manager

Date 3/12/14

PAC

Date

Programme Manager

Date