Global Environment Facility

GEF

Monique Barbut
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July 30, 2007

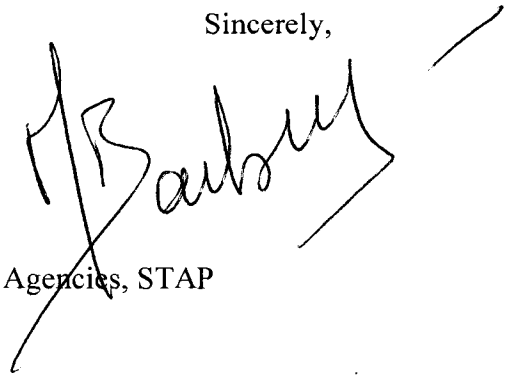
Dear Council Member,

The World Bank, as the Implementing Agency for the project, ***Regional (Kenya, Ghana): Lighting the "Bottom of the Pyramid"***, has submitted the attached proposed project document for CEO endorsement prior to final approval of the project document in accordance with the World Bank procedures.

The Secretariat has reviewed the project document. It is consistent with the proposal approved by the Council in August 2006, and the proposed project remains consistent with the Instrument and GEF policies and procedures. The attached explanation prepared by the World Bank satisfactorily details how Council's comments and those of the STAP have been addressed. I am, therefore, endorsing the project document.

We have today posted the proposed project document on the GEF website at www.theGEF.org. If you do not have access to the Web, you may request the local field office of the World Bank or UNDP to download the document for you. Alternatively, you may request a copy of the document from the Secretariat. If you make such a request, please confirm for us your current mailing address.

Sincerely,



cc: Alternates, Implementing Agencies, STAP

REQUEST FOR CEO ENDORSEMENT
UNDER THE GEF Trust Fund

GEFSEC PROJECT ID: 2950
IA/EXA PROJECT ID: 521198
COUNTRY: Kenya/Ghanna
PROJECT TITLE: Lightning the Bottom of the Pyramid
GEF IA/EXA: IFC
OTHER PROJECT EXECUTING AGENCY(IES): n/a
DURATION: 4 years
GEF FOCAL AREA: Climate Change
GEF STRATEGIC OBJECTIVES: CC-1, CC-2, CC-4
GEF OPERATIONAL PROGRAM: 5, 6
COUNCIL APPROVAL DATE: June 2006
COUNCIL APPROVED AMOUNT*: USD 5.4 M
CEO ENDORSEMENT AMOUNT*:USD 5.4 M
EXPECTED AGENCY APPROVAL DATE: August 07
EXPECTED SUBMISSION DATE OF MID-TERM REPORT: December 2009
EXPECTED GRANT CLOSING DATE: December 2011
EXPECTED SUBMISSION DATE OF TERMINAL EVALUATION/ PROJECT COMPLETION REPORT: June 2012

FINANCING PLAN ($)		
	PPG**	Project*
GEF Total	n/a	5,400,000
Co-financing	(provide details in Section d): Co-financing)	
GEF IA/ExA		5,000,000
Government		
Others		1,750,000
Co-financing Total		6,750,000
Total		12,150,000
Financing for Associated Activities If Any:		

* For multi-focal area projects, indicate agreed split between focal area allocations
** May refer also to previous PDF grants
***Projects that are jointly implemented by more than one IA or ExA

FOR JOINT PARTNERSHIP***		
GEF PROJECT/COMPONENT ($)		
(Agency Name)	(Share)	(Fee)
(Agency Name)	(Share)	(Fee)
(Agency Name)	(Share)	(Fee)

Approved on behalf of the *World Bank/IFC.*. This proposal has been prepared in accordance with GEF policies and procedures and meets the standards of the GEF Project Review Criteria for CEO endorsement.

Steve Gorman
GEF Executive Coordinator
Date: July 2, 2007

Project Contact Person
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1. **FINANCING** (for all the tables, expand or narrow table items as necessary)

a) PROJECT COST

Project Components/Outcomes	Co-financing ($)	*GEF ($)*	**Total ($)**
1. Component 1: Forming Private Sector Consortium	50,000	54,000	104,000
Component 2: Market Assessment (various segments and products)	50,000	1,080,000	1,130,000
2. Component 3 - Mapping and Engaging Distributors	50,000	410,000	460,000
3. Component 4 - Conveying findings to industry, and support individual firms entering the market	5,300,000	1,675,000	6,975,000
4. Component 5 - Building Market Support Institutions	800,000	1,780,000	2,580,000
5. Project Management budget/cost*	501,000	400,000	901,000
Total Uses of Funds/project costs	6.75 MM	5.4 MM	12.15 MM

* This item is the aggregate cost of project management; breakdown of this aggregate amount should be presented in the table b) below:

b) **PROJECT MANAGEMENT BUDGET/COST**[1]

Component	Estimated Staff weeks	GEF($)	Other Sources ($)	Project Total ($)
Locally recruited personnel*	***387***	**184,000**	**300,000**	**484,000**
Internationally recruited consultants*	**N/A**	**0**	**0**	**0**
Office facilities, equipment, vehicles and communications	**N/A**	**116,000**	**91,000**	**207,000**
Travel		**0**	**60,000**	**60,000**
Miscellaneous		**100,000**	**50,000**	**150,000**
Total		**400,000**	**501,000**	**901,000**

* Local and international consultants in this table are those who are hired for functions related to the management of project. For those consultants who are hired to do a special task, they would be referred to as consultants providing technical assistance. For these consultants, please provide details of their services in c) below:

c) CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS:

Component	**Estimated Staff Weeks**	**GEF($)**	**Other Sources ($)**	**Project Total ($)**
Personnel	**914**	**1,000,000**	**143,000**	**1,143,000**
Local consultants*	**1,559**	**3,000,000**	**119,000**	**3,119,000**
International consultants*	**309**	**1,000,000**	**237,000**	**1,237,000**
Total	**2782**	**5,000,000**	**499,000**	**5,499,000**

d) CO-FINANCING

[1] For all consultants hired to manage project or provide technical assistance, please attach a description in terms of their staff weeks, roles and functions in the project, and their position titles in the organization, such as project officer, supervisor, assistants or secretaries.

Name of Co-financiers (source)	Classification	Type	At Concept ($)	At Work Program ($)	At CEO Endorsement ($)*
Participating companies ("Subsequent to CEO endorsement"; Please see Explanatory Note # 3 on Section 3 below)	Private Sector	in kind	0	750,000	750,000
	(select)	(select)			
IFC and/or Donors (see Explanatory Note # 2 on Section 3 below)	Exec. Agency	in cash	3,500,000	1,000,000	1,000,000
IFC (target investment as appropriate and if necessary; "Subsequent to CEO endorsement"; Please see Explanatory Note # 3 on Section 3 below)	Private Sector	in cash		5,000,000	5,000,000
Co-financing (see Explanatory Note # 2 on Section 3 below)	Private Sector	(select)	20,500,000	n/a	n/a
Total Co-financing			24,000,000	6,750,000	6,750,000

* Reflect the final commitment amount of co-financiers and attach documents from co-financiers confirming co-financing commitments. Describe any difference of final commitment compared to those expressions of interest at concept stage or at work program inclusion.

2. RESPONSE TO REVIEWS

a) COUNCIL
IFC received no questions from Council Members

b) GEF SECRETARIAT

PLEASE NOTE: We have reproduced without any edits or changes the answers provided to the reviews and questions from the GEF Secretariat up to the inclusion in the Work Program. As appropriate, we added a note (NOTE FOR CEO ENDORSEMENT) on the end of each answer pointing out relevant updates and sections of the Project Appraisal Document.

GEF Review Sheet of Project Concept Note
January 13, 2006
Program Manager: Zhihong Zhang
Requested Project Information by Work Program Inclusion

1. Endorsement letters from the participating countries will be required

IFC Comments: Endorsement letters received from Ghana and Kenya.

2. Countries and markets are specified, including the number of people/households who will make the switch from fuel-based to modern lighting. Direct and indirect GHG emissions reduction is estimated as a result of the project.

IFC Comments: IFC selected Ghana and Kenya for Project implementation. Three (3) scenarios have been developed for market penetration by WLED-based lighting products and resulting GHG emission reductions. A detailed description of the selection process and assumptions behind IFC market estimates can be found, respectively in Section 3 (Country Selection) and Annex A (Incremental Cost Analysis).

3. Markets for replication are identified and activities planned.

IFC Comments: The Project Brief describes the global nature of the fuel-based lighting problem that the Project is trying to address and the large potential for replication in other developing countries, most of which have similar conditions to Ghana and Kenya. These commonalities include (i) a significant proportion of the population lacking access to the grid, (ii) extensive reliance of this population on fuel-based lighting, (iii) existence of alternative product distribution channels, and (iv) an investment climate which does not deter interest and engagement by the international private sector.
As part of its strategy for replication, IFC has:

- Selected 2 countries that account for 10% of the total non-electrified population in Sub-Saharan Africa and almost 1% of the global non-electrified population. This provides sufficient scale to validate the project approach for address this global problem; and
- Designed a market-focused project that positions the private sector to play the leading role in developing a new market for WLED-based lighting products. The benefit of this approach is that once the private sector validates the market opportunity in the target countries, it will automatically seek to expand into additional markets, requiring limited or no further IFC/GEF support.

For further details, please refer to Section 4 (Strategic Context and Project Rationale) and Section 9 (Sustainability and Replicability)

4. Document the involvement of the local key stakeholders (local governments, end-users, industry, etc.)

IFC Comments: IFC has undertaken an extensive consultation process in preparing the Project. This has strongly influenced the Project design and ensured focus on key barriers. Consultations include discussions with 50 international WLED companies and over 70 meetings with local stakeholders in candidate countries. For a detailed documentation of those consultations, please refer to Section 4.5: Project Rationale, which discusses how those consultations influenced the project design, Section 6: Stakeholder Participation, Annex D: List of Meetings with Stakeholders, and Annex F (Sample of International Lighting Firms To be Invited to Join Consortium). (NOTE FOR CEO ENDORSEMENT: To date 142 private companies and 56 stakeholders have expressed interest in participating in the Project. Please see Annex F and G of Project Appraisal Document for list of firms and stakeholders that expressed interest in joining the Project)

5. Sources of co-financing are specified.

IFC Comments: IFC describes in the Project Brief both the sources of co-financing (donors and IFC), and the sources of leverage (private sector and end-users). Based on its experience with similar market transformation projects, IFC believes the project will be able to leverage a very significant level of resources from the private sector and end-users. For more detailed discussion please refer to Section 8: Project Budget, Financial Modalities, Financial Plan and Cost Effectiveness. (NOTE FOR CEO ENDORSEMENT: Please see section on Project Summary for a discussion on the fact that the Project will now be a pilot to a much larger World Bank Group Program on off-grid lighting in Sub-Saharan Africa. Please see also Figure 4 "Source of Total Funds", which indicate $4.6 MM being already leveraged for the Project as part of this larger World Bank Group. Further, IFC and IBRD are jointly undertaking a series of discussion with donors on funding this larger off-grid lighting initiative, building on the GEF-funded pilot in Kenya and Ghana.)

6. Document collaboration with ESMAP and other partners.

IFC Comments: IFC has discussed collaboration with several partners, including other multilaterals, international initiatives such as GVEP, and local NGOs in each of the target countries. In particular, IFC has discussed collaboration with (i) ESMAP concerning its DFID-funded program for SMEs in Africa, and (ii) IBRD concerning its project in Ghana also seeking GEF funding. IFC has identified many potential areas of collaboration and synergies between these initiatives and will be pursuing those during implementation. Further, during pre-appraisal IFC has undertaken an extensive review of between 10 and 17 existing initiatives in each of the target countries seeking to bring modern energy services to non-electrified populations. IFC will seek areas of collaboration with selected existing initiatives as appropriate for the project. For details on our efforts on collaboration, please refer to Section 7.6 (Institutional Coordination and Support). (NOTE FOR CEO ENDORSEMENT: See revised session on Institutional Coordination and Support for a summary of the partnership between IFC and IBRD towards a World Bank Group program on off-grid lighting in Sub-Saharan Africa)

GEF Review Sheet of Project Brief

April 13, 2006
Program Manager: Zhihong Zhang
Requested Project Information by Work Program Inclusion

IFC responses to the comments from the GEF Secretariat on the Project Brief for the Project "Lighting the Bottom of the Pyramid". A summary table is provided below and the remainder of this document provides more detailed responses to GEF questions/comments.

SUMMARY OF RESPONSES

GEF Question/Comment IFC Response

1. Identify and address barriers for consumer adoption of new technologies The project design has identified key consumer barriers, such as high cost and low affordability, mismatch between product design and end-user needs and lack of information. The project encompasses specific actions to remove those barriers, such as focusing on more affordable WLEDS, mobilizing micro-lending as necessary, ensuring proper product design and promoting consumer awareness campaigns.

2. Need to clarify use of $3.5MM of GEF funds for Step 5 IFC has set 6 main actions planned for those funds. IFC has provided a tentative language to avoid pre-determining actions to be taken 3-4 years from the start of the project, ensure the project retains the necessary flexibility to respond to the evolving market conditions. During appraisal IFC will refine its estimates and will further consult with GEF (NOTE FOR CEO ENDORSEMENT: IFC revised the budget and addressed GEF comments on two levels. First, following appraisal, the revised budget allocates less resources to Step 5 (a portion of its was reassigned to Step 2 and 3). Second, IFC broke down the activities of Step 5 to note the anticipated activities for that phase and indicative costs. IFC is still proposing to have some resources are allocated to Step 5 without a clearly defined activity at this point in time, in order to give IFC the flexibility to respond, as appropriate and if necessary, to industry and market development activities that we cannot fully anticipate at this stage)

3. Need to clarify assumptions and methodology for CO2 reduction calculations A preliminary summary that aims to offer additional details is provided in Annex A (NOTE FOR CEO ENDORSEMENT: IFC has added under the Annex A: Incremental Cost Analysis a sub-section "Summary of Assumptions and Methodology" that provides a detailed discussion on IFC assumption)

4. Need specific targets for performance indicators in the logframe Preliminary targets included (see preliminary list on Annex B). During appraisal IFC will further refine indicators and targets. (NOTE FOR CEO ENDORSEMENT: IFC has reviewed the indicators and targets. There were minor changes in the indicators and a review of the targets. See Annex B Logframe)

5. Document collaboration with ESMAP and other partners IFC has consulted with ESMAP and a number of other partners, both international and local , to explore collaboration opportunities. See Project Brief on page 37 for details. (NOTE FOR CEO ENDORSEMENT: See revised session on Institutional Coordination and Support for a summary of partnership between IFC and IBRD towards a World Bank Group program on off-grid lighting in Sub-Saharan Africa)

6. Explain reduction of co-financing from $12-30MM to $6.75MM Co-financing has not fallen but has been to large extent are-categorized as leverage. In fact, the project has increased the total resources from 3rd parties raised for the project from $ 12-30MM to $78MM (NOTE FOR CEO ENDORSEMENT: Leverage potential, while hard to predict given the nature of the Project, is likely to remain very significant given the larger World Bank Group program on off-grid lighting, and strong response received from the lighting industry to date)

7. Market penetration of 10% seems too ambitious IFC agrees it is an ambitious target, but notes it aimed at setting a target that sets a credible, large scale and lasting market transformation and consider a 10-year period. During appraisal IFC will be refining its market penetration estimates but WLEDs market penetration by the end of the project is likely to be around 4-5%.(NOTE FOR CEO ENDORSEMENT: Following GEF comments, and appraisal IFC has revised the potential market penetration and is targetting a market penetration rate of 2% (low end) to 10% (high-end) within 10 years. See Annex A: Incremental Cost Analysis for a discussion on our assumptions concerning market penetration)

8. Need for separate M&E budget IFC set $300,000 for M&E. It will integrate more clearly the M&E budget in the total budget. (NOTE FOR CEO ENDORSEMENT: See Section 11 on M&E for revised and detailed budget)

DETAILED RESPONSES

1. On GEF's suggestion that barriers for consumer adoption of new technologies also be identified and addressed as part of the project design.

IFC fully agrees on the importance on incorporating the customer's perspective for the adoption of new technologies. Building on previous project experiences, literature and its pre-appraisal process, IFC has identified in the project design key barriers to consumer's adoption of new technologies, including (i) high product cost and limited affordability, (ii) mismatch between product design and consumer needs, (iii) lack of information on the benefits of new products and (iv) challenges around distribution and post-service sales. To address these barriers, IFC has:

- Included in the project design actions to overcome known barriers for consumer adoption of new technologies, such a (i) mobilizing micro-lending as necessary, (ii) performing a comprehensive consumer research, and product testing to ensure WLED products are designed to meet consumer needs, (iii) promoting consumer awareness campaigns, and (vi) mapping a range of distribution channels to ensure products are delivered and serviced properly, and
- Retained for the final part of the project (Step 5) sufficient flexibility to respond with a range of actions to new or unanticipated barriers for consumer adoption of WLED that may be found during the course of the project.

Importantly, IFC's focus on WLED-based lighting solutions derives from the first-cost barrier which greatly constrained development of a robust solar home system (SHS) market. In large part because of the affordability issue, SHS's have not penetrated beyond the wealthier segments in Africa. Stand-alone WLED lighting systems provide an opportunity to penetrate this market through systems ranging from $25-$100, versus typical SHS cost of $600-$1,000.

2. On the fact that Step 5 calls for $3.5MM of GEF funds, but lacks clarity concerning the actions to undertaken and how GEF funds will be used

Based on previous experiences with market transformation projects, IFC believes that it will have to engage in several fronts to build the necessary institutions to support the long-term development of WLED markets. As discussed in the Project Brief, IFC's envisions undertaking 6 main actions during Step 5, namely (i) Support and Mobilizing Financing, (ii) Assessing the Potential for Local Manufacturing/Assembly, (iii) Aggregated purchasing, (iv) Performance and Quality Assurance, (v) Raising End-user Awareness, and (vi) Pro-actively Managing Solid Waste from Batteries. IFC has provided a total cost estimate of $3.5 MM based on previous experiences as it found that a detailed budget for each activity would be premature as market conditions, and the required intervention, will vary during the course of the project. Experience shows that IFC will likely have to emphasize some of the aforementioned actions while deemphasizing others, and probably add or drop one or two actions. Hence, IFC language did not mean to be cautious but to reflect the need to plan some key actions while remaining able to rapidly adapt the project actions when market conditions change. Should GEF Sec require, IFC can during appraisal develop some indicative numbers per action under Step 5, as well can have a specific consultation with GEF Sec by the end of Step 4 to discuss the envisioned actions for Step 5. (NOTE FOR CEO ENDORSEMENT: IFC revised the budget and addressed GEF comments on two levels. First, following appraisal, the revised budget allocates less resources to Step 5 (a portion of its was reassigned to Step 2 and 3). Second, IFC broke down the activities of Step 5 to note the anticipated activities for that phase and indicative costs. IFC is still proposing to have some resources are allocated to Step 5 without a clearly defined activity at this point in time, in order to give IFC the flexibility to respond, as appropriate and if necessary, to industry and market development activities that we cannot fully anticipate at this stage)

3. On the request for a clearer explanation of the key assumptions and the method for calculating CO2 emissions reduction.

IFC will review and incorporate in the Project Brief a summary of the Incremental Cost Analysis assumptions and methodology. A preliminary summary is provided in Annex A of this document.

4. On the need to provide specific targets for each of the indicators in the logframe.

IFC will review the logframe to include specific targets. A preliminary review is provided on Annex B of this document. Further refinement of targets will be developed during appraisal.

5. On collaboration with ESMAP and other partners

IFC has consulted with a number of international and local partners to explore opportunities for collaboration. Please refer to page 37 of Project Brief. Should GEF require additional information on that, IFC will be pleased to provide it.

6. On the drop in co-financing from $12-30MM (Concept Note) to $6.75MM (Project Brief) and GEF's request for a proportional reduction of GEF funds.

IFC estimate for co-financing was not reduced but re-categorized. At the concept level, IFC estimates were based on a preliminary assessment of 3rd party resources IFC anticipated raising for the project. At that stage, IFC did not differentiate between co-financing and leverage, and aimed only at ensuring that realistically the project would raise enough 3rd party resources to meet minimum GEF requirements. In the preparation of the Project Brief, IFC developed a much more detailed evaluation of the amount of 3rd party resources that IFC could raise, and if those

would fall into the "co-financing" or "leverage" category according to GEF definitions. The total amount of resources IFC envisions raising, both as co-financing and leverage, has indeed increase substantially from the Concept Note to the Project Brief, from $12-30MM to $78MM. IFC reckons that the requested GEF financing of $6MM is the minimum necessary to ensure an appropriate implementation and management of the project as envisioned to create the market impact projected.

7. On the fact that the project's base case market penetration for WLEDs – at 10% - could be too ambitious.

IFC recognizes the challenge for a new technology to reach a 10% market penetration. Yet IFC has opted for targeting what it reckons to be the necessary level of penetration if a credible lasting market transformation is to be achieved. Based on that target, IFC then planned the appropriate level of resources and set the key settings of the project design, such as creating a strong sense of competition amongst WLED companies. The goal is to have a realistic target, but deliberately test a more aggressive and large-scale market transformation model. This target, however, should be seen as indicative and over a 10-year period, based on the preliminary assessment performed during the pre-appraisal effort. IFC envisions reviewing and detailing its target during the appraisal process and setting specific milestones and timeframe for the market penetration by the completion of the project. Subject to further refining during appraisal, IFC would expect the market penetration by the end of the project to be around 4-5%.

8. On the need for a separate M&E budget and for its integration into the project budget.

IFC has budgeted $300,000 for an independent evaluator to monitor and evaluate the project (see page 48 of Project Brief). IFC will provide a detailed budget for M&E and integrate it in the overall project budget. (NOTE FOR CEO ENDORSEMENT: See Section 11 on M&E for revised and detailed budget)

GEF Requests on Bilaterals on May 19,2006
IFC Summary of Changes in the Document

GEF Question/Comment Changes in Document Doc Section

9. Identify and address barriers for consumer adoption of new technologies Language included to further stress that barrier identified affect not only suppliers, but also consumer's adoption of new technologies Section 4.5.4 of Project Brief. Also included in Executive Summary

10. Need to clarify use of $3.5MM of GEF funds for Step 5 Language included clarifying use of GEF funds under Step 5 Section 8 of Project Brief

11. Need to clarify assumptions and methodology for CO2 reduction calculations
Summary of assumption and methodology included See ICA in Project Brief. Also included in Executive Summary

12. Need specific targets for performance indicators in the logframe Specific targets included See Annex on Logframe. Also included in Executive Summary.

13. Document collaboration with ESMAP and other partners Documented in Project Brief Section 7.6 of Project Brief

14. Explain reduction of co-financing from $12-30MM to $6.75MM Explained on bilaterals. See Annex on IFC response to GEF SEC Review Sheet on Project BriefAnnex H

15. Market penetration of 10% seems too ambitious Explained on bilaterals. See Annex on IFC response to GEF SEC Review Sheet on Project Brief Annex H

16. Need for separate M&E budget Included budget line specific to M&E See Figure 16

C) REVIEW BY EXPERT FROM STAP ROSTER (IF REQUIRED)

STAP Reviewer: Daniel M. Kammen
Position: Class of 1935 Distinguished Chair in Energy
Energy and Resources Group & Goldman School of Public Policy
Director, Renewable and Appropriate Energy Laboratory (RAEL)
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STAP Review

Note: two of the project consultants for this effort, Professor Arne Jacobson and Ms. Rebecca Ghanadan are my current and recently graduated students (see, e.g. the listed references: Moner-Girona, et al., 2006, and Jacobson and Kammen, 2005).

Some of the comment presented here grew out of both our collaborative field and analytical work on the energy markets in Eastern and Southern Africa, and our shared assessment of this project.

Overall:

This is an ambitious and potentially very important project, and should be supported.

The most exceptional feature of this project is the plan to develop essentially a new technology and market-base in Africa (some use of LED lighting exists, but it is very limited). The potential to develop this industry for the African market, and in a financially meaningful partnership with the global semiconductor industry has great promise, if managed truly to meet the 'bottom of the pyramid' needs. At the same time, the risk without oversight for this needy market segment to be served poorly is real. This project appears to have the needed safeguards in place, given the track-record of efforts in Africa (such as the prior IFC PVMTI program in Kenya).

The focus on a new, application-specific, technology for Africa reduces (though does not eliminate) many of the complexities of interventions in existing markets. One of the greatest strengths of this project is the ability to leverage LED lighting at a relatively large scale due to the state of the international industry and the potential to meet a critical set of price and

performance points that have great appeal and demand in Africa. The decision to focus on multiple countries, while challenging, is also well-taken in this context so that the market size can be increased, and so that a range of applications can be addressed.

At the same time, this arrangement leads to the two key recommendations of this review:

1. Establish an international advisory committee, with primary membership of ministries and consumer (NGO) watchdog groups that have real oversight authority in the commercial operation in each country. External advisors who have no commercial role in the project should also be represented on the committee. This may at first seem overly onerous, but the market potential of this partnership, and the degree to which a LED program that works as envisioned will, in effect, bind the consumers to this technology, warrant this approach. As the experience with the technology grows, and the more and less profitable market segments become clear, an oversight team will be needed to be sure that the 'Bottom of the Pyramid' approach does not in any way degenerate into a preferred push on the best-performing market segments.

IFC Response:
The Project design provides for the creation of three national Advisory Committees which will represent local needs. These Committees will consist of relevant government and non-governmental representatives and will meet regularly to guide the implementation of the project. In addition, the findings of each national Committee will be shared with their counterparts and all three Committees will be brought together at regular intervals to discuss the progress of the project at an international level.

2. A more detailed market analysis that is presented in the PCD is required. This can be done once the project is approved (as a pre-commercial assessment, but also as a baseline plan for the use of the advisory committee in evaluating project development. Aspects of this analysis could include:

- Learning curve analysis of the technology (see, e.g. Duke and Kammen, 2003). In fact, the analysis of the amorphous silicon solar cell market potential in Africa presented in this paper could be used quite effectively in exploring what different price-points and specific products might do in the market context of these nations.
- An analysis of technology adoption in African context (identifying priority segments), and;
- Clearer identification of the priorities & approaches in reaching different market segments (i.e. lighting for applications across income scales).

IFC Response:
Step 2 of the Project's proposed 6-step implementation approach is entirely focused on market analysis with the objective of developing a detailed understanding of market segments, consumer needs and trade-offs, competitive price points, and likely adoption patterns. The reviewer's recommendations for this analysis will be incorporated into the program design.

Lighting markets in Ghana, Kenya, and Tanzania all qualify, generally, as "lighting the bottom of the pyramid" from an OECD perspective. However, the market is not at all unified, and these analyses are necessary to develop a more detailed & realistic expectations of what market support is needed (and what the environmental, fuel, and other benefits maybe).

IFC Response:
Steps 2 and 3 of the Project's proposed 6-step implementation approach will assess market needs and distribution options on a country specific basis.

Finally, one significant methodological caution. The analysis presented for this project assumes lighting "displacement" a priori. Namely, the LED lights will offset other, incandescent purchases. It would be a more accurate understanding to think of LEDs offering high quality, relatively low cost lighting that may displace/substitute or add to existing lighting options to African end-users.

While the distinction makes a difference for assumptions about GHG offsets, it does not make a difference for the claim that LEDs certainly improve upon people's existing lighting options in Africa. It is non-trivial to recognize this difference because the GHG benefits of PV in Africa have been commonly emphasized in the literature, often because of the need to meet incremental cost goals when other objectives (employment, service provision, security, quality of life) are also part of the goal set.

IFC Response:
The Project's methodology assumes market penetration and energy savings articulated as fractions of total lighting energy, as opposed to numbers of households or light sources. It is important to note that the potential for lighting-related CO2 reductions from traditional whole-house solar electric systems have been curbed (Hankins 2005) in part by the limited efficacy of traditional fluorescent lighting used therein, and end-users sometimes prefer to use scarce solar electricity for other end uses (e.g. television). Consequently, among relatively affluent households, the introduction of alternative lighting may be taken as an augmentation to existing lighting rather than as a substitute (as has been observed for current solar home systems) and thus could result in little if any reduction in energy user or associated emissions. We believe that for our target market this "take-back effect" will be limited, and virtually non-existent in the case of single-vendor night-market businesses or the poorest households (which use only one light source and can barely afford the kerosene they use today). We believe that the proposed technology will be significantly more successful than conventional solar lighting because: (i) it will provide more effective lighting at lower cost than the alternative; (ii) it will be targeted at lower income households which are more likely to take the solar light as a substitute to (rather than augmentation of) existing kerosene, and (iii) it will make possible more than one affordable point of light for a given consumer.

Aspects Needing Particular Attention:
As stated above a concern is that the project document treats the market as a single entity and thus not specific enough about market development and blurring opportunities/constraints, costs/benefits across different applications and groups. A clearer market analysis framework (even if it spells out where uncertainties) would make it possible to begin to talk about priorities, barriers, and needs of different market segments as separate entities. That is, what is the composition of the market pyramid within Kenya, Tanzania, Ghana? This would be a valuable contribution to the "bottom of the pyramid" literature and will be critical to successful project implementation.

End use analysis and product development will need to be geared differently to different groups. And talking concretely about segments will also lead to more appropriate assessments. End user needs, applications, ability to pay, distribution channels, and potential GHG/environmental

benefits will all be highly specific to different market segments. One can envision an approach needing to develop different approaches for i) small business applications & urban backup applications, ii) peri-urban & rural middle class, and iii) rural non-middle class. As stated in the overall comments, this need not be completed prior to project approval, but should be planned and budgeted into the overall effort. The advisory committee could, again, be a natural recipient of the analysis.

One of the most important contributions of a highly leveraged project like this is its potential to exploit all avenues for bringing prices for LED lighting technologies down. This may be via standard learning curve demand (though likely small in global context). But more likely in catalyzing many of the specific market "innovations" needed to make prices and technologies fit lighting needs and purchasing power capabilities in Africa. It would be ideal to include a more explicit analysis of what the learning curve potential is for LED lighting over the next 5 years or so.

From a business and service perspective, it would also make sense to commission an explicit analysis of what are the key factors keeping efficient lighting technologies costly in Africa, and how this project will directly go about reducing them (i.e. are they a result of import duties, wholesale or distribution surpluses, small quantity purchases, transportation, etc). In the case of the Kenyan solar market, the evaluation and presentation back to the Office of the Vice President of the size and impact of import tariffs, was particularly important in subsequent government decision—making (Duke, et al, 2002; Jacobson and Kammen, 2005)

IFC Response:
Steps 2 and 3 of the Project's proposed 6-step implementation approach will assess market needs and distribution options on a country specific basis. Step 2 is entirely focused on market analysis with the objective of developing a detailed understanding of market segments, consumer needs and trade-offs, competitive price points, and likely adoption patterns. The reviewer's recommendations for inclusion of analysis on why current technologies remain expensive and the potential for learning-curve benefits in WLED-based technology analysis will be incorporated into program design.

Specific Comments:
The economic analysis needs to be expanded. Technology penetration rates are a) not likely to all be so simple or similar, and b) there needs to be more analysis of the different services provided to different socioeconomic segments. Again, this task, if done properly, is a large effort, and could be formulated as a pre-feasibility effort to look at a range of technology entry points.

As well formulated by Prof. Jacobson:

At the "entry level" of the spectrum will be stand-alone light sources (usable individually or in multiples) at price points in the vicinity of US$5 each. In practice, lights of different sizes (light output) would be offered, ranging from 0.1 to 1.0 Watts, and perhaps higher for specialized applications, with a range in prices for perhaps $2 to $10 each. These will be powered by removable "AA" style (or similar) batteries, already available in the local market. In this configuration, either disposable batteries at $0.25 each (lower first cost and higher operation cost) will be used, or rechargeable batteries at ~$1.50 each charged by local micro-enterprises using solar photovoltaic or grid-based charging at a cost of perhaps $0.10 per charge. Alternatively, third parties may elect to establish micro-grids with central power at the scale of a

cluster of homes or greater. Consumers can graduate from disposable to rechargeable batteries or microgrids as they become able to afford third-party recharging or their own charging device. The next step upwards will be to stand-alone systems with integrated charging (PV, hand cranked, etc). These systems would be modular in that they could be purchased incrementally (e.g. Charger ~$15-$20) plus one or more light points at perhaps $5 each. Lastly would be relatively high-end configurations including a package with multiple light sources, charging, and even ancillary services such as cell phone or radio power. These would be valued more highly, e.g. because they would defer phone charging costs of ~$10/month) and would be brought to the market at a correspondingly higher price point.

IFC Response:
This characterization of the market opportunities and nuances has been integrated in our proposal. The economic analysis will be refined during the appraisal process and throughout the Project life as the understanding of each specific market is improved. The needs and potential penetration rates of each market segment in each country will be key data points provided to the private sector consortium and will enable them to develop products and market entry strategies which suit demand.

The job creation potential of this project – a major benefit -- is under-emphasized and should be given much more attention. While a GEF proposal requires attention to environmental benefits, development benefits are equally (if not more) significant. The proposal discusses in a short section the possibility of local manufacture, however with a strong caveat of only doing this if it makes sense in "least cost terms".

The potential exists here to make job creation as a more explicit goal. To support the potential of local manufacture, a cost comparison analysis is in order. This area seems a large area of potential untapped benefits (and challenges) not highlighted in the proposal.

IFC Response:
Project design has been carefully structured to provide an intervention that enables but does not distort a sustainable market response. To this end, careful economic cost-benefit analysis will be provided to the private sector consortium to ensure that it gives appropriate consideration to the potential for local manufacture and makes an optimal decision when locating its manufacturing facilities.

Page 2, remove, 'young juggernaut of the solid-state lighting industry' phrase.

IFC Response:
Suggestion incorporated into submission.

Figure 6: should not be included in the PCD. This is part of a report my doctoral student Rebecca Ghanadan, who provided input to the project in writing for the World Bank. It has not been published at this time and the figure is not attributed properly to Ms. Ghanadan.

IFC Response:
Suggestion incorporated into submission.

References:

Moner-Girona, M., Ghanadan, R., Jacobson, A., and Kammen, D. M. (2006) "Decreasing PV costs in Africa," ReFocus: The International Renewable Energy Magazine, January/February, 40 – 45.

Jacobson, A. and Kammen, D. M. (2005) " Science and engineering research that values the plant", The Bridge: Journal of the National Academy of Engineering, Winter, 11 – 17.

Duke, R. D. and Kammen, D. M. (2003) "Energy for Development: Solar Home Systems in Africa and Global Carbon Emissions "Climate Change for Africa: Science, Technology, Policy and Capacity Building, Pak Sum Low, editor (Kluwer Academic Publishers), 250 - 266.

Duke, Richard. D, Jacobson, Arne, and Daniel M. Kammen (2002) "Product quality in the Kenyan solar home industry", Energy Policy, 30 (6), 477-499.

3. JUSTIFICATION FOR MAJOR CHANGES IN THE PROJECT, IF ANY[2]

There is no major change in the Project design, objectives and implementation plan. However, note the following comments concerning the Project:

Note 1 - Readjusting the Focus on LEDs: At the Work Program stage, IFC had designed a program focused solely on LEDs, given this technology's potential to provide higher quality and more affordable off-grid lighting products that can commercially displace fuel-based lighting. During the appraisal process, however, IFC learned through its consultations with the industry and stakeholders that while LEDs are the most promising solution to increase access to modern lighting services, other technologies, such as CFL may be able to serve well certain segments of the market. For instance, some companies pursuing this market are seeking to enter with a portfolio of products that includes, for instance, LED and CFL-based off-grid lighting products. As a result of that consultation and of the appraisal process, the final design will retain its strong focus on LEDs, but will be open to support lighting companies seeking to enter the market with technologies other than LEDs. That added flexibility will strengthen the program, ensuring that it is technology neutral and supports the best solution to increase acess to modern lighting services and reduce GHG emission associated with fuel-based lighting (See additional elaboration in the PAD, Section 1).

Note 2 - Table D, Co-financing amount - Reduction of Co-financing from $20,500,000 at the Concept Level to N/A at Work Program and CEO Endorsement: At the Concept Note, IFC did not differentiate between co-financing and leverage or type of co-financiers, and was considering a program encompassing 3-5 countries. Hence the $20.5MM listed as **"**co-financing**"** and $3.5MM listed as **"**co-financing**"** from donors from IFC/Donors, which were indicative estimates that reflected initial expectations for both co-financing and leverage, from several sources, and up to 5 countries. At the work program level, IFC refined its assessment of the expected sources of co-financing, which remained the same for the CEO Endorsement.

[2] Provide justifications for any major amendments in the project, including an increase of project amount exceeding 5% from the amount approved by the Council. Justification for such amendments and the project document will be circulated to the Council for a four-week review period. For procedures to the approval for major amendments, refer to the Council paper: *Project Cycle Update: Clarification of Policies and Procedures for Project Amendment and Drops/Cancellations, GEF/C.24/Inf.5*

Note 3 - Table D, Co-financing classification: Based on our understanding of the GEF's definition of different types of co-financing , we listed at the Work Program those that we expect to provide by CEO Endorsement ("Initial") and those that we would expect to provide throughout the project ("Subsequent to CEO Endorsement"). Concerning the co-financing listed "Subsequent to CEO Endorsement", IFC expects private firms to provide in-kind contributions across several of the project activities, from their time and resources to review and provide inputs to the market research plan and costs associated to their business development, to the costs associated to attending the Project's industry meetings. IFC also expects that mobilization of financing will be required at some point during the life of the Project. This may take the form of a direct investment in a company seeking to locally assembly modern lighting products, and/or may entail mobilizing other equity, vendor and/or micro-financing. As appropriate, IFC will engage to mobilize these funds, using its own resources and/or mobilizing 3rd party resources (e.g. working with regional private equity funds, structuring a guarantee program to mobilize local commercial funding, etc). The mobilization of these funds will be undertaken if necessary and under the appropriate structure (or structures) to achieve the objectives of the Project.

Note 4 - Table C, Consultants Working For Technical Assistance Components: The Project is designed to have a small, core IFC staff, whose primary role would be to a center of expertise on the market and a key source of technical support for all participating companies in the market development effort. The target profile of the team members will be marketing and new business development specialists with appropriate levels of project management experience. This team is anticipated to leverage extensively local consultants, hence the high amount allocated to local consultants in the budget. These local consultants would be performing many of the key Project tasks, under the PMO's supervision. Those tasks would include, but not be limited to (i) market research of different segments, (ii) mapping, profiling and supporting the engagement of distribution channels, (iii) technical and implementation support concering consumer education campaigns, (iv) technical and implementation support concerning the development of performance standards, (v) support outreach efforts to the local private sector and stakeholders, and (vi) organize industry and stakeholders meetings throughout the course of the Project. International consultants will be used selectively and only when local expertise is not available. For instance, international consultants will be engaged in the development of performance standards for modern off-grid lighting products and, as appropriate, may be engaged in capacity building for local financial institutions to mobilize local funding to the off-grid lighting market, among other activities.

4. REQUIRED ATTACHMENTS

a) Project Appraisal Document
b) Report on the Use of Project Preparation Grant
c) Confirmed letters of commitments from co-financiers (with English translations)
d) Agency Notification Template on Major Project Amendment and provide details of the amendment, if applicable.

DOCUMENT OF

INTERNATIONAL FINANCE CORPORATION

LIGHTING THE BOTTOM OF THE PYRAMID

GEF Project Appraisal Document

July 2007

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1 Project Summary

Project rationale, objectives, outputs/outcomes, and activities.

The objective of the project "Lighting the Bottom of the Pyramid" (the Project) is to accelerate the development of markets for modern (electric) off-grid lighting products to increase access to modern energy and reduce GHG emission by substituting the fuel-based lighting widely used in Ghana and Kenya. Recent technological developments in lighting technology, and in particular in the area of solid-state lighting - specifically light emitting diodes (LEDs) - creates an opportunity to accelerate the penetration of superior off-grid lighting technology and replace fuel-based lighting across the developing world. Off-grid lighting products sold as a result of the Project will reduce the reliance of unelectrified households and small businesses on carbon-intensive fuel-based lighting (e.g. kerosene, candles and biomass), whose consumption is equivalent to 33% of total primary energy used for household lighting globally, representing 58% of global residential electric lighting GHG emissions. The alternative lighting products will also promote sustainable economic development by providing improved light quality at lower prices to communities that currently spend a disproportionate amount of their limited incomes on high cost fuels.

The Project will also be the launching pad for a broader World Bank Group (WBG) program on off-grid lighting across Sub-Saharan Africa as part of the WBG commitments under the Clean Energy Investment Framework. This WBG program, currently being refined, will build on the market-based approach of this Project, and leverage IFC and IBRD strengths and resources towards a broader program reaching additional countries in Sub-Saharan Africa. Among other planned initiatives, this WBG program will strengthen and expand on the Project's market-based approach by adding initiatives that will strengthen local institutions to support the long-term engagement of the private sector and a sustainable increase in access to modern energy services. Those initiatives currently under development may include a broader and comprehensive effort on developing product performance standards, a "Development MarketPlace" competition to uncover and engage local entrepreneurs already or interested in providing modern solutions in off-grid lighting, and an effort to pursue programmatic carbon credits from the off-grid lighting programs. The WBG program will be implemented by a joint IFC-IBRD team. As a result, the Project's impact will be much broader than Kenya and Ghana, and its financial leverage higher given the additional mobilization of funds from IBRD for off-grid lighting.

The Project will be technology neutral but have a strong focus in leveraging the potential of LEDs. The Project will in fact represent the first inclusion of LED technology in the GEF portfolio. The decision to promote, albeit not exclusively, LED-based products in addition to other off-grid lighting technologies (such as Compact Fluorescent Lamps, CFLs), was driven by the disruptive potential of this technology: widely used in niche applications for over 3 decades, it is being recognized as the "next generation" for general illumination, LEDs provide high quality lighting while only requiring low levels of power. This makes LEDs suitable for small, off-grid lighting products[1] that are superior in quality and cost of ownership to fuel-based lighting, and avoid health and safety hazards associated with fuel-based lighting. LED-based lighting products holds the promise to overcome many of the problems experienced in GEF solar-home system interventions: prices can be truly competitive with fuel based lighting; lighting can be sold as a 'product' not a 'system' (sized as a single light point in an affordable product package); lighting can be sold by non-technical retailers alongside other categories of consumer products; products do not require technicians for installation; products can be designed around specific end-user needs or as multi-purpose portable lights which compete directly with the ubiquitous kerosene lantern; and products do not have to rely on a particular power source but can be designed to use whatever makes sense (solar, wind-

[1] E.g. rechargeable battery-based lighting systems powered by photovoltaic panels, mechanical devices, or other small-scale portable sources of electricity

up, recharge station, etc). While the Project will have a strong focus on LEDs, given this technology widely recognized promise for low-cost, high quality off-grid lighting solutions, the Project will remain neutral in terms of lighting technologies, balancing a focus in LEDs with an openness and flexibility to test and support other technological solutions that may prove successful in commercially displacing fuel-based lighting. For instance, non-LED lighting companies are also being invited to participate in the private sector consortium being formed by the Project. In addition, a comprehensive market research to be carried by the Project will test a few products, and while we project that at least 70% of the products will use LED, the Project will be open to test non-LED based lighting technologies that have something unique to offer (see further below detailed discussion on Project activities).Lastly, it is envisioned that if companies using technologies other than LED are successful in achieving the project objectives, namely to commercially displace fuel-based lighting, the Project will be open to support them (e.g. IFC direct funding, if appropriate).

This approach is based on extensive consultation with the lighting industry. As part of the Project development activities, IFC has spent the last two years engaging a range of players from the industry, both globally and locally in the target markets. Between the pre-appraisal and appraisal process, IFC consulted with over 100 lighting companies and over 90 stakeholders relevant to the Project. The response to the Project has been very strong and positive. Lighting manufacturers and suppliers, using a range of lighting technologies and operating both internationally and in Africa only, expressed great interest in the market provided by an estimated $38 billion/year that worldwide goes towards fuel-based lighting. Distributors in Kenya and Ghana, both energy and non-energy related expressed great interest in the market for off-grid lighting given the latent demand for better lighting services. Stakeholders by and large welcomed a large-scale initiative that aims to engage the private sector in the effort to increase access to modern energy, and validated the core premises of the Project.

Despite this interest, all companies identified two barriers which inhibit them from developing this market alone: (i) high costs of understanding the customers' lighting needs and behavior and of identifying the appropriate distribution channels to reach them; and (ii) lack of key institutions required to develop this new market, such as product standard and quality control, vendor and consumer financing, and awareness raising amongst end-users about the benefits of modern alternatives to fuel-based lighting.

Based on this assessment, and drawing on experiences with other market interventions, such as the Photovoltaic Market Transformation Initiative (PVMTI) and the Efficient Lighting Initiative (ELI), IFC concluded that an appropriate intervention would reduce the transaction costs for each company developing the market, while remaining inclusive to all interested players, fostering innovation and competition, and allowing market forces to ensure consumer demand is met. IFC will not use donor funds to subsidize individual products or companies, but rather to catalyze the private sector, undertaking as a "neutral coordinator" two core initiatives on behalf of the entire industry: (i) organize the effort and share the common costs of understanding the customer, and identifying and engaging appropriate distribution channels; and (ii) mobilize resources and institutions that will serve all companies pursuing this market, including product certification, financing (vendor and consumer), and raising customer awareness.

This proposed Project design and strategy has been developed in partnership with the industry and its final plan received a very strong support from the lighting industry and stakeholders at large. Following GEF Council Approval to the Project in July 2006, IFC has as part of the appraisal process returned to lighting companies and stakeholders and officially invited them to join the project. **As of February 5, 2007 198 private companies and stakeholders from 35 countries have expressed interest in participating in Project by registering at the Project's website (www.ifc.org/led). Private companies, 142 in total, range from LED manufacturers and distributors to entrepreneurs and design companies, and from global companies, such as Osram and Philips to local entrepreneurs in**

Kenya and Ghana. Stakeholders, 56 in total, include, among others, NGOs, universities, research centers and other international development organizations. We quote below a recent public statement of Philips' CEO Gerard Kleisterlee that summarizes the perspective from the lighting industry.

" 'Lighting the bottom of the pyramid' is a global initiative to develop a commercial solution to bring modern lighting to these 1.6 billion people, for example by developing alternative off-grid systems of higher quality and lower energy consumption. Business can clearly play a role here because a 38 billion market must be an attractive market. But since this market, as many markets for low income people in developing countries is not very well known or explored, it is essential that governments and international organizations such as the World Bank, NGOs, and various companies get together in a network to work out the appropriate business models. That is exactly what we are doing at the moment under the leadership of the International Finance Corporation."

To meet its objectives, the Project will be implemented in a structured process that will: (i) reduce market entry barriers for suppliers, (ii) reduce consumer costs (information, price, etc) in adopting the products, and (iii) ensure the long-term sustainability and commercial viability of the market.

Figure 1: Project Core 6-Actions

Action		Summary
1	**Form a Private Sector Consortium**	IFC will formally engage a significant number of local and international companies interested in pursuing this market. Companies will be expected to invest substantial effort and resources to the collaborative efforts administered through the Project.
2	**Understand Customer Needs and Preferences**	IFC will lead, on behalf of and in partnership with the private sector, an assessment of the end-user needs and preferences in lighting products among the target market of off-grid consumers.
3	**Identify New Distribution Channels**	IFC will lead, on behalf of and in partnership with the private sector, an effort to engage a number of local distribution channels that reach the unelectrified public.
4	**Set Parameters for Modern Off-grid Lighting Products and Foster Competition**	IFC will convey to the industry the findings from Steps 2 and 3, and support interested industry members in executing their strategies, such as creating joint ventures, establishing production and/or distribution consortia.
5	**Build Institutions for Market Development**	IFC will support the establishment of key institutions and policies for the market development effort. This may including mobilizing financing, establishing a product certification process, raising customer awareness, etc
6	**Exit**	Once a self-sustaining market is established, and private companies are actively engaged in executing their marketing strategies, the Project intervention will be completed

Key indicators, assumptions, and risks (from Logframe)

The primary indicator will be GHG emission reductions caused by the displacement of fuel-based lighting. The IFC projections assume for Kenya and Ghana combined a total population of 19 million end-users, comprising households and small businesses. IFC project a range of 2-10% of market penetration (386,000 to 1.9 million) of LED and other modern off-grid lighting products which would reduce carbon emission in Ghana and Kenya by 782,000 to 3.9 million tonnes over a 10-year period. The target by the end of the project is a 4% market penetration of LEDs and other modern lighting products (772,000) and reduction in GHG emissions of 1,564 million tones. An intermediate target for the Project is to reach 1% market penetration of modern lighting products (or 193,000), and reductions of 391,000 million tones in GHG emissions from fuel-based lighting by the end of 2nd year of the project. Additional indicators will include: (i) number of manufacturers entering the market; and (ii) number of alternative products made available in the market. The main risks relate to the possibility of limited market uptake or a change in industry interest. Further, market development is always subject to macroeconomic factors. IFC's selection of Ghana and Kenya is intended to mitigate these risks in three ways: i) the aggregate market is substantial enough to interest the international industry ($1.45 billion per year spent on lighting-fuel); 2) both markets have a vibrant private sector and strong entrepreneurial class; 3) Kenya and Ghana are currently a common entry point and a regional hub for business serving, respectively, Eastern and

Western Africa., 4) both countries exhibit stable market conditions in the African context; and 5) the East-West Africa combination diversifies exposure to regional macroeconomic trends and presents an entry point into two large regional markets.

Financial modality and cost effectiveness

The Project budget is estimated at $12.15 million for 4 years of operation. IFC expects substantial investment from participating private firms, whose contribution would be in the form of cash expenditures and in-kind staff investment. *IFC is requesting GEF to fund $5,400,000* and will contribute an additional $1,000,000 from donors and/or IFC cash contribution to support to the program operations. Direct industry contributions over the 4 years to co-finance the Program implementation costs are anticipated to total $750,000. As the industry has yet to receive the benefits of the Project (e.g. information on consumer needs, access to distributors, etc) to then respond with investments in its own business development, product design, etc, IFC did not seek at this stage formal commitments for co-funding. Instead, IFC has asked companies to review the project strategy and its benefits, and asked that if the companies felt this was an attractive enough market, and the project was appropriate in supporting them understanding and entering this market, to "sign-up" via a special website to capture these early expression of interest in the Project. As noted above over 140 companies have "signed up" as of February expressing interest in participating in the Project.

In addition, IFC would also aim to deliver $5,000,000 of investment to support the commercial sustainability of the Project, leveraging an additional $6,250,000 in investment in market development from industry in in-kind contributions. These costs and contributions could take many forms depending on the Project needs that are eventually defined by the industry and the market's development. They range from credit facilities to support vendors and micro-credit institutions involved in the Project, to debt or equity to support the establishment of local manufacturing. IFC investee companies in the region are potential sources of support as well. IFC has identified interest in participating from several such players in the local market.

Concerning co-financing from donors, the Project expects co-financing from the Government of Luxembourg ($500,000), Government of Norway ($400,000), and the European Commission (€ 2,800,000 of which a significant portion is "earmarked" for dissemination/replication). These commitments are currently being formalized and should be in place by the end of 2007 (Calendar Year). In addition, the Project is expected to generate significant amounts of leverage through the funding to the World Bank Group project "Lighting Africa". About $4.6 million has been secured for Lighting Africa, and there are ongoing discussions with donors to further fund an African wide program on off-grid lighting building upon this GEF/IFC pilot.

The table below provides the operational budget. It has both costs for specific components, and overall project costs. We note that the Project Management Office's (PMO) primary mandate is to directly support the the project's market development effort, and it is envisioned that 80% of their time will be fully dedicated to that end. The activities the PMO may carry to that end will include, but not be limited to, facilitating business partnerships, supporting the development of individual firm strategies, planning and implementing (with local expert support) consumer education campaigns, work with appropriate parties as appropriate on the development of performance standards, enabling further market assessment any company may want to undertake, and support the development of key institutions (e.g. product testing center in a local university) etc. Hence, the PMO is not a mere overhead cost on the administration of the Project but a key center of support and expertise on the market, and an integral part of the effort to develop the market. To reflect that, we also prepared a table highlighting the cost per component, which allocates the PMO-related costs to each component based on our judgment, and provides a picture of the different costs of the sub-components.

Figure 2: Indicative Budget –Use of Funds

		Total	Year 1	Year 2	Year 3	Year 4
Project Administration - Staff Costs for Project Management		484,000	121,000	121,000	121,000	121,000
Travel Costs Directly Related to Project Implementation		60,000	15,000	15,000	15,000	15,000
Office equipment, vehicles and supplies		207,000	129,000	26,000	26,000	26,000
M&E	M&E (includes $30K last year for post-project M&E)	150,000	30,000	30,000	30,000	60,000
Total Project Management Cost		**901,000**	**295,000**	**192,000**	**192,000**	**222,000**
Project Components Costs						
	Of Which					
Component 1	Forming and Sustaining Private Sector Consortium	54,000	25,000	25,000	2,000	2,000
	Industry In-Kind Contribution (1)	50,000	40,000	10,000		
Total		*104,000*	*65,000*	*35,000*	*2,000*	*2,000*
Component 2	Market Assessment, including cost of products for field test	1,080,000	360,000	360,000	180,000	180,000
	Industry In-Kind Contribution (1)	50,000		50,000		
Total		*1,130,000*	*360,000*	*410,000*	*180,000*	*180,000*
Component 3	Distribution Channels Mapping and Engagement	410,000	50,000	200,000	100,000	60,000
	Industry In-Kind Contribution (1)	50,000		50,000		
Total		*460,000*	*50,000*	*250,000*	*100,000*	*60,000*
Component 4	Mobilizing industry - webportal, industry networking/mobilization engagements, conveying findings, local assembly feasibility study, etc	1,150,000	200,000	400,000	350,000	200,000
	IFC Financial support to companies entering the market, if necessary (1)	5,000,000		1,000,000	2,000,000	2,000,000
	Ongoing support and monitoring of products market penetration	525,000	137,834	137,650	124,758	124,758
	Industry In-Kind Contribution (1)	300,000			150,000	150,000
Total		*6,975,000*	*337,834*	*1,537,650*	*2,624,758*	*2,474,758*
Component 5	Peformance Standard and Certification Process Development	500,000	100,000	150,000	150,000	100,000
	Consumer education campaign	500,000	0	200,000	200,000	100,000
	Support to local Fis (banks, leasing, microfinance) to engage in off-grid lighting sector	300,000		100,000	100,000	100,000
	Capacity Building to relevant local institutions (energy business associations, manufacturing/industry business associations, solar energy associations, etc)	200,000		70,000	70,000	60,000
	Other Activities for Market Development, as defined by consortium of lighting companies	780,000		250,000	350,000	180,000
	Industry In-Kind Contribution (1)	300,000			150,000	150,000
Total		*2,580,000*	*100,000*	*770,000*	*1,020,000*	*690,000*
Total Components Costs		**11,249,000**	**912,834**	**3,002,650**	**3,926,758**	**3,406,758**
TOTAL BUDGET		**12,150,000**	**1,207,834**	**3,194,650**	**4,118,758**	**3,628,758**

(1) Per approved Project and current PAD, this co-financing is subsequent to CEO endorsement

Figure 3: Cost Per Component of the Project

	Cost (US$)	Cost (% of Total)	% of GEF Funding
Project Management Office	901,000	7%	45%
Component/Phase 1	104,000	1%	52%
Component/Phase 2	1,130,000	9%	96%
Component/Phase 3	460,000	4%	89%
Component/Phase 4	6,975,000	57%	24%
Component/Phase 5	2,580,000	21%	69%
Total	12,150,000	100%	44%

Based on earlier IFC experiences in market transformation projects, IFC's experience working with donors in Africa, and preliminary discussions IFC has held with donors and international industry players, IFC believes it will be able to substantially leverage GEF funding. IFC estimates that the Project would leverage up to $18.7 million from end-users through purchase of the more energy-efficient lighting products, and $6.25 million from private companies investing in product development and marketing initiatives in direct support of the Project objectives. In serving as the launching pad of a broader WBG program on off-grid lighting, the Project is positioned to leverage additional resources both for Kenya and Ghana, in issues such as seeking carbon credits from the program, a global product quality certification process, and the "Development Marketplace" contest, but also towards replication of the Project in other countries across Sub-Saharan Africa.

Figure 4: Source of Total Funds

Source	Type	Use	Amount
GEF	Grant	Project Operating Costs	$5,400,000
IFC/donor	Co-finding in Grant/Cash	Project Operating Costs	$1,000,000
Private Firms	Co-Financing in-kind	Market Development Costs	$750,000 (Subsequent to CEO Endorsement)
IFC	Co-financing	Market Development Costs	$5,000,000 (Subsequent to CEO Endorsement, and if necessary)
Total Project Cost	***GEF, Donors, IFC and Private Sector***	***Project Operating Costs and Market Development***	***12,150,000***
Consumer	Leverage	Market Development Costs	$18,750,000 (middle case)
Private Firms	Leverage	Market Development Costs	$6,250,000 (est)
World Bank Group	Leverage	Broadening of the Program, with CDM, Development Marketplace and other countries	4,760,000 (est)
Total Project Funding Mobilization	***GEF, Co-financing and Leverage***	***Project Operations Costs and Market Development***	***$41,910,000***

As the industry has yet to receive the benefits of the Project (e.g. information on consumer needs, access to distributors, etc) to then respond with investments in its own business development, product design, etc, and co-fund project activities (e.g. industry meetings, consumer education campaign, etc) IFC did not seek at this stage formal commitments for co-funding. Instead, IFC has asked companies to review the project strategy and its benefits, and asked that if the companies (i) felt this was an attractive enough market, and (ii) the project was appropriate in supporting them understanding and entering this market, to express their interest in the project by "signing-up" via a special website set up to capture these early

expression of interest in the Project. As noted above, as of February 2007, over 140 companies expressed interest in participating in the Project.

Projections on in-kind contribution from companies assume different levels of company engagement and costs during the Project. For instance, this estimate assumes (i) 100 companies/consortia investing during the duration of the project US$ 15,000 in market or product development partially or entirely driven by their interest in the Project's target market, (ii) Assumes 50 companies/consortia that will remain deeply involved and active in the target markets, investing on average US$30,000 for product & market development during the life of the Project, and (iii) assumes 25 companies/consortia contributing about US$ 130,000 on average for development of the final products, commercialization, business development, etc. Hence, a company that participates in the Project and decides to invest in the market would spend on average $175,000 to enter this market. Projections presented on consumer leverage are based on the middle case, where as much as 750,000 households and small businesses would acquire a modern off-grid lighting product at a $25, which is assumed as an indicative average price.

IFC estimates the Project would reduce emissions by 782,000 tonnes to 3.9 million tonnes, and hence the estimated GEF Project cost per tonne of CO_2 is, will range from $6.9/tonne (low case) to $1.38/tonne (high case)

Figure 5: Cost-Effectiveness

	Low Case	Middle Case	High Case
Period of evaluation (years)	10	10	10
Fuel-based lighting energy savings	2%	5%	10%
GEF Cost	5,400,000	5,400,000	5,400,000
Reduced CO2 emissions (1000 tonnes, over 10 years)	782	1,954	3,909
GEF Cost/tonne CO2 ($)	6.9	2.7	1.38

2 Project Development Objective

2.1 GEF Strategic Priorities and Operational Program Fit

The Project focuses on three GEF strategic priorities:

- **CC 1 Market transformation for high-volume low-GHG products:** Market transformation of baseline lighting technology which represents 3.9 megatonnes of CO_2/year in the target markets;
- **CC 2 Increased access to local sources of finance:** Access to local finance will be potentially an important element of the Project strategy for which IFC is particularly well situated to address through its support (both expertise and investment instruments) to commercial lending institutions;
- **CC 4 Productive uses of renewable energy:** IFC's project preparation work has highlighted multiple channels for adopting LED-based and other modern off-grid renewable electric lighting packages to enhance and enable productive uses, including home-based productive cottage industries, increased retail sales from enhanced lighting, and expanded access to education.

The Project is submitted under two GEF operational program areas:

- **GEF OP5 -- Removal of Barriers to Energy Efficiency and Energy Conservation** – the Project will target the removal of specific barriers that hinder more energy efficient lighting products from reaching the 55 million people still relying on fuel-based lighting in Ghana and Kenya.
- **GEF OP6 -- Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs** – It is expected that the most likely products to displace fuel-based lighting will involve renewable technologies (e.g., photovoltaics, mechanical/wind-up and pedal-

powered electricity as a source to drive solid-state lighting technology).

2.2 Project Development Objective

The Project's main development objectives are to (i) reduce annual GHG emissions, and (ii) improve living standards of the poorest of the poor by providing access to affordable modern off-grid lighting services. The Project will achieve this by displacing the use of traditional lighting technology (kerosene, paraffin, candles, firewood) by populations and small businesses lacking access to reliable electricity services, with modern electric lighting technology that is designed to operate off the electric grid. The Project is expected to generate a wide range of local and global environmental and development benefits, including:

- Reduction of carbon emissions from fuel-burning for lighting. The Project target to reduce between 782,000 (low-case scenario) to 3.9 megatonnes (high-case scenario) of CO2 emissions over a 10-year period, or 2 to 10% of the off-grid lighting-related CO2 emissions from Ghana and Kenya, which are estimated at 3.9 megatonnes/year. (For details on the assumptions and methodology, please refer to Annex A on Incremental Cost Analysis)

- Raising disposable income at the household and small business level by:
    - Reducing living costs of households, which spend as much as $5/month on kerosene-based lighting and, in some cases, as much as an additional $5/month on other lighting solutions, such as biomass or batteries for low-quality flashlights.
    - Raising productivity of small businesses – higher quality lighting will reduce operating costs and increase sales by allowing for longer hours of operations during evening work hours, and higher sales due to larger customer traffic.

- Improving living conditions, specifically by improving health, safety and educational conditions. While indoor air pollution comes mostly from cooking, fuel or biomass burning for lighting also constitutes a health hazard. Further, kerosene lamps are a major safety hazard as manifested in substantial data regarding burns and fire at the household level. Lastly, the cost and low quality of fuel-based lighting greatly constrains access to education, primarily in the rural poor.

3 Country Selection

IFC has undertaken a detailed approach to select the countries between the development of original Project Concept and the Project appraisal. The former indicated that IFC would review the conditions of five countries:

South Africa, Uganda, Ghana, Tanzania, and Kenya. During pre-appraisal, IFC undertook market assessments to identify country suitability based on the criteria below.

Figure 6: Criteria for Country Selection (from Concept Note)

Criteria	Rationale
Market Size	The 'market' size from the private sector stand point, will be one of the key factors in attracting participation. Current estimates are based on populations or households relying on fuel-based lighting.
Market viability	Basic market conditions need to exist, including: an active entrepreneurial class -- even if functioning with varying degrees of efficiency; existing distribution networks which can be tapped into to introduce modern lighting technology; existence of local financial institutions which might act as intermediaries for vendor or consumer finance products; and competitive advantage of modern lighting solutions, based largely on prevailing fuel costs.
Availability and quality of local stakeholders promoting energy access	The Project will seek to build partnerships with local players in the delivery of market testing, market assessments, consumer education, and product quality assurance initiatives. Such local participation is a key success factor
Investment climate	To engage the private sector and achieve sustainable impact, Project countries need to offer an overall conducive environment for private sector development.
Energy Access Policies	The overall policy environment needs to be supportive of solutions or initiatives to increase energy access. Subsidies for kerosene and tariffs on imported modern lighting technology components are such factors.

During its pre-appraisal process as in its preparation of the Project Brief for GEF's Council Approval, IFC undertook a detailed assessment of the five candidate countries in selecting the two target markets. This assessment included:

- Extensive desk research on the conditions concerning energy access in each country;
- A total of over 80 meetings with stakeholders, industry, researchers, and a variety of entities involved in local private sector and renewable energy market development in Africa, including:
    - Over 10 meetings and/or interviews with internal and external experts on the 5 countries, and local stakeholders in all 5 countries to discuss (i) conditions for the Project, (ii) potential impact of the Project given other existing initiatives.
    - IFC's pre-appraisal effort involved, among many activities, missions to Ghana, Kenya, Tanzania and South Africa to assess local conditions for the project across the range of criteria described above. These missions included over 70 meetings with stakeholders and potential project partners in these countries.

After this assessment, IFC concluded that Ghana and Kenya offered the best conditions to ensure the Project's success. Key aspects of the findings in the selected countries included:

- significant interest from both local private sector and energy access stakeholders;
- country geographies that provide an opportunity to test the approach in both East and West Africa, and which offer international technology providers attractive entry points into two key regional African markets;
- together, the two countries offer a very attractive market for the private sector, with a total spending of US$1.4 billion/year on fuel-based lighting (further discussed in the document);
- together, in the year 2000 the two countries accounted for 10% of the total non-electrified population in Sub-Saharan Africa and almost 1% of the global non-electrified population. This offers sufficient market size to test if the Project's approach for a large-scale solution is achievable, and to clarify whether the approach can be replicated in other countries; and

- market conditions - including the investment enabling environment - that are favorable for private sector investment.

While South Africa also ranked high, it was dismissed on the basis that the impact of the project would be limited compared to the other countries, given its level of economic development and existing policies in place (and capacity at hand through ESKOM) for expanded electrification through the grid. IFC found that Uganda and Tanzania, compared to the other 3 countries, did not have the necessary level of private sector development and economic conditions to support a successful implementation of the Project approach envisioned here at this stage of the countries' development.

During the appraisal process, IFC reviewed the country choices, and further validated the conclusion that Ghana and Kenya offer the best conditions for testing this approach in a pilot project for subsequent replication across Africa. During the appraisal process, it also became evident that the regional business and markets in Eastern and Western African are becoming more integrated, and that both Kenya and Ghana are important regional business entry points and hubs for companies interested in serving regional markets. For these reasons, the appraisal process further validated the choice of Kenya and Ghana as the countries where the Project will be piloted.

4 Strategic Context and Project Rationale

4.1 Country Eligibility

Both countries have ratified the United Nations Framework Convention on Climate Change and are thus eligible for GEF funding:

- Ghana ratified the UNFCCC on 06/09/1995
- Kenya ratified the UNFCC on 30/08/1994

4.2 Strategic Context – The Global Picture

An estimated 1.6 billion people around the world lack access to electricity, and the numbers are increasing in certain regions such as Sub-Saharan Africa. This population relies on traditional sources of energy to meet basic service needs. It is well established that traditional sources of energy – be it firewood, charcoal, candles or kerosene - are expensive, polluting, inefficient for lighting provision, and/or extracted from the surrounding natural environment in a non-sustainable fashion. Fuel-based lighting thus has a significant negative impact and impairs society's ability to progress economically and socially.

Figure 7: Lack of Electrification in Developing Countries (2000)

Region	Total Population	Electrification Rates	Population Without Electrification
Developing Countries	4,565	64%	1,634
Sub-Saharan Africa	657.10	23%	509

Compounding the problem, is the growing realization that once promising solutions have shown their limitations: (i) grid extensions, have proven costly and unfeasible as a large scale solution in the medium term, particularly for dispersed rural communities, and (ii) once promising off-grid solutions, such as solar home systems, have failed for the most part to meet the affordability constraints of the majority of this population. Hence, the urgent need for new approaches which offer a large scale and sustainable solution to the provision of modern energy services to the non-electrified population.

Given the dimension of the social, economic and environmental challenge posed by lack of access to modern energy, the WBG made "energy access" one of the 3 key pillars of its *Clean Energy Investment Framework*, and within that "energy access" pillar, a key focus is the promoting of solutions for off-grid lighting. In that context, and as noted earlier, the Project will serve as a launching pad of this broader WBG initiative on off-grid lighting.

4.3 Strategic Context in Ghana and Kenya

The combined markets of Ghana and Kenya, account for 10% of the total non-electrified population in Sub-Saharan Africa and almost 1% of the global non-electrified population. In global terms, the electrification rates in both countries – but particularly in Kenya – are substantially below those of other developing country markets.

Figure 8: Electrification Rates in Ghana, Kenya and Tanzania (2005)

Country	Total Population (Millions)	Electrification Rates	Population Without Electrification (Millions)
Ghana	21.0	38%	13.0
Kenya	33.8	15%	28.6
Total	**54.8**	**24.1%**	**41.6**

4.4 Country Drivenness

The governments of Ghana and Kenya are aware of the challenges of energy access which constrain development at great cost to their countries, and have adopted strategies to respond to them. In acknowledging the limitations of government solutions - particularly given the overwhelming capital requirements of grid-connected electric utility solutions - both countries have embraced private sector solutions to increase access to modern energy services. IFC has identified as many as 10 policy initiatives in each of the target countries. A brief background and lists of selected initiatives per country are provided below.

4.4.1 Ghana – Background and Selected Energy Access Initiatives

Ghana's political drive for energy access was galvanized by the power crisis in 1997. Up until this point, Ghana had enjoyed excess capacity from the Volta River dams. The combination of successive years of drought, limited new investment in infrastructure, and long-term commitment to supply energy-intensive aluminum smelters put substantial pressure on the country's energy supply leading to frequent national power shortages. The power crisis triggered policy reforms intended to encourage new investment and competition in the sector. Although Ghana's electrification rates are high relative to other sub-Saharan nations, the country is highly polarized with the south dominated by urbanized, grid-connected communities and the north dominated by dispersed, rural, un-electrified communities. Progress by the National Electrification Scheme has slowed in recent years and there is a realization at the policy level that grid-connection may not be the most efficient way to provide energy access to disbursed rural communities. A selected list of the government actions is presented below.

Figure 9: Selected Government Actions on Energy Access in Ghana

Action	Summary
1. National Electrification Scheme (NES)	• Began in 1989 with the target of providing grid connection to all communities with over 500 residents by 2020. • Funded by grants, concessionary credit, a National Electrification Fund levy and government funds. • The 500 person community cut-off excluded 3.8m people when the plan was initiated in 1988 and this population is expected to grow to 7m by 2020. Even if 100% successful, NES will therefore leave 24% of the population without grid connection..
2. Self-Help Electricity Program (SHEP)	• A component of the NES. Commits to prioritize grid connection of communities within 20km of the grid network which procure and install their own low voltage poles.
3. Energy Sector Reform	• Act 541, 1997: Energy Commission created as an autonomous body to direct development of energy supplies including demonstration of renewable energy projects. • Act 538, 1997: Public Utilities Regulatory Commission created to set and revise tariffs • Act 691, 2005: National Petroleum Authority (NPA) created to oversee deregulation of downstream oil market as part of the Accelerated Deregulation Program. Currently, petroleum product pricing is set by the NPA and adjusted to ensure import price parity, but complete price deregulation is planned. Several price hikes over the last five years, including a 50% increase in February 2005. The most sensitive to these price changes are the rural dwellers: expenditures on healthcare and household products have dropped in response. The Tema refinery is in a poor state of repair and running at well below capacity - regular kerosene shortages result in illegal price increases.
4. Strategic National Energy Plan (SNEP) 2006-2020	• One of the 10 core objectives is to accelerate use of renewable energies and energy efficiency technologies. Actions include: removal of fiscal and market barriers; funding support for schools and hospitals; pilot projects; performance standards; expansion of current solar/wind import duty (10%) and VAT (15%) exemption to also include biomass equipment; and income tax exemptions for renewable energy manufacturing. • Renewable energy targets include 15% rural penetration with renewables and a national mix of 10% by 2020. • The Petroleum section of the SNEP has specific recommendations on reducing kerosene dependence by removing subsidies and supporting alternative lighting solutions.

4.4.2 Kenya – Background and Selected Energy Access Initiatives

The Kenyan government has undertaken a series of actions towards promoting energy access. The stated national goal is to provide 10% rural electrification by 2010 and 40% by 2020. There is recognition that grid-independent solutions may be more economical in some areas. Particularly noteworthy is the country's effort to promote PV-based solutions, which reached approximately 300,000 households and saw as much as 15% annual growth in installations. In addition, much of the effort to promote energy access has involved significant collaboration amongst many ministries, including Energy, Environment and Natural Resources, Agriculture and Rural Development, Information Transport and Communication as well as other departments such as the National Environment Secretariat, Forestry Department, and Forest Research Institute. Below is a selected list of initiatives on energy access in Kenya.

Figure 10: Selected Government Actions on Energy Access in Kenya

Action	Summary
1. Rural Electrification Program (REP)	• The Rural Electrification Program (REP) has made an effort to extend the range of electric lighting, although the vast majority of the population remains non-electrified. The focus of the program has been on electrifying towns, commercial enterprises, and market centers, while households have received less attention. Subsidies for rural electrification do exist on a limited basis, although the liberalization of electricity pricing has curtailed affordability.
2. Energy price policy	• Kerosene pricing (subsidy/taxation): price has increased recently due to liberalization of petroleum markets and a June 02 tax increase – it has become less affordable for the poor and use declined from 406,000 tonnes in 1999 to 384,000 in 2000. Kerosene costs almost $1/literbut prices differ by 10-300% between urban and rural areas. • Electricity pricing (subsidy/taxation): liberalized.
3. Solar Market Pricing	• There are no subsidies for solar systems, but the government has eliminated import duties and taxes (VAT) on solar PV modules; the import duty on lead acid batteries is 35%. Most solar systems are sold on a cash basis (>80%). As many as 15-20% of systems are sold through "hire purchase" credit shops. A very small percentage of systems are sold through other credit arrangements. Approximately 30,000 solar modules are sold per year in the Kenya market, making it one of the largest markets per capita among developing countries.
4. Renewable energy law	• Being discussed as part of the Energy Bill 2006

In conclusion, both countries have demonstrated concern about the lack of access to modern energy services and are taking action to address it. Further, in each country, the Project directly supports these policy efforts and government strategies to promote energy access, and is consistent with the government's interest in engaging the private sector in energy access-related efforts.

4.5 Project Rationale

The project's core rationale is (i) to remove key barriers that are deterring the private sector from bringing in large-scale LED-based and other modern off-grid lighting products to non-electrified communities in Ghana and Kenya, and (ii) to build on the self interest of modern lighting suppliers and off-grid lighting, distributors and end-users to accelerate the development this market.

To better articulate the details of the Project's rationale, we discuss below (i) the technological opportunity, (ii) why the focus on off-grid lighting, (iii) the private sector drivers, and (iv) the barriers deterring the private sector firms from developing this market by themselves.

4.5.1 The Technological Opportunity

The Project rationale stems from the recognition of key breakthroughs in lighting technology that have emerged in recent years, including those on off-grid CFLs and particularly with LEDs. Widely recognized as the "next generation" in lighting technology, and already proven in many applications in advanced economies, LEDs provide high quality lighting while only requiring very low levels of power. This

characteristic makes LEDs suitable for small (more affordable), high quality off-grid lighting products[2] that are superior in quality and cost of ownership to fuel-based lighting, and carry no health or safety hazards. This has been proven by field studies which show that light emitting diodes offer advantages in light delivery to tasks while incurring low operating costs, and this can be achieved with zero carbon dioxide emissions (<5 watt) using small, non-emitting, power sources (e.g. photovoltaic panels or wind-up mechanisms) which are sized to match the lighting energy demand (Jones et al, 2005). Therefore, LEDs promise to be a compelling alternative to fuel-based lighting, with significant and sustainable environmental and development benefits

Figure 11: Comparison: Selected LED Lighting Solution vs. Fuel-Based Lighting

Technology	**Candle**	**Simple wick, kerosene lamp**	**Pressurized mantle, kerosene lamp**	**1 WLED lamp, solar rechargeable battery**
Illuminance on work surface (lux)	1.1	1.1	182	320
First cost ($US)	0.10	1	10	25
Annual operating cost ($US)	58.40	8.92	56.73	4.38
Carbon dioxide emissions (kg)	…	40	299	0
Total cost per unit of "illuminance service" *	**36.65**	**5.81**	**0.23**	**0.03**

*($US/1000 lux-hours). Assumes first cost amortized over three years. Data from Jones, et al. 2005 Right Light.

The technology's application in small, single-purpose lighting products presents an opportunity to reduce the product costs, and more effectively address the first-cost barriers which have, to date, constrained commercial uptake of more capital-intensive multi-purpose off-grid systems, such as solar home systems. This approach of "smaller products" which meet the income constraints of low income populations has already proved successful with many consumer goods serving the bottom of the economic pyramid, from soap bars to pre-paid cell-phone cards. Hence, LEDs offer an opportunity for a different and more promising approach for market-based solutions to reach non-electrified populations.

4.5.2 Why Lighting? – The Real Impact of Off-Grid Lighting on Sustainable Development

Fuel-based lighting is a highly polluting process that emits an estimated 190 million tones/year of CO_2 on a global level. However, the potential transformative impact of modern, off-grid lighting solutions goes well beyond avoided CO_2 emissions. Lighting is a major determinant of income and productivity. This transformative potential comes from many different sources:

- *Environment Benefits* - The environmental impacts of fuel-based lighting are multifaceted. The foremost impact is the release of greenhouse gas emissions from kerosene, LPG, candles, and fuelwood used for lighting purposes. For Ghana and Kenya, we estimate annual carbon dioxide emissions at 3.9 million metric tones per year. Reliance on fuelwood for light (a practice that is common in many households in the target countries) also has associated impacts on deforestation, and the attendant issues of land degradation, desertification, and erosion. The indoor environment is also impacted by emissions from inefficient fuel combustion. The extensive use of incandescent-based flashlights translates into large volumes of toxic solid waste, almost always inappropriately disposed of and therefore leading to water source contamination, as well as other downstream problems. Our

[2] E.g. rechargeable battery-based lighting systems powered by photovoltaic panels, mechanical devices, or other small-scale portable sources of electricity.

estimates indicate that 260,000,000 small dry-cell batteries are sold annually for lighting purposes in Ghana and Kenya, virtually all of which end up in the solid waste stream. The usage of more efficient lighting products should contribute to a reduced level of battery usage, and related environmental problems.

- *Increase in disposable income of households* - Lighting typically accounts for 10-15% of household energy use, behind cooking and heating, but it represents a much higher share of household energy spending due to the high costs of kerosene, candles and dry-cell batteries. Based on primary data collected in Ghana and Kenya, as well as our review of the literature, we found that lighting service costs were in certain cases as high as 30% of household income – and this for only two or three hours of poor quality light per evening from a single lantern. We encountered a collective of single mothers in Nairobi's Kibera slum who typically spend 15% of their income on lighting to run even the simplest (dimmest) kerosene "tin" lamps.

- *Increase in Productivity of Small Enterprises* – There is an established positive correlation between the quality of the lighting in commercial enterprises and retail sales. Better lighting has been associated with improved customer traffic and higher sales.[3] During our pre-appraisal process, we observed a number of very specific instances in which non-electric lighting hampered the productivity of businesses, and we received feedback on the potential benefits of new technologies:

    - A small non-electrified enterprise near Lake Victoria which recently received solar lighting. The vendor's revenues increased 60% as a result of his being able to illuminate his wares at night.

    - Vendors of shoes, detergent, and food products at a major night market reported upon seeing LED-solar prototypes that they would be able to extend their operating hours by 30 to 50% if this form of lighting became available. They also universally believed that their sales volumes per hour would increase as a result of their wares being more easily seen and more attractive (due to better color rendering of white LED sources compared to their existing orange-tinted kerosene lanterns).

    - Outdoor shopkeepers reported that with LED lighting they would avoid periods of market closure due to wind or rain (both of which extinguish their flame-based lighting sources). They also perceived an additional benefit of being able to more easily and accurately count money and make change for customers.

    - Anecdotal evidence with a high street lighting post covering several streets of Kibera in Nairobi suggests that the greater sense of security and illumination considerably increase economic and social activity in the evenings compared to non-illuminated areas.

[3] *Display & Design Ideas,* March 2, 2003 noted that "research shows lighting as a retail money maker: New test results yield important data on how shelf lighting boosts sales," and "accenting products with illumination…customers paid more attention to the display and engaged in purchase-oriented behaviors more often." Furthermore, "Of all store customers who…browse merchandise, 33.3% made a purchase when the lighting was on compared to 14.3% when the lighting was off." In "WLEDs: Saving Energy in Retail Windows," 2004, the Lighting Research Center of Rensselaer Polytechnic Institute found that customers stated they could see more clearly, see color more accurately, found products more visually appealing, and had an increased preference for a product display lit by WLEDs, compared to standard lighting.

Educational Benefits – There is an established link in the literature between quality of lighting and levels of educational performance. During pre-appraisal, we observed baseline lighting services in schools as low as 2% of that specified as required for reading tasks, and high costs often limited the number of hours that lighting was available for study. Formal evening study periods are common for older students in our target countries, and typically one or two kerosene lanterns are provided for 30 or 40 students. The lighting products proposed by the Project could provide substantially higher levels of illumination at lower cost. We have also identified chalkboard lighting as an appropriate application for the types of products to be developed by the private sector under this project.

4.5.3 Proven Market Drivers for Better Lighting Across the Value-Chain

Having identified the technological opportunity with modern off-grid lighting, in particular LED-based lighting, and the far-reaching environmental and developmental impact it could have, IFC turned to the issue of if and how to engage the private sector. The Project's insight is to realize that the 1.6 billion people worldwide currently lacking electricity, while mostly living under extreme poverty conditions, are not isolated communities but rather an *integral part* of a well developed market and can be accessed via well functioning distribution channels. This market – while fragmented and mostly informal – functions well enough to deliver fuel-based lighting services that represent no less than 17 percent of the global lighting market, and accounts collectively for a total spending of $38 billion in fuel expenditures each year. In Ghana and Kenya, as summarized below, this total "market" represents an annual spending of US$1.4 billion by non-electrified households and small businesses.

Figure 12: Fuel-Based Lighting Market in Ghana and Kenya

By Source	Ghana ($ MM/year)	Kenya ($ MM/year)	Total ($ MM/year)	CO_2 (1000 tonnes/year)
Kerosene	389	658	1,047	2,802
Propane	35	59	94	155
Candles	20	31	51	65
Batteries	63	190	253	0
Biomass	2	5	7	887
Total	**509**	**943**	**1,452**	**3,909**

Source: IFC estimates

Further, and as important, the lighting market serving this non-electrified population is currently limited to a low quality, and relatively high-cost solution, namely fuel-based lighting. Hence the potential opportunity for a commercial approach that would bring a far more efficient solution, such as LED-based and other lighting products, to this market. In the planning and appraisal of the Project, IFC found that the incentives for such market transformation exist across the entire value-chain, from suppliers all the way to end-users, for the following reasons:

- **Lighting Suppliers Need New High Growth Markets** - The international electric lighting industry is a mature and extremely competitive industry. As technologies mature, products are becoming increasingly "commoditized", forcing global and local manufacturers to operate with limited profit margins (as low as 2 percent for incandescent and linear fluorescent for instance), and in that scenario manufacturers fight for market share of a relatively static market.[4] Even some segments within the

[4] We have seen the recent commoditization of CFL technology for example, with prices going from as high as $23 (retail in Argentina in 1999 at the beginning of the IFC/GEF ELI program) in specific markets to a commodity price of $1 each for high quality products purchased by the container in the GEF-

lighting industry that until recently presented high growth opportunities, such as applications of LEDs in mobile phones, are experiencing a reduction in growth rates as the mobile phone industry matures and demand slows down. The opportunity to reach, through this pilot project, a new market with 50 million new consumers in Ghana and Kenya that spend as much as US$1.4 billion/year on lighting is very attractive. Furthermore, once companies have proven this market in Ghana and Kenya, they can expand their view to the larger markets of West and East Africa, and then to the US$38 billion/year global market. The greatest evidence of this interest is that 142 lighting-related companies have signed up to participate in the project.

- **Consumers Are Burdened by the High Cost and Low Quality of Fuel-Based Lighting** - Both non-electrified households and small businesses spend a significant amount of their income on fuel-based lighting and other poor lighting solutions, such as flashlights or torches. In certain homes visited during IFC's field missions, expenditure on kerosene for lighting consumed 15% of the household income, and further spending on lighting, including capital and operating costs of low quality flashlights and batteries, amounted to an additional 15% of their income. In interviews with street vendors and small businesses, IFC's field missions found that a one-man shop in a night market spends as much as US$ 5.90/month on kerosene for lighting. The high cost of fuel-based lighting and the low quality of its service provides a powerful motivation for consumers to test and embrace an alternative such as LED-based lighting, as long as the products are designed to meet the consumers' needs and the price is set at an affordable level.

- **Local Distributors Find Better Lighting Can Boost Revenues** - IFC met with a large number of local distribution companies, ranging from multinationals such as Coca-Cola and Unilever to domestic companies with networks into non-electrified areas, such as HoneyCare, which has 5,000 beekeepers and exports honey to several countries. IFC found two categories of distributors that expressed interest in better lighting solutions:

    - Distributors that own, or rely on a large network of small retailers in non-electrified rural and urban areas, expressed interest in better lighting as it allows for more hours of operation, and drives more customer traffic sales – both for the distributors and their retailers;
    - Distributors that sell products directly, or via networks of smaller retailers, to non-electrified areas expressed interest in modern, off-grid lighting products as a potentially successful addition to their offering mix.

Perhaps the best evidence of the potential for modern off-grid lighting products, such as LED-based lighting products is the presence of a nascent, but aggressive pool of local entrepreneurs in both Ghana and Kenya that are already trying to bring LED-based and other modern off-grid lighting solutions to the market. A few anecdotal examples include:

- In Kenya, we met with the owner of a retail shop who had been importing LED-based lighting systems for a few months from China. Interestingly, he noted that one of the main barriers for his business was his ability to determine the proper product specifications, as the technology was new to him and he did not have the sufficient expertise or relationships in this industry to build that capacity.

- Also in Kenya, met with local company assembling a range of LED products, which were engineered and planned out of Germany, and target, among other segments, micro businesses such as fishermen.

funded Vietnam lighting program last year. Therefore, this is an industry eager for new areas offering high growth.

- In Ghana, we met with one local solar business that has been importing small batches of Chinese made LED wind-up flashlights to test in the local market, while another entrepreneur is seeking investors to establish local assembly of solar LED lantern that he had sourced from Hong Kong.

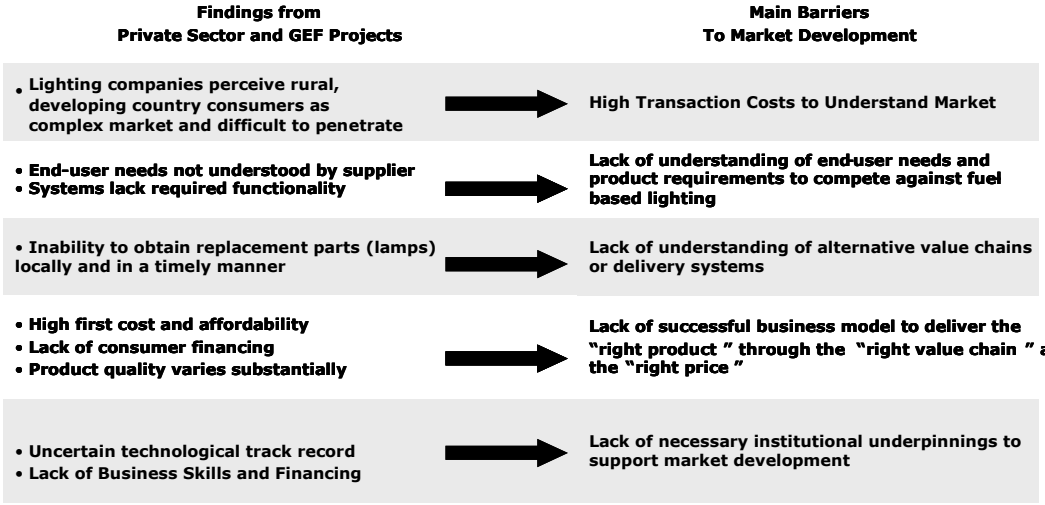
While evidence of private sector interest and initial attempts to develop this market is encouraging, the introduction of affordable, modern off-grid lighting solutions, such as those using LED, into non-electrified areas has been slow. This is due to a number of barriers, which IFC has identified based on its past experiences in market interventions (ELI and PVMTI), consultations with the private sector, its pre-appraisal and appraisal work, and its review of the literature on previous efforts to transform markets around off-grid solutions. These barriers are discussed below.

4.5.4 Removing Key Barriers to Market Development

Despite their interest in pursuing this market, private firms have encountered some significant barriers to developing the market substantially. In discussing their needs, a broad array of companies have sought the engagement of IFC to facilitate the removal of these key impediments to the development of the market. In addition, experience with previous market development efforts, including lighting, have fallen short of understanding and addressing barriers for end-users adoption of new, modern products. These barriers, which affect both suppliers and consumers, are presented in Figure 12, and were identified by a combination of IFC discussions with the private sector, pre-appraisal and appraisal field research, and prior GEF-sponsored field experiments. These barriers fall into five broad categories:

- high information and transactions costs facing individual modern lighting companies to improve their understanding of the market, and their understanding of how best to develop it;
- lack of understanding of barriers at the end-user level for adoption of new products, including end-user needs and product requirements to compete against fuel-based lighting;
- lack of understanding of alternative value chains and distribution channels to which may be adapted to deliver modern lighting products;
- lack of functioning business models (the "right" products being delivering through the "right" value chains with "reliability" and at an "affordable and competitive price"); and
- lack of institutional support for market development (e.g. consumer and vendor financing, product quality control, customer awareness of the product category, and similar institutional functions which cannot be directly provided by individual private companies competing in the market).

Figure 13: Barriers for Market Development
According to GEF Findings and IFC Interaction with the Private Sector



These barriers are further explained below:

- **High Transaction Cost to Understand the Market** – Despite many endeavors around off-grid lighting, there is a widespread lack of data describing almost every important link of the lighting value chain. There is also very little formalized research into the lighting needs and patterns of use of the various end-user market segments. Due to the diverse and informal nature of both the distribution channels and the end users, the research efforts needed to properly understand this market are complex and costly.

- **Lack of Understanding of End-User Needs and Product Requirements –** In the absence of good data on the end-user and consumer behavior, the alternative lighting products currently delivered are designed and priced inappropriately to overcome barriers to adoption of new products, and really compete with traditional sources of lighting. Hence, many superior technologies in practice become inferior solutions and are not adopted by the end-user. As evidence of this, efforts at promoting solar lighting have had very limited success (although more so in Kenya than most developing countries). We observed PV-equipped households fitted with incandescent lamps which, unsurprisingly, were not utilized given the rate at which they would deplete the batteries. Insufficient quality and amount of useful light combined with preference for television have meant that solar lights are often left off in favor of kerosene, etc.

- **Lack of Understanding of Delivery Systems –** The distribution systems reaching non-electrified areas are complex, including a number of formal and informal, wholesale and retail channels. The ability to map and engage the 'right' distribution channels can define the success or failure of a new product launch. For instance, engaging a distribution channel with multiple "layers" before reaching the end-user means multiple mark-ups and a higher delivered price to the end-user. The inability or willingness of a distributor to stock sufficient inventory may hinder customers' ability to obtain replacement parts (e.g. lamps) locally and in a timely manner, undermining end-users confidence in the product.

- **Lack of Successful Business Models –** With poor information on end-users and the channels required to reach them, managers are likely to develop business models that are ineffective**.** For example, we encountered solar CFL lanterns that aimed in principle to serve non-electrified populations but were priced between $90 and $200, equivalent to the entire annual household income of many rural poor. Another common issue is which financing approach to integrate with the product offering to make it more affordable. Existing micro-credit systems in Kenya (banks or "hire-purchase" stores) usually require that the borrower have a regular salary/paycheck, from which payments can be automatically deducted (something that only about one-third of the population receive). In Ghana, most lending institutions are actually savings banks, since loans are only possible once a large deposit has been saved. The lack of capital induces consumers to purchase lighting equipment with low first cost but very high lifecycle cost (e.g. battery-powered flashlights and small kerosene lanterns). Failure to develop the right business models, explains to a large degree the universal lack of market success of many novel, superior technologies among the end-users targeted by the Project

- **Lack of Institutional Underpinnings –** The target markets lack key institutions to support large-scale market development. In many cases, the absence of effective systems to ensure minimum quality standards in new products results in the sale of cheap, low-quality replicas which hinder end-

user confidence in the whole product category, and create a major barrier to widespread adoption of new products by the end-user. For instance, there has been significant "market spoiling" due to non-functioning solar systems (estimated at 60% in Kenya), poor lighting installation in otherwise functioning solar systems, promises of performance (e.g. AA battery life) that were not borne out in practice, and low-quality components (CFLs and LEDs). In other cases, consumers lack the means to get educated about the differences in products, and hence cannot make the necessary judgment that would otherwise induce a shift to a novel, modern energy solution. Further, in certain circumstances, entrepreneurs trying to promote a new product lack the access and expertise to set the proper specifications for the products and are deterred from their efforts if an initial "trial-and-error" effort to promote a new product proves unsuccessful.

Given these barriers, a **superior technology** can become in practice an **inferior solution** to meet the needs of the end-user and generate large-scale adoption of new products, and thus the technology may fail to penetrate the market. These barriers have, to date, deterred the large-scale penetration of modern off-grid lighting products, such as LED-based lighting products, despite the huge promise and potential of the technology and the motivation and drive of the private sector to bring it to market. Should these barriers be lowered, and information be made available to address perceived risks and enabling partnerships to form and to share costs, the private sector could promote a significant market change within a relative short time frame.

4.5.5 Opportunity for an IFC/GEF Intervention

Reducing the barriers to entry into a new market or for adopting a more efficient lighting technology is something that IFC/GEF is well positioned to provide. The opportunity is for IFC/GEF to act as an "industry facilitator", providing solutions that are commonly required by all companies interested in developing a new market, but that are expensive to any individual company to undertake alone. In playing that role, IFC/GEF will be lowering the costs for the private sector in pursuing this market, lowering the barriers for adoption of modern off-grid lighting products by consumers, and accelerating the development of markets for modern off-grid lighting products.

4.5.5.1 Lessons Learned

This industry facilitator role, however, must be refined to take into account key lessons from previous projects. In defining IFC/GEF's role in this Project, particular attention was given to lessons learned (both positive and negative) from the Photo-Voltaic Market Initiative (PVMTI) run by IFC in Kenya, India and Morocco and the Efficient Lighting Initiative (ELI) run by IFC in seven countries. These lessons include:

- **Market transformation projects should be built upon proven and sustainable market drivers** – IFC believes that a key success factor for market transformation initiatives is to focus on promoting markets where the private sector has demonstrated a proven, real and sustainable interest but yet, due to a combination of market barriers, cannot pursue that interest on its own. Further, IFC found that understanding these drivers, and the real nature of these barriers, is not trivial and requires a significant amount of upfront work. As a result, in developing the Project, IFC has spent almost three years in consultation with the international lighting industry to understand their interest, the type of barriers they face in bringing LED-based solutions to non-electrified populations in developing countries, and what kinds of interventions from IFC would address these barriers.

- **Flexibility and agility to respond to industry needs** – Markets are dynamic and companies' needs (and technology options) evolve over time. The Project needs to be structured to evolve and adapt to remain responsive to the companies needs throughout the duration of the Project.

- **Recognize and understand market forces are already in play** – The Project needs to be designed not to "create" market forces but to "leverage" existing market forces, as companies and entrepreneurs have already expressed the motivation to pursue this market. Therefore, the intervention needs to recognize the specific needs of the market and act only on those, avoiding unnecessary actions that have no effect or, worse, risk disrupting or distorting these existing forces and the healthy competition that they generate.

- **Do not "pick winners" for the market** – The Project cannot anticipate what the market will demand, and neither IFC nor GEF are well positioned to make that judgment. Therefore, it is critical that Project be "solution neutral", providing equal support to all companies to compete in the market. An inclusive and broad participatory approach will maximize competition, allowing the market to pick the winners and increasing the likelihood that consumers' needs are met.

- **Act only where the industry cannot act by itself** – while there are several beneficial roles IFC/GEF can play to support the private sector, it is important to draw a clear line between the roles for industry and the roles for the facilitator. The Project should require companies to show commitment, ability and willingness to undertake costs related to market development, and the Project should not provide a "free ride" to companies.

- **Price point, multi-functional products and the scalability of projects –** Many international initiatives to promote off-grid solutions have faced similar obstacles in gaining commercial sustainability and scale. In reviewing many of these experiences, IFC found that the most common approach has been to promote multi-functional systems, such as solar home systems, and to increase affordability through consumer financing. In most cases, this formula, while logical, has failed to be scalable as the products, size and technical complexity made it out of reach for the majority of the population, and hence limited the interest of much of the private sector. In addition, though life-time product cost analysis makes sense from a theoretical perspective, consumer behavior of the very poor is not always economically rational and high first costs can be a real problem to market acceptance. The alternative approach can be found in the growing body of successful commercial experiences amongst private companies operating in developing countries. Those experiences "at the bottom of the pyramid" highlight the need to reduce the product price point to levels appropriate to the end-users' income. The most common approach to achieve that reduction in price point has been to reduce the product size. For instance, in the streets of many developing countries, one can buy a single cigarette rather than a pack, or a sachet of shampoo rather than a bottle. This body of experience has been a key guiding principle of the Project's focus on one single energy use, lighting, and its excitement about the promise of modern off-grid lighting technologies, in particular LEDs, for small, compact, non-technical and more affordable off-grid lighting consumer products.

- **The need to understand customer behavior -** IFC found during its review of international energy access initiatives that many Projects are designed on "assumptions" about customer behavior. In remarkably few cases rigorous research was conducted to understand how the target population behaves as a consumer, and if and how the Project design needed to respond to that. For instance, to some populations solar home systems are a status symbol whereas to others these systems are seen as a symbol of social and economic exclusion, highlighting the lack of access to the grid. Concerning solar lanterns, there have been a substantial number of attempts to design and promote them, yet none has reached a high-level of penetration. In some instances, it has been found that while a

household might own solar lanterns, probably gained through donor programs, those were not used at all and kerosene lamps continued to be relied upon. Identifying these nuances in customer behavior is a key success factor. To that end, IFC has included in the design of the Project an entire phase dedicate to develop such in-depth understanding of consumer behavior, barriers and requirements for adoption of new products.

- **Identify and leverage alternative distribution channels –** rather than attempting to create entirely new distribution networks, and the various participants required to make these work, far greater access to consumers can be achieved by leveraging existing distribution channels that successfully distribute other product categories.

5 Project Description

The Project is designed to be an intervention strictly focused on the removal of the barriers described above, fulfilling roles that the private sector alone cannot effectively undertake, and acting where IFC/GEF is uniquely positioned to have a significant impact in reducing transaction and information costs for the whole value-chain.

Figure 14: Barriers to Market Development and Project Actions

Main Barriers To Market Development	Project Actions
High Transaction Costs to Understand Market	• Use IFC role as "honest broker" and ELI experience to engage private manufacturers and distributors in sharing costs of understanding the market
Lack of understanding of end-user needs and product requirements to compete against fuel-based lighting	• Perform field test with several products and compare against fuel-based lighting • Perform customer surveys to understand end user preferences and constraints
Lack of understanding of alternative value chains or delivery systems	• Identify alternative value chains that can deliver products reliably and at affordable price, and provide post-sales support
Lack of successful business model to deliver the "right product" through the "right value chain"	• Set parameters for competitive products against fuel-based lighting (price, reliability, functionality) and convey to industry most promising value-chains to adopt and promote products that meet those product parameters
Lack of necessary institutional underpinnings and successful business models	• Use IFC network, experience and relationships to establish key institutional underpinning to support new business models, including, but not limited to: – mobilizing consumer, SME, vendor financing – setting parameters for product certification – organize campaigns promoting technologies and educating consumers

The Project will have 6 core actions, each targeted at removing the five specific barriers noted above, in addition to a final, planned exit.

Figure 15: A 6-Step Plan to Remove Barriers and Achieve Project Objectives

Project Steps	Project Actions
Step 1	• Use IFC role as "honest broker" and ELI experience to engage private manufacturers and distributors in sharing costs in understanding the market
Step 2	• Perform field test with several products and compare against fuel-based lighting • Perform customer surveys to understand end user preferences and constraints
Step 3	• Identify alternative value chains that can delivery reliably and at affordable price products to end-user and provide post-sales support
Step 4	• Set parameters for competitive products against fuel based lighting (price, reliability, functionality) and convey to industry most promising value-chains to adopt and promote products that fall within those parameters
Step 5	• Use IFC network, experience and relationships to establish key institutional underpinning to support new business models, including, but no limited to: – mobilizing local and/or international financing – setting parameters for product certification

5.1 General Project Plan

The Project is designed to engage and leverage the private sector interest in bringing modern off-grid lighting products to non-electrified populations in developing countries. The Project plan entails a gradual implementation process with 6 core actions. Punctual reviews of progress after each step will be undertaken by IFC to ensure the expected results are being achieved, and adjustments are undertaken as necessary. These 6 actions are detailed below.

Action 1 – Forming a Private Sector Consortium

Under this phase of the project, we will engage with and form a consortium of domestic and foreign companies and relevant stakeholders representing all stages of the value chain, from manufacturing to retail, and key constituencies of the Project. As part of the Project appraisal, since mid-August 2006 IFC has aggressively promoted the Project to companies to confirm their stated interest, presenting the business case for them, the Project activities, and objectives. This has included several calls with lighting companies and meetings in person in the US, Europe, Asia and Africa, and a half-day seminar and an exhibition booth at the 2006 Intertech LED conference, a global LED conference held in San Diego on October 2006. Over 45 companies paid $500 to attend IFC's seminar. Further, IFC has reached out to other organizations representing a vast range of stakeholders, from local and international NGOs, to universities and industry associations. The result of that effort is that to date, 198 organizations have signed up to participate in the Project. Below is the list of organizations organized around general categories for their primary activity.

As appropriate, the Private Sector Consortium will also include industry associations. For instance, IFC has held during appraisal preliminary conversations with the Kenya Renewable Energy Association, the Kenya Private Sector Alliance, the Ghanaian Solar Industry Association, and the Association of Ghanaian Industries. These and other associations are expected to join the consortium and play an important role in facilitating partnerships between firms. The consortium will be fully involved in the design and execution of the project, ensuring that IFC/GEF is responding directly to the needs of the private sector and end users for their development of this market. The consortium will also provide the primary platform for facilitating the creation of relationships between local and foreign companies that will foster partnerships and alliances that in turn enable market success.

The consortium will be operationalized in several ways. First, a dedicated website will be created to share information and share communication with all participants. A basic website was set up for the Project during appraisal to allow companies to sign up to participate in the Project. IFC will expand that website to take maximum advantage of the internet tools to facilitate collaboration, share information and market development. Second, regular conference calls will be scheduled as necessary to discuss actions, findings and/or address concerns from the private companies. Third, regular industry meetings will be organized during key steps of the Project. For instance, a kick-off workshop is expected to bring all parties together, discuss the working process and set the plan for the following phases. In the completion of each phase, regular meetings will take place to share findings and lessons learned, and to discuss next steps.

The consortium's modus operandi will be dynamic and will be adjusted as necessary to respond to the needs of the private companies as the project evolves.

Figure 16: List of Organizations that Signed-Up to Participate in the Project as of February 5, 2007

	Country	Company	Primary Activity
1	United States	YEBY Associates	Private enterprise w/ interest in lighting/energy related areas
2	United States	Tetra Tech	Private enterprise w/ interest in lighting/energy related areas
3	United States	Strategies Unlimited	Private enterprise w/ interest in lighting/energy related areas
4	United States	ON Semiconductor	Private enterprise w/ interest in lighting/energy related areas
5	United States	Kennedy & Violich Architecture	Private enterprise w/ interest in lighting/energy related areas
6	United States	Bell Labs, Alcatel-Lucent	Private enterprise w/ interest in lighting/energy related areas
7	United Kingdom	Jeffcott Associates	Private enterprise w/ interest in lighting/energy related areas
8	United Kingdom	DIY Solar	Private enterprise w/ interest in lighting/energy related areas
9	Sweden	Borg & Co	Private enterprise w/ interest in lighting/energy related areas
10	Kenya	Energy for Sustainable Development	Private enterprise w/ interest in lighting/energy related areas
11	Italy	Agriconsulting S.p.A.	Private enterprise w/ interest in lighting/energy related areas
12	Haiti	toutadesign	Private enterprise w/ interest in lighting/energy related areas
13	Finland	Motiva Oy	Private enterprise w/ interest in lighting/energy related areas
14	United States	Yokohama Electron Co., Ltd	LED Manufacturer
15	United States	SLUSA	LED Manufacturer
16	United States	ORAMIC LLC	LED Manufacturer
17	United States	next generation lighting	LED Manufacturer
18	United States	Lighting Technologies	LED Manufacturer
19	United Kingdom	advanced leds ltd	LED Manufacturer
20	South Korea	SeoulSemiconductor.co.,Ltd. (Korean	LED Manufacturer
21	Slovak Republic	ALCOM Ltd.	LED Manufacturer
22	Madagascar	BushProof	LED Manufacturer
23	Ireland	SOLAS	LED Manufacturer
24	India	Binay Opto Electronics Pvt. Ltd.	LED Manufacturer
25	India	Alternate Lighting	LED Manufacturer
26	Hong Kong SAR	SuperNova Optoelectronics Corp.	LED Manufacturer
27	Germany	DigitaLicht AG	LED Manufacturer
28	China	XIamen Hualian Electronics Company	LED Manufacturer
29	China	Tekcore.Co.Ltd.	LED Manufacturer
30	China	LEDTECH	LED Manufacturer
31	China	Edison Opto Corporation	LED Manufacturer
32	China	Advanced Optoelectronic Technology	LED Manufacturer
33	Canada	Quantum5x Systems Inc.	LED Manufacturer
34	United States	SEU LTD	LED Distributor/Marketer
35	United States	PROFESSIONAL ALMSP, INC	LED Distributor/Marketer
36	United States	Pfizer	LED Distributor/Marketer
37	United States	Nebula Lighting Ststems	LED Distributor/Marketer
38	United States	Magnitude Electronics, Llc	LED Distributor/Marketer
39	United States	Enertech Solutions, Inc	LED Distributor/Marketer
40	United States	DBLD	LED Distributor/Marketer
41	United States	Chestnut Biosensors	LED Distributor/Marketer
42	United States	Chandar Systems	LED Distributor/Marketer
43	United States	Arrow Electronics	LED Distributor/Marketer
44	United Kingdom	SUSTAIN IT Ltd	LED Distributor/Marketer
45	United Kingdom	ecoledlighting ltd	LED Distributor/Marketer
46	United Kingdom	Constellation Lighting UK Limited	LED Distributor/Marketer
47	Kenya	SOLAR WORLD EA LTD	LED Distributor/Marketer
48	Kenya	FREEPLAY MARKET DEVELOPMENT LTD	LED Distributor/Marketer
49	India	Virtual Renewables	LED Distributor/Marketer
50	India	Singlewatts Solar Energy P Limited	LED Distributor/Marketer
51	India	Litetronics India	LED Distributor/Marketer
52	India	ANKURAN	LED Distributor/Marketer
53	Hungary	ples zrt	LED Distributor/Marketer
54	Ghana	Deng Limited	LED Distributor/Marketer
55	Germany	Osram	LED Distributor/Marketer
56	Canada	Philips *	LED Distributor/Marketer
57	Canada	Glenergy Inc.	LED Distributor/Marketer
58	Canada	ET ILLUMINATION INC.	LED Distributor/Marketer
59	Canada	Afro Light	LED Distributor/Marketer
60	Australia	Worksafety Solutions	LED Distributor/Marketer
61	Australia	Barefoot Power	LED Distributor/Marketer
62	Argentina	M&A SRL	LED Distributor/Marketer
63	United States	PolyBrite International, Inc.	LED Assembler
64	United States	Litecontrol	LED Assembler
65	United States	Lamina Ceramics	LED Assembler
66	United States	GLobal Energy and Light Corp	LED Assembler
67	United Kingdom	Vos Solutions ltd	LED Assembler
68	United Kingdom	GreenLed Light Limited	LED Assembler
69	United Kingdom	G24 Innovations	LED Assembler
70	The Netherlands	Led-Vision	LED Assembler
71	South Africa	CADCOM KENAKO	LED Assembler
72	Singapore	Solarviz	LED Assembler
73	Kenya	Solarelectro Co. Ltd Kenya	LED Assembler
74	Kenya	Solapak LTD.*	LED Assembler
75	Kenya	PEMAGI ENERGY LTD	LED Assembler
76	India	Solid State Lights	LED Assembler
77	India	MIC Electronics Ltd	LED Assembler
78	India	InnovLite	LED Assembler
79	India	Global Enterprises	LED Assembler
80	India	Globaal Elex.	LED Assembler
81	India	Avinaash Enterprises	LED Assembler
82	Ghana	SPRINGS SYSTEMS LIMTED	LED Assembler
83	Ghana	F. MALAWI ENGINEERING COMPANY	LED Assembler
84	Canada	SGi Lighting	LED Assembler
85	Canada	Carmanah Technologies Corporation	LED Assembler
86	Australia	Gee-Tek P/L	LED Assembler
87	United States	TCC Systems, LLC	Distributor/Marketer to Rural Areas
88	United States	SunNight Solar	Distributor/Marketer to Rural Areas
89	United States	Envirofit International	Distributor/Marketer to Rural Areas
90	United States	d.light	Distributor/Marketer to Rural Areas
91	United States	Creative Systems International	Distributor/Marketer to Rural Areas
92	United States	Blackwater	Distributor/Marketer to Rural Areas
93	United Kingdom	SC Johnson	Distributor/Marketer to Rural Areas
94	United Kingdom	Nkaqx Strategy Ltd	Distributor/Marketer to Rural Areas
95	The Netherlands	Free Energy Europe SA	Distributor/Marketer to Rural Areas
96	Tanzania	Secure Systems	Distributor/Marketer to Rural Areas
97	Sudan	Magzoub for electrical,solar power and	Distributor/Marketer to Rural Areas
98	South Africa	Freeplay Energy plc	Distributor/Marketer to Rural Areas
99	South Africa	CBI	Distributor/Marketer to Rural Areas
100	Singapore	DRS TECHNOLOIES PTE LTD.,	Distributor/Marketer to Rural Areas
101	Kenya	THIKA EDUCATIONAL SERVICES	Distributor/Marketer to Rural
102	Kenya	Solar World EA Ltd	Distributor/Marketer to Rural
103	Kenya	DAVIS & SHIRTLIFF LTD.	Distributor/Marketer to Rural
104	Ghana	Virtue Engineering Services ltd.	Distributor/Marketer to Rural
105	Ghana	Rural Energy & Environment	Distributor/Marketer to Rural
106	Australia	Ultralite	Distributor/Marketer to Rural
107	United States	Star Funding	Entrepreneur
108	United States	Savanna Pride, LLC	Entrepreneur
109	United States	Process Systems	Entrepreneur
110	United States	Planetwize Media	Entrepreneur
111	United States	Panalytics	Entrepreneur
112	United States	Pacific Alchemy, Inc.	Entrepreneur
113	United States	Occidental International Limited	Entrepreneur
114	United States	NYU Stern School of Business	Entrepreneur
115	United States	Meridian Design	Entrepreneur
116	United States	Maui Product Development	Entrepreneur
117	United States	Light Stuff	Entrepreneur
118	United States	JOFKA DEVELOPMENT	Entrepreneur
119	United States	GeoPraxis	Entrepreneur
120	United States	CoolSpell, LLC	Entrepreneur
121	United Kingdom	Student	Entrepreneur
122	United Kingdom	L3 Lighting Ltd	Entrepreneur
123	United Kingdom	GYA	Entrepreneur
124	South Africa	Individual	Entrepreneur
125	Peru	Quantum Solutions	Entrepreneur
126	Kenya	Techbiz Ltd	Entrepreneur
127	Kenya	Practical Action *	Entrepreneur
128	India	MYRRA Ventures	Entrepreneur
129	India	greenfive power pvt ltd	Entrepreneur
130	India	bohra electronics	Entrepreneur
131	Hong Kong SAR	Valence Semiconductor	Entrepreneur
132	Ghana	wilkins engineering	Entrepreneur
133	Ghana	hardcore concretes	Entrepreneur
134	Ghana	Global Sustainable Energy	Entrepreneur
135	Canada	Iza-Sar Inc.	Entrepreneur
136	United Kingdom	CARE Enterprise Partners	Investor
137	The Netherlands	Crescat Consult	Investor
138	Nigeria	industrial development	Investor
139	Kenya	Pipal Limited	Investor
140	Kenya	Bridgeworks Africa Limited	Investor
141	Kenya	Acumen Fund	Investor
142	Indonesia	Oracle Capital Holding	Investor
143	United States	SEEDS	Donor/Foundation
144	United States	PRIVATE DONER	Donor/Foundation
145	United States	HMGI LLC	Donor/Foundation
146	United States	Development Marketplace	Donor/Foundation
147	United States	Cunningham & Doyle Trust	Donor/Foundation
148	United States	California Energy Commission	Donor/Foundation
149	India	GRAMEEN SURYA BIJLEE	Donor/Foundation
150	Ghana	Gold Coast Projects Ltd	Donor/Foundation
151	France	UNDP *	Donor/Foundation
152	France	Paris Microfinance Network	Donor/Foundation
153	Canada	Nemalux LED Lighting	Donor/Foundation
154	Afghanistan	USAID *	Donor/Foundation
155	United States	Rocky Mountain Institute	NGO
156	United States	IDE	NGO
157	United States	Harvard University/Sustainable	NGO
158	United States	CADEC	NGO
159	United States	Building with Books	NGO
160	United Kingdom	SolarAid	NGO
161	United Kingdom	GVEP	NGO
162	Sweden	Engineers Without Borders *	NGO
163	South Africa	Gender and Energy Research	NGO
164	India	IIEC	NGO
165	Ghana	KITE, Ghana	NGO
166	Ghana	Disability Options	NGO
167	Germany	Madagaskar Vision e.V.	NGO
168	Germany	Global Nature Fund	NGO
169	Ethiopia	WONDER	NGO
170	Ethiopia	ENSED	NGO
171	Canada	Rotary District 7040	NGO
172	Austria	Renewable Energy and Energy	NGO
173	Kenya	freelance	Media
174	United States	WebFirst	Other
175	United States	UCOP	Other
176	United States	Lighting Research Center	Other
177	United States	Lawrence Berkeley National Lab	Other
178	United States	jujodzine	Other
179	United States	International Association of	Other
180	United States	ideo	Other
181	United States	Cornell University Johnson	Other
182	United States	American University	Other
183	Tanzania	National Bureau of Smbila	Other
184	Switzerland	World Business Council for	Other
185	Sweden	FourFact AB	Other
186	South Africa	private	Other
187	Kenya	catholic university	Other
188	Italy	DEI University of Padova	Other
189	India	Studio Korjan	Other
190	India	MS	Other
191	Ghana	CSIR-INSTITUTE OF	Other
192	Germany	European Patent Office	Other
193	Finland	Helsinki University of	Other
194	Canada	Self employed	Other
195	Brazil	UFRJ - Universidade Federal do	Other
196	Belgium	European Copper Institute	Other
197	Australia	Research Institute for	Other
198	Afghanistan	DG Lights	Other

* Organizations with more than one individual or office registered

Action 2 – Developing an Understanding of Customer Needs and Preferences, and Barriers to Adoption of New Products

As noted above, there is an absence of information on the existing structure and cost of lighting energy use in off-grid areas. Similarly, there is very limited information on barriers for consumer adoption of new products. Local stakeholders we interviewed were unanimous that this gap should be filled. We have planned a two-step strategy for characterizing the market and user needs, which will in turn support firms in defining their strategy to meet the end-user needs.

- The administration of end-user survey instruments will fill this information void by identifying and clarifying end-user needs and preferences in terms of lighting services, total spending, key purchasing criteria, and social/cultural drivers of lighting choices. In addition to inform the Project strategy, this assessment will establish baseline data for the M&E study. The specific format will be defined with professional support. IFC identified in its appraisal at least 6 companies operating in Kenya and Ghana that seem qualified to carry this work. IFC has asked for a preliminary concept proposal indicated the suggested approach, timeframe and price and will through an appropriate selection process select one or more companies to carry this work. As appropriate, IFC may join forces with other local stakeholders with similar interest to share costs and maximize results. Other segments or sub-segments will be assessed overtime, based on the industry needs and new market opportunities.

- To augment the data on baseline lighting equipment and utilization, we will conduct structured measurements of lighting service levels provided by a variety of modern off-grid products, with at least 70% being LEDs, according to the indicative protocol outlined in Annex E. The results of this work will enable us to craft realistic design recommendations for private partners seeking to develop and introduce improved lighting systems, and will allow for improved assessment of the enhanced lighting service levels, productivity, and quality of life provided by improved lighting designs.

Identifying Off-Grid Lighting Applications and Opportunities for Aggregate Demand

A key goal of Step 2 will also be to identify specific segments in the market. During its pre-appraisal and appraisal process, IFC identified a number of different applications of lighting, household and non-household, which may require different types of lighting solutions. In addition, in identifying specific segments, IFC can facilitate the process of Demand Aggregation, thus fostering the development of an initial critical mass in the market to accelerate the market development. We provide below an indicative list of the different applications and segments IFC has preliminarily identified during its pre-appraisal process.

Also, IFC will leverage its existing relationships with the private sector to promote aggregate demand for off-grid lighting. Many of the companies IFC interacts with in the infrastructure sector (e.g. mining) undertake substantial community development projects and could serve as a potential source of large-scale demand by buying off-grid lighting products to or on behalf of its community members.

Figure 17: Indicative List of Off-Grid Light Segments and Needs Identified by IFC

Main Segment	Sub-Segments/Different Applications	Factors and preferences	Comments
Household	Kitchen		
	Bathroom	0.1W would suffice	
	Living Room	1W indirect is preferred	
	Study Light	1W direct is preferred	
	Night light for children	0.1W (or less) would suffice	
	Cottage Industry	1W (perhaps multiples) preferred	
	Animal care	Portability required	
	Doorway	0.1W would suffice	
	Security	0.1W would suffice	
	Non-electrified slums	Electricity resellers charge 300 KSh/month per light socket (~$4US). 100W incandescent typically used.	Approximately 1.6 million people in Nairobi alone
Non-Household	Non-electrified small and medium enterprises	5 million as of 2006 (est)	22,000 "stalls" in Nairobi alone
	Night markets		
	Night Watchmen	Most live in slums (where light is also needed)	Potential for Demand Aggregation
	Clinics		Potential for Demand Aggregation
	Schools		Potential for Demand Aggregation
	Chicken farms	Use costly pressurized kerosene	Potential for Demand Aggregation
	Fishermen	Need light to attract fish. Investigate proper spectrum (perhaps UV). This is the most cost-intensive example we've encountered, with kerosene-use estimates ranging from 2-15 liters/day per boat	Potential for Demand Aggregation
	Refugee camps		approx 1 million people / Potential for Demand Aggregation
	Mining	Often use kerosene and flashlights	Potential for Demand Aggregation
	Retail/Kiosk Chains	Coca-Cola, Unilever, etc	Potential for Demand Aggregation for Kiosks/Retail Points

Action 3 – Identifying, Mapping and Engaging Local or Regional Distribution Channels

The Project will explore a large variety of alternative channels. Potential distribution partners will be part of the private sector consortium set in Step 1, as others are identified they will be also invited to join the consortium. Meetings held during our pre-appraisal and appraisal efforts confirmed that adequate and in some cases novel distribution infrastructure already exists in the market. For instance, Table 2A and 2B below displays is the number of retail vendors for other off-grid energy products, and the market share in distribution amongst different channels in Kenya. The data indicates the presence of vendors even in small towns and at least 7 types of competing distribution channels for off-grid energy products.

Figure 18: Number and Market Share of Vendors for Off-Grid Energy Products in Kenya

A - Number of Vendors for Off-Grid Energy Products in Cities of Different Sizes

Town	Population(1999 Census)	Solar & Battery Retail Vendors
Nairobi	2,143,254	> 50
Kisumu	332,734	18
Nakuru	231,262	19
Meru	126,427	12
Bungoma	73,048	13
Kerugoya	35,595	14
Chuka	7,271	5

B – Market Share in Off-Grid Energy Market of Different Distribution Channels

Shop Type	Percentage of Shops(n = 311 shops in 45 towns)
Hire Purchase Credit	41%
Electronic Appliances	16%
Electrical Hardware	13%
Automotive Spare Parts	11%
General Hardware	6%
Solar & Battery Specialist	5%
Other	7%

Notably, many of the most promising distribution networks are not currently engaged in energy access and have not been approached by existing energy access players. We list below potential distribution partners we have identified to date. Examples range from refugee camp operators (serving approximately half a million people cross the three countries) and automotive and industrial battery supplier (e.g. Chloride Exide, which has relationships with 2,500 battery dealers and charging enterprises across the country) to Coca-Cola and Unilever (comprising the largest existing distribution networks). Further, the prospect of coupling lighting with cell phone charging suggests one of the more intriguing potential distribution strategies. Many non-electrified people own cell phones and have to pay for expensive charging services (typically $0.20 to $0.30 per charge). There are already 6 million cell phone users in Kenya, and the growth rate is high. The second largest operator in Ghana is expecting to increase its subscribers from 550,000 today to 1 million by the end of 2006. Cell phone calling cards are purchased through thousands of small kiosks, which are potential sites for do-it-yourself charging systems, or solar-powered charging services for phones and associated lighting peripherals.

IFC has also during appraisal identified unique distribution channels meeting the local market needs and realities. Those include, for instance, an established practice amongst certain businesses of organizing road shows through villages in the rural area to sell a broad range of products directly to the rural population. As appropriate, IFC will engage these and others channels during the project implementation.

As appropriate and necessary, IFC will consider the development of special initiatives to engage the distributors to take part into the program, including as appropriate programs on demand-side financing.

Figure 19: Indicative List of Potential Partners in Distribution Based on IFC Appraisal Process

Organization	Activity
Areeba	Largest mobile phone network provider in Ghana (1.7 million subscribers).
Associated Battery Manufacturers	Manufacture automotive and industrial batteries (& battery recovery/recycling program). Interested in small-scale solar market.
Celtel	Cell phone service provider, large distribution network
Chloride Exide	Large seller of automotive and industrial batteries; 30% of sales in solar panels
Coca-Cola	Specializes in small kiosks and shops; large distribution networks in all three countries
Cooperative Credit Unions Association	Represents 260 credit unions. Able to retail as well as finance off-grid lighting products.
DENG Ltd	Solar home system and solar lantern distributor. Currently importing sample off-grid flashlights
Dizengoff Ghana Ltd	Distributes Millenium solar products and Motorolla mobile phone handsets
Energy Foundation	Public private partnership promoting energy efficiency and renewable energy. Successful distributor of CFLs.
Eveready	Import of batteries and flashlights. Working intensively with flashlights and other off-grid lighting solutions.
Frigoken, LTD.	Major processor of green beans with 30,000 workers
GOIL	Major distributor of kerosene.
Honeycare	Free-trade honey (5000 producers)
Kenital	Solar system installer
Mabati Rolling Mills	Large sheet-metal roofing manufacturer
Melcom	General store retailer and distributor
OneTouch	Second biggest mobile phone service provider in Ghana (550,000 subscribers).
Somotex Ltd.	Markets and distributes LG products
Safaricom	Large mobile phone service provider
Sangyug Enterprises	Importer and wholesaler of wide range of consumer products, including solar
Sollatek	Solar lantern distributor
Solux Lantern	NGO entitled "Volunteers for an Ecological Year" Lanterns rented to households and charged at school
Suntopway Solar	Importer and sales of a range of solar PV systems
Star Breweries	Major brewing company. Sources maize by prefinancing small scale farmers. Could incorporate off-grid lighting product financing.
Unilever Tea East Africa	Major tea producer; 26,000 employees
Unilever	Most effective distributor of fast moving consumer goods
U.N. High Commissioner for Refugees	Operations in refugee camps (including fuelwood delivery)
Wilkins Engineering	Grid connection and solar home system installer. Planning to assemble solar LED lanterns based on samples collected in Asia
Wise Energy Ltd	Distributes Stroomwerk Energy solar equipment

Action 4- Set parameter for products to compete against existing off-grid lighting and support individual companies in entering the market

The findings from Step 2 and Step 3 will provide a wealth of information on the features that will be required in modern off-grid lighting products to successfully displace fuel-based lighting on a large scale. This information will be shared with the industry consortium members, who will apply it in the development of their product design and distribution strategy. The information that will be compiled includes, but it is not limited to:

Consumer lighting needs – the various household and commercial lighting needs will be categorized, characterized and quantified. These uses might include, for example, broad room lighting for general activity, focused area lighting for cooking or reading, broad-beam portable lighting for outdoor activity, focused beam lighting for security, for lighting a walkers path or for warning oncoming vehicles that a pedestrian is on unlit road (see Table 1 for more detail). This information can be incorporated into product design to ensure that the off-grid lighting products fulfill customer needs.

Acceptable Pricing Point for Different Segments: different segments and sub-segments of the market may have different purchasing powers, purchasing decision criteria and motivations. This information will assist companies in defining with more accuracy their product design, pricing and overall strategy.

Cost vs Quality trade-offs – Current market solutions represent limitations of both supply and demand and work must be done to understand the real drivers. For example, virtually all battery-powered lighting is currently provided by disposable (non-rechargeable) batteries, which keep upfront costs down but result in high operating costs for end users. This research will inform customer preferences and drivers around cost and quality in product design.

Causes of Market Failure – the Project will also provide private sector partners with information on the typical causes of failure during product launch in the target markets. For example the "Achilles heel" of technologies are often the secondary components such as switches or hinges.

Design Requirements for Distribution – The distribution channels may affect the requirements in terms of product design. If distributed through channels moving rugged units (e.g. roofing units), the product would have to be more rugged and able to cope with hard transportation conditions. Should the product be distributed with similar consumer products, e.g. cell phones, then it may have to have a design that does not compete substantially in space in trucks or shelves. Distribution channels may also affect pricing as the working capital available for inventory of the smallest retailers may determine the price point of products they stock.

Other Barriers for Consumer Adoption of Modern Off-Grid Lighting Products – The Project will seek to identify behavioral, cultural and/or other subjective factors that may affect the end-users ability and willingness to adopt new, modern off-grid lighting products.

During this action, IFC will engage with companies on an individual basis, and as appropriate, may make available its financial products and advisory services to qualified companies seeking to enter this market. For instance, should a company decide to set a local assembly plan, IFC would consider as appropriate and under its regular investment review process providing debt, equity and/or other financial solution to support that endeavor. Likewise, should a company require some vendor financing, trade financing, micro financing, etc to support whichever business strategy it has chosen, IFC will seek to support individual company strategies with its financial and advisory solutions.

Action 5– Building institutional support for market development

It is anticipated that as companies seek their own individual strategies, they may find common barriers that could be addressed effectively by the Project. The principles for IFC intervention would based on the lessons learned discussed above, and aimed at supporting the industry where it cannot effectively in actions it cannot effectively do on its own. We have identified a range of preliminary natural roles for IFC in creating a fertile market for innovative off-grid lighting solutions. The overarching value of the following strategies will be to reduce real and perceived risks for private-sector market actors, and undertake activities that the private sector cannot efficiently undertake themselves to spur development of the broader market. This preliminary list is subject to redefinition through the lessons learned in the first four stages of the project and to be informed by consultation with stakeholders.

Support and Mobilizing Financing – The lighting solutions offered to the market under this project will be smaller and thus more affordable than has been the case in the past. Yet, first costs may remain a barrier for some. Vendor financing and/or micro-credit is an important potential part of our strategy, depending upon the price point match between the products which find acceptance in the market and customer ability to pay on cash terms.[5] However, because financed purchase approaches will not be appropriate for all end-user groups, we do not see it as a panacea to catalyzing the market. The Project will explore opportunities for strategic partnerships to deliver consumer and vendor finance, where the need is apparent and the uptake feasible to reduce the affordability barrier for consumer adoption of these new products. For instance, IFC may partner with one or more local banks to mobilize financing for this sector as a whole.

Assessing the Potential for Local Manufacturing/Assembly – The focus of the Project is about providing consumers with a viable modern alternative to fuel based lighting and so the choice of where to manufacture off-grid lighting products, either locally in Africa or elsewhere internationally, will be made by the private sector partners (not IFC/GEF) and based on purely economic factors. However, there is a keen interest in establishing local manufacturing/assembly in our target countries and existing (albeit at very small scale) assembly of solar lanterns and other consumer electronics suggest that domestic assembly may be viable[6]. The Project will therefore provide its private sector partners with a detailed study of the benefits and costs of local manufacturing so that they can make an informed decision as to where to site the various stages of manufacture from components, to assembly, to packaging.

Aggregated purchasing – Many modern energy products are sold at a huge premium in the Project's target markets due to the small volumes purchased. The project will seek to facilitate bulk purchasing of completed systems as well as critical components to enable the market to achieve economies of scale at an earlier stage than it would otherwise. Orchestrating disparate buyers can serve the goals of minimizing prices and ensuring quality and consistency of products.

[5] In Kenya micro-financing approaches are presently offered through special retail shops called "hire-purchase" stores, where consumers can purchase over time (e.g. 48 months) at ~22% interest). In our target countries, the Savings and Credit Cooperatives (SACCOs) representing most worker bodies (e.g. tea growers) are said to have larger capital reserves than the formal banks, and are already active in generating loans to their members. An established practice among some large companies is to offer salary-deduction payment systems, In Ghana the 260 members of the Credit Cooperative have expressed interest in both retailing and financing lighting products. More informal credit is provided by 'Susus', individual savings collectors who move between small vendors providing working capital savings and loans. Barclays Bank in Ghana is currently providing financing to these Susus which provides an access point to this lending channel.

Performance and quality assurance – Product quality challenges can adversely impact the market and have already done so in these countries with markets for solar panels, batteries, light sources, and ancillary components. In Kenya, for instance, recent studies identified PV modules available in the market performing below their advertised levels. Building on the IFC experience developed in the IFC/GEF Efficient Lighting Initiative, and leveraging the self-sustaining ELI Quality Certification Institute based in China, IFC will explore the role that a product quality certification regime might play in avoiding "market spoiling" associated with the introduction of poor quality products in the market. The Project will thus integrate a consumer education program with some sort of quality assurance effort to protect consumers and avoid market spoiling so often associated with early-stage technology market development.

Raising End-user Awareness – Virtually all of the market actors we interviewed identified the lack of consumer education on lighting matters as a key barrier to the ability to successfully introduce new lighting solutions. We will build on extensive lessons available from previous efforts on the effective means of building consumer awareness. Those include successful experiences with "road show" events strategically located and timed with weekly rural markets, where they can easily reach 5,000 to 10,000 otherwise widely dispersed consumers. Existing department stores, for instance, have experimented with "lighting trailers" that exhibit new lighting options in rural locations, a strategy also employed by renewable energy distributors in Ghana. Further, past experiences indicated that the most effective awareness raising tool in all two countries is the radio as this has the widest audience of any medium in these communities.

Pro-actively Managing Solid Waste from Batteries -- There is a growing realization across Implementing Agencies that many of the programs promoting off-grid solutions have had the unfortunate side effect of creating a significant solid waste problem due to unmanaged battery disposal. Many of these programs lacked any mechanism to minimize or mitigate this issue and the end result has been a reduction in the net positive impact of the programs and the creation of a long-term environmental problem to certain local communities.

An innovative component of this Project will be to try to establish from the outset the systems required to ensure proper management of the solid waste generated. To that end, during its pre-appraisal process IFC has consulted with local battery manufacturers that have established recycling programs to assess their interest in participation. For instance, IFC met with one company in Kenya that has an extensive network of car battery charging operations serving non-electrified areas, which as part of its service also collects and recycles batteries. This company claims to collect for recycling as much as 60% of the batteries used by its customer base. IFC found these companies to be motivated to participate in the Project which represents an opportunity to expand their business. The feasibility and structure of this Project's component will be further assessed during appraisal.

Action 6 - Exit

A recurring message received in our interviews was that traditional donor-based initiatives are rarely sustainable after external infusions of funding cease. IFC has designed the Project to avoid this trap by focusing all activities on market development, engaging the private sector by leveraging industry's self-interest, and requiring a substantial level of industry co-financing at each stage of the project. It is thus the aim for this project to develop a true market for improved lighting systems and bring it to such a point that it will sustain itself. At that time, IFC plans to withdraw from the market. IFC's experience in seven markets in four continents with the IFC/GEF Efficient Lighting Initiative demonstrated how this can be done successfully. In addition to the country-based activities which have spurred sustained market

growth, the global Product Quality Certification Institute which was developed to support the program continues operations to this day.

6 Stakeholder Participation

The Project has engaged a number of stakeholders in the concept development and will continue to do so throughout the future phases. Stakeholders will be involved in the Project through many different channels including: formal and informal consultations; participation in advisory or implementation committees that will be created to support the design and execution of the Project; and in reacting to the findings and conclusions of the different phases of the Project through industry workshops.

IFC's engagement of stakeholders has been extensive. Since 2005, IFC has consulted with over 100 international lighting companies regarding their interest in entering developing country markets and participating in a LED market development effort. In the course of our pre-appraisal and appraisal work we met with over 90 organizations to ascertain their perception of the lighting issue and potential interest in project participation. We conferred with a wide range of potential Africa-based players that could be involved in production or distribution of innovative lighting products, including:

- **Consumer product providers** such as CocaCola, Unilever, LG, Star Brewing Company, Honeycare, Frigoken, and Mabati Rolling Mills;
- **Retailers** such as Sangyug Enterprises, Suntopway Solar;
- **Mobile phone service providers** such as CelTel, OneTouch, Safaricom;
- **Lighting-related products** such Eveready, Philips, Osram, African lighting entrepreneurs, etc.
- **Financial organizations** (K-Rep, Ghana Microfinance Institutions Network);
- **NGOs** (e.g. CERES, ETC Foundation, KITE, Technoserve, New Energies);
- **Solar providers, consultants, or trade associations** such as DENG, Wilkins Engineering, Solarnet, KEREA, Kenitel, Kickstart, Bright Home Solar, Kenya Solar Technicians Association, Energy for Sustainable Development Africa, Sollatek, Integral Advisory Limited, Solux Lanterns, Wise Energy and Ghana's Renewable Energy Industry Association, Kenya Private Sector Association, Kenya Renewable Energy Association, Association of Ghanaian Industries, Ghana's Association of Solar Companies;
- **Public sector entities** such as the Kenya Ministry of Trade and Industry, the Ghana Ministry of Energy, the Ghana Energy Foundation, the Foreign Investment Promotion Authority of Kenya, and the Ghana Institute of Industrial Research., The Ghana Standards Board, the Kenya Standards Board; and
- **Other international or donor organizations:** UNDP, DFID, USAID, The UN High Commissioner for Refugees.

Our proposition received nearly universal interest, and most of those we met signaled one or more specific ways in which they can envision becoming involved in the project. Below is a table with the stakeholders, part from lighting companies, that have signed up to take part in the Project.

Table 1: List of Stakeholders that expressed interest in participating in the Project as of February 5, 2007

	Country	Company	Primary Activity
1	United States	SEEDS	Donor/Foundation
2	United States	PRIVATE DONER	Donor/Foundation
3	United States	HMGI LLC	Donor/Foundation
4	United States	Development	Donor/Foundation
5	United States	Cunningham &	Donor/Foundation
6	United States	California Energy	Donor/Foundation
7	India	GRAMEEN SURYA	Donor/Foundation
8	Ghana	Gold Coast	Donor/Foundation
9	France	UNDP *	Donor/Foundation
10	France	Paris Microfinance	Donor/Foundation
11	Canada	Nemalux LED	Donor/Foundation
12	Afghanistan	USAID *	Donor/Foundation
13	United States	Rocky Mountain	NGO
14	United States	IDE	NGO
15	United States	Harvard	NGO
16	United States	CADEC	NGO
17	United States	Building with	NGO
18	United Kingdom	SolarAid	NGO
19	United Kingdom	GVEP	NGO
20	Sweden	Engineers	NGO
21	South Africa	Gender and	NGO
22	India	IIEC	NGO
23	Ghana	KITE, Ghana	NGO
24	Ghana	Disability Options	NGO
25	Germany	Madagaskar	NGO
26	Germany	Global Nature	NGO
27	Ethiopia	WONDER	NGO
28	Ethiopia	ENSED	NGO
29	Canada	Rotary District	NGO
30	Austria	Renewable	NGO
31	Kenya	freelance	Media
32	United States	WebFirst	Other
33	United States	UCOP	Other
34	United States	Lighting Research	Other
35	United States	Lawrence	Other
36	United States	jujodzine	Other
37	United States	International	Other
38	United States	ideo	Other
39	United States	Cornell University	Other
40	United States	American	Other
41	Tanzania	National Bureau	Other
42	Switzerland	World Business	Other
43	Sweden	FourFact AB	Other
44	South Africa	private	Other
45	Kenya	catholic	Other
46	Italy	DEI University of	Other
47	India	Studio Korjan	Other
48	India	MS	Other
49	Ghana	CSIR-INSTITUTE	Other
50	Germany	European Patent	Other
51	Finland	Helsinki	Other
52	Canada	Self employed	Other
53	Brazil	UFRJ -	Other
54	Belgium	European Copper	Other
55	Australia	Research	Other
56	Afghanistan	DG Lights	Other

In addition to the stakeholders that expressed interest in participating in the Project, will continue to focus on engagement a broad array of stakeholders, broadly defined under the categories below.

Table 2: Preliminary Range of Stakeholders

Manufacturers	• For the context of this project, a manufacturer will be defined as the various private sector players involved through the product design, manufacture and assembly process. The final number of participants will be determined by the (i) number of different products introduced, (ii) manufacturer's expertise and skill set, (iii) resources made available by manufacturers in support of the Project, (iv) amount of capital manufacturers are willing to co-fund, and (v) interest of manufacturers
Distribution partners	• For the context of this project, a distributor will be defined as a party that sells the finished product to retail sales organizations or end users. Specific distribution partners that have already signaled interest are shown in Table 2. Distributors may be (i) For-profit organizations (including manufacturers) which sell products to retailers or end users, (ii) Cooperatives and consumer associations, (iii) Non-profit organizations which sell or provide products to end users or other organizations, (iv) Government organizations that sell or provide products to end users or other organizations (rural clinics, schools, refugee camps, etc.).
Service Partners	• For the purpose of this document, service partners will be defined as organizations which perform repair and maintenance of the products distributed as a result of the Project. Service partners may be (i) Manufacturers, (ii) Distributors, (iii) Other organizations that have the ability to perform repair and maintenance, and (iv) Individuals able to provide service and repair as a profitable business. • The final number of service partners will be determined by (i) number and variety of different products being introduced, (ii) potential consumer base a service partner operates in, (iii) service skill set, expertise, and track record, (iv) fit in terms of Program goals, and (v) service organization interest in the Project. • Outside the scope of the Pilot Project, it is expected that more service organizations will enter the marketplace as interest builds across the market.
Financial institutions	• For the purpose of this document, financial institutions will be defined as public as well as privately operated banks, microfinance corporations, venture capital organizations, and existing non-traditional providers of financing. There are existing micro-credit mechanisms, as well as other ways to spread first cost (installment payments, "hire-purchase" stores, "Susu's"). Solarnet—Kenya's solar trade association—has begun administering a small microcredit operation (sponsored by UNDP)—for financing solar home systems and similar programs have been run by DANIDA in Ghana. • The project will attempt to utilize financial institutions, as necessary, in order to provide funding throughout the supply chain. Where useful and necessary, IFC will seek to support these local financial institutions through a variety of Technical Assistance and financial product offerings (credit lines, guarantees) to support the availability of micro-credit and other financial products in the local market. Manufacturers will need capital in order to invest in the purchase of components and equipment necessary to manufacture the product and to train personnel in the use of this equipment.
Government Agencies	• The Pilot Project will utilize the target country's local and national government in an Advisory role. Collaborative opportunities with government will be developed to integrate the Project into the various government programs supporting rural electrification and solar technology dissemination during implementation of the full-sized project. Ministries of Trade and Industry will be engaged to collaborate on trade issues, statistical bodies for market research, and health, agricultural and education ministries as representatives of large end-user groups. In some cases, government agencies may be end users (e.g. in the case of rural clinics, which are often non-electrified and use kerosene for lighting).
End users	• Consumers using kerosene (and other lighting fuel sources) seek a better source of lighting. For several reasons, the non-household sector is also an ideal point of introduction. Firstly, SMEs are probably growing faster than population itself and are most abundant in non-electrified areas. Secondly, improved lighting not only reduces the costs of doing business but stands to increase sales and/or other metrics of productivity. Lastly, early deployment of new lighting solutions in the business sector is a way of exposing the population at large to the new lighting technologies.
Technical assistance and other implementing partners	• These will include bilateral and multilateral development agencies interested in economic development, NGOs, industry associations, consulting organizations, and industry experts. These partner vendors will be involved in much of the research, product design, and Pre- and Post-market evaluation that will take place. IFC's own TA presence in the African region is strong and local IFC TA staff is anticipated to play an important administrative role in executing the project.

7 Implementation arrangements

The implementation arrangements aim to ensure the Project is managed in an efficient and prudent manner, and achieves its objectives. The planned arrangement builds on IFC's previous experiences in similar projects and on key principles we have identified for successful project implementation. Further, the implementation arrangements also aim to capture possible synergies with IFC's existing operations in Ghana, and Kenya. We discuss those principles and arrangements below.

7.1 Key Principles of the Implementation Strategy

Given the nature of the Project, the Project implementation strategy must be dynamic and ensure the Project responds to the private sector needs and evolving market conditions. To that end, Project implementation will proceed on four main principles:

(i) Embrace a management approach (and strategy) that is dynamic and adapts to the evolving needs of the private sector,

(ii) Limit IFC/GEF engagement strictly to activities that the industry itself cannot undertake alone;

(iii) Promote and support competition in the market as a fundamental objective and employ competition to ensure fairness in Project activities.

a. This latter principle means opening Project activity participation and beneficiaries to all comers able to fulfill minimum requirements (e.g, provide quality products), and select participants for resource-constrained activities based on common criteria. IFC will draw from its experience in working with the lighting industry to accelerate market development in the Efficient Lighting Initiative to ensure fairness, maintain credibility, and promote competition.

(iv) Properly recognize and prudently manage the risks involved in large-scale market development initiatives. To that end, IFC will set up a (i) proper M&E plan (discussed further below), (ii) implement the Project gradually through 6 core actions (as discussed above) and (iii) as part of its ongoing project management IFC will pay attention to progress in a few critical points, which if unsuccessful could hinder the Project's viability, such as:

a. End of Action 1 - IFC will assess the level of interest the Project has attracted from the local and international private sector and if that level is sufficient to support the implementation of a successful Project. Given the strong response of the lighting industry to the Project already, this item has been largely accomplished, but IFC will monitor the sustainable interest of companies as the Project advances.

b. End of Action 2 - when IFC will have a in-depth understanding of the consumer profile and market demand, IFC will review if that is consistent with initial assumptions and if and how attractive it remains for the private sector

c. End of Action 3 - IFC will assess if the private sector has demonstrated the necessary interest and motivation in developing and executing individual business strategies to enter this market.

Given that the Project will be the launching pad of a broader WBG program, an additional principle will be to capture to extent possible all synergies arising from having now the WGB infrastructure and resources more easily available to the Project.

7.2 Indicative Project Governance Structure

7.2.1 The Project Management Office

The core team implementing the project will form the PMO, which will oversee and manage all aspects of the project implementation. The PMO will be constituted of 4-5 IFC-staff hired at the beginning of the Project and for the 4-year period to support the Project. The PMO will encompass (i) a general program manager overseeing the whole Project (to be based in Accra or Nairobi based on negotiations with selected candidate) (ii) a country leader for Kenya, based in Nairobi, (iii) a country leader for Ghana based in Accra, and (iv) one or two junior associates or specialists (e.g. a marketing specialist) to support the country leaders, and (v) a team assistant to support the team (based on the same country as the general program manager). The PMO staff will use IFC's administrative infrastructure and technical assistance delivery offices in Nairobi, and Accra. IFC's presence in these two countries is fully operational, and is currently supporting investment and technical assistance projects. As the PMO will be hosted under IFC's existing operations in Africa, the PMO will have full access to the market, regulatory and business expertise and relationships with the private sector, government and civil society that IFC has developed to date in Africa through the full slate of IFC experts currently developing investment and technical assistance in Africa.

Table 3a: PMO Budget Per Year

	Total	Year 1	Year 2	Year 3	Year 4
Project Administration - Staff Costs for Project	484,000	121,000	121,000	121,000	121,000
Travel Costs Directly Related to Project	60,000	15,000	15,000	15,000	15,000
Office equipment, vehicles and supplies	207,000	129,000	26,000	26,000	26,000
M&E	150,000	30,000	30,000	30,000	60,000
Total Project Management Cost	**901,000**	**295,000**	**192,000**	**192,000**	**222,000**

Table 3b: PMO Budget Per Source

Component	Estimated Staff Weeks	GEF($)	Other Sources ($)	Project Total ($)
Locally recruited personnel	387	184,000	300,000	484,000
Internationally recruited consultants	N/A	-	-	-
Office facilities, equipment, communications, etc	N/A	116,000	-	116,000
Vehicles acquisition	N/A		91,000	91,000
Travel	N/A	-	60,000	60,000
Miscellaneous	N/A	100,000	50,000	150,000
Total	**N/A**	**400,000**	**501,000**	**901,000**

The total costs related to the administration of the project for the 4-year period are estimated at $901,000, including Monitoring and Evaluation. Staff costs related to the project administration ($484,000) accounts for 54% of the PMO costs, and assumes that 20% of staff time will be dedicated to administration (the remaining 80% will allocated to directly support the implementation of the several project components). The office operations cost ($207,000), which accounts for 23% of the PMO costs. Office operation costs for Year 1 a broken down in 3 main costs: (i) two cars (one for Kenya and one for Ghana) to support operations oversight, particularly in rural areas, estimated at $44,500 each[7], (ii) a set-up cost per staff of

[7] For budgeting purposes, the car to be purchased is assumed to be the equivalent of a Toyota Land Cruiser. Price based on research of retail price for such cars in Ghana and Kenya.

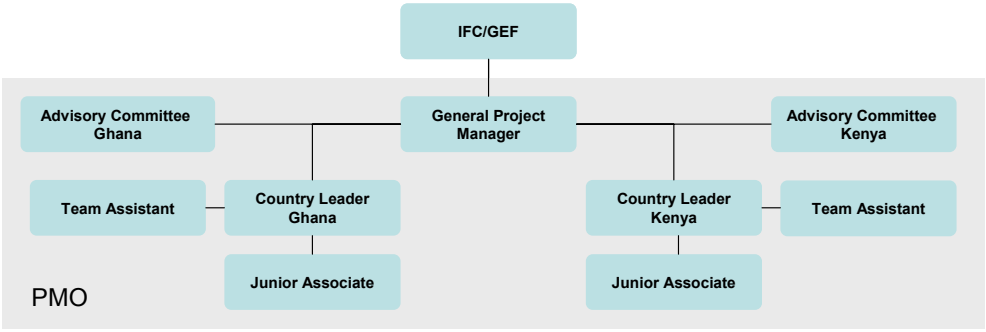
$4,000 (assuming computer, furniture, communications, and other basic infrastructure) or $20,000 in total for the two countries, and (iii) a cost of $20,000 per year (or $800/month per office) to cover operating expenses, including fuel, vehicle maintenance, communications, supplies, etc). From Year 2-4, only the costs related to operating expenses ($20,000 for the two countries), such as fuel, vehicle maintenance, supplies, etc are included in the budget.

The governance structure will remain flexible to adjust to the needs of the industry as well as capture any synergies that may arise as the broader WBG Lighting Africa program on off-grid lighting is further developed.

7.2.2 The Advisory Committees

In order to ensure full participation of local and international stakeholders in the Project and build a supportive constituency for the Project objectives across the private and public sectors, the PMO will establish Project Advisory Committees in each of the two target countries to ensure continued input and support to the Project by local stakeholders from the private, non-profit, and government sectors. The Project Advisory Committees will have a balanced membership of approximately 15 members in each country. Typical members would include: (i) representatives of the relevant government entities (e.g. ministry of energy, foreign investment promotion authorities), (ii) heads of key local business associations (e.g. manufacturers association), (iii) selected local experts in off-grid energy markets, (iv) selected NGOs or other civil society representatives of relevance to the Project. The Project Advisory Committees' primary purpose is to provide an organized forum to communicate with all key stakeholders, a vehicle for the Project to benefit from the experience and knowledge of the local stakeholders, and a means for building consensus and support for policy initiatives which might support development of the market. The Project Advisory Committees will meet approximately twice per year to discuss progress, share experiences and provide inputs to the PMO. In order to achieve cross-fertilization between the project countries, including transfer of knowledge and experience and sharing of policy successes, at least one meeting involving representatives of both Committees will be undertaken. As appropriate, the PMO may invite external experts, local or international, to participate in some of these meetings. Costs related to the Advisory Committee would be part of the PMO costs, and are expected to be very low, as most participants will be based in the country and join the Advisory Committee without any remuneration, and the activity requires limited infrastructure. For instance, based on IFC experiences with other similar committees, these meetings are likely to take place at IFC's office or the venue of one of the members of the Advisory Committee.

Figure 20: Indicative Project Governance Structure



7.3 Management of GEF Funds

IFC, as the executing agent is solely responsible for the management of the GEF funds. In the project execution structure, the PMO (located as a subsidiary of the local IFC technical assistance office), under the direct management of IFC's Private Enterprise Partnership facility, will manage use of the GEF funds.

7.4 Normal Project Expenditures

GEF funds for Project expenditures will include technical assistance activities, Project operations and administrative costs, Project activities undertaken in support of market development, and monitoring and evaluation.

7.5 Project Term and "Exit Strategy" for GEF Funds

The Project is planned to last 4 years, when IFC/GEF intervention will be completed. If the Project budget is not fully spent at that time, and key activities remain to be undertaken which IFC determines to be important to ensure sustainable impact of the Project at that time, then the Project life will be extended accordingly. The strategy for exiting the Project is to ensure that the market advancements achieved during the project are self-sustaining. Thus, a critical mass of market growth, supported by an enhanced capacity in the market to develop, access, distribute and finance stand-alone electric lighting products, will be established upon the Project close. Thus, by the end of the fourth year, should the 6-Step plan be executed properly, the private sector will be leading the development of the market, and IFC/GEF role as big facilitator will no longer be necessary to support this market transformation.

7.6 Institutional Coordination and Support

The Project team has identified and consulted with other multilateral institutions, NGOs and other stakeholders active in the target markets to ensure that the Project is not redundant and is designed and implemented in a way that complements other initiatives. Particularly noteworthy is the growing collaboration between IFC and IBRD towards a large-scale World Bank Group program that, building on the GEF-funded Project in Kenya and Ghana, will seek to replicate and enhance this market-based approach in a number of countries in Sub-Saharan Africa.

7.6.1 The Planned World Bank Group Program on Off-Grid Lighting

Increasing Energy Access is a key element of the WBG's Clean Energy Investment Framework. Among other initiatives and to a large degree due to the Project, the promotion of modern off-grid lighting is a key element of the WBG's efforts on increasing energy access. To that end, IFC is collaborating with several units of the World Bank, including the Energy (Anchor) Unit, the Africa Region and ESMAP to design the expansion of the Project to other countries in Sub-Saharan Africa. Current activities that IFC and IBRD are jointly undertaking include (i) a review of which countries should be targeted, (ii) funding efforts for this larger program, (iii) planning of key initiatives, such as the development of performance standards, and (iv) identifying potential synergies between World Bank and IFC programs in Africa. This collaboration is also reaching out to other potential strategic partners. For instance, IFC, ESMAP, Energy Unit, met with Global Village Energy Partnership (GVEP) to discuss collaboration in the program. In addition, IFC has leveraged, and will continue to do so during the Project, the extensive research developed by ESMAP to date on the topic of energy access.

7.6.2 Capturing Synergies Between Projects: The Ghana Example

In Ghana, the Project team has consulted with the World Bank to ensure that the Project complements the World Bank's "Development of Renewable Energy and Energy Efficiency" project. The IFC team has worked with the task manager of this project in order to ensure that the projects provide, in sum, a larger leverage of GEF resources than could be achieved by either of the projects individually.

Specifically, the World Bank's proposed GEF project in Ghana is connected to the US$80 million IDA Energy Development and Access Project and has four components: (i) a renewable energy policy framework and capacity building (ii) large-scale grid-connected renewable energy; (iii) mini-grid renewable energy and energy service companies (ESCOs); and (iv) stand alone renewable energy systems. Component (i) of the World Bank program will create an improved investment climate for the IFC Project's private sector partners with greater clarity on rural grid extension and improved tax incentives for renewable energy. Component (iv) of the World Bank program provides opportunities for direct cooperation and is clearly complimentary with the IFC Project. The IFC and World Bank project teams have aligned their programmatic designs to optimize this. The component (iv) is intended to remove technical, awareness, market and financing barriers to the acceptance of off-grid micro-solar and wind systems (500W-2kW) and will a) build capacity of the Apex Bank and its participating rural banks b) support the solar industry association with marketing and awareness campaigns and training provision c) provide incentives for the expansion of renewable energy dealer networks and d) provide re-financing to rural banks for long-term credit provision to consumers. The focus of the World Bank project is therefore the development of renewable energy institutional capacity, which is highly complementary to the product and market development focus of the IFC project. The World Bank's focus on solar home systems -- compared to IFC's focus on integrated lighting systems, as opposed to multi-point solar home systems -- ensures that the two will not be redundant. Cooperation is planned in terms of consumer credit provision and dealer network expansion, although the IFC project intends to take a broader view to product distribution than just the specialist renewable energy retailers, where the World Bank project is focused.

Further opportunities for GEF project coordination are created by the current Kwame Nkrumah University of Science and Technology (KNUST) application to the GEF Small Grants Programme to design its own solar LED lantern in cooperation with the private company Wilkins Engineering as a commercializing partner. Ghana's main university, the KNUST has a Center for Energy Research and Development in its College of Engineering with a long running (10 years) active program in off-grid solar solutions. The lab has run community solar battery charging stations and built its own LED lantern in a kerosene lantern frame (the K-Electric Lantern has 1 incandescent bulb for a high-light setting and 4 LEDs for a low-light setting). They attempted to commercialize this with UNESCO funding but the price was too high. The target price range for the new GEF sponsored design is US$10-15 and three separate designs will be built and tested. The IFC project team has consulted with KNUST and the GEF Small Grants Programme coordinator for Ghana to ensure that both projects will be fully coordinated and complimentary. IFC would hope that, with a successful product development effort at KNUST, their product could feed into the marketing channels (and leverage manufacturers' capabilities) to be developed under the IFC Project.

7.6.3 Coordination with In-Country Initiatives

IFC has also identified and reviewed a number of existing initiatives in Kenya and Ghana that offer opportunities for synergies and collaboration. A selected list of these initiatives is presented below. During appraisal, IFC will further review opportunities for collaboration and, as appropriate, set partnerships with the relevant entities.

Kenya – As indicated below, Kenya has a number of organizations and initiatives targeting energy access. IFC has evaluated this range of initiatives – coordinating with those for which such interaction is appropriate at this stage – and has determined that the proposed Project fits an important niche within this picture, complementing them effectively. All of the private sector entities contacted during pre-appraisal expressed interest in directly participating in the proposed Project. Many of the NGOs and consultancies have valuable knowledge and networks and similarly expressed interest in being involved in the project.

Table 4: Indicative List of Complementary Energy Access Programs/Initiatives in Kenya

Organization/Initiative	Activities
GVEP	Involved in national policies to promote energy access in Kenya
UNDP	Working on a Regional Energy Strategy for Eastern Africa
African Energy Policy Research Network	Regional NGO that conducts policy-oriented research on energy, environment and sustainable development.
Practical Action [formerly called ITDG (Intermediate Technology Development Group)]	International NGO focused on sustainable technology solutions. Ran Household Energy Regional Project out of Arusha in 90s. Developed Glowstar Solar Lantern as part of Energy Program, sponsored by DFID, now manufactured in China on license by Sollatek.
ENERGIA	An international network of women and sustainable energy whose goal is to engender energy and empower women
Centre for Environment & Renewable Energy	NGO founded 97 to lobby for environmentally sound technologies.
Transworld Radio Solar Project	Focusing on solar cookers.
Circle of Light	U.S. religion-based organization, providing village community solar solutions. Started in Kenya in 02, now entering Ghana.
Solarnet	Non-profit organization that supports renewable energy development in the East Africa region.
Kenya Private Sector Alliance	Industry association seeking to promote the local private sector
Kenya Foreign Investment Promotion Authority	Government agency responsible for attracting foreign investors

Ghana – Similarly to Kenya, Ghana has a number of organizations and initiatives around energy access. IFC has reviewed these programs and/or consulted with these organizations and believes that the Project is complementary with all of them. Again, virtually all the entities IFC contacted wished to pursue discussions about their potential role in our initiative. Many of the NGOs and consultancies have valuable knowledge and networks and expressed interest in being involved in the project.

Table 5: Indicative List of Complementary Energy Access Programs/Initiatives in Ghana

Organization/Initiative	Activities
UNDP/GVEP/Ministry of Energy "Energy for Poverty Reduction Plan for Ghana"	Currently under development through a multi-stakeholder process
IDA Energy Development and Access Project with associated GEF Renewable Energy and Energy Efficiency Proposal.	US$80m project currently in development supporting energy access through investment in transmission, distribution, access expansion and capacity building. The associated Renewable Energy and Energy Efficiency project will be funded with US$16-18m from the IDA and an application for GEF funding of US$5-7m entered the pipeline in August 2005.
GEF/UNDP sponsored Renewable Energy Service Project (RESPRO)	Applied a US$4m grant to create a fee-for-service model in Solar Home Systems implementation. UNDP now focusing on cooking with the promotion of efficient stoves and LPG.
DANIDA Solar Home System Project	Attempted micro-credit payment for solar home systems. Created 14 Energy Service Centers (solar battery charging) and offered loans for batteries/bulbs.
PV Solar Training Centre (DENG Ltd and GTZ)	Centre runs 2 week long technical training programs for solar technicians, providing skills in design and construction of solar systems.
USAID	Currently supporting West African Gas Pipeline project and development of a commercial market for gas in Ghana.
World Bank/Ministry of Education solar lantern distribution	Tender for and distribution of 8,000 solar lanterns to state schools. Sollatek won this tender in 2005.
GEF Small Grants Program LED Lantern Design Funding Application	Applying through the GEF small grants program for US$2000 to design its own solar LED lantern in cooperation with the private company Wilkins Engineering as a commercializing partner.
DFID Challenge Funds	Ongoing program providing small funds for local sponsors and innovations.
CIDA/KNUST/University of Regina Solar Battery Charging Stations	Funded by CEDA, KNUST and the University of Regina set up commercially focused solar battery charging stations.
DANIDA/New Energies solar lantern distribution.	New Energies, an NGO, distributed solar lanterns supplied by DENG and paid for by Danida. Lanterns provided for adult education in night schools.
Donor Sector Working Groups	Agencies focusing on energy include AFD, the Swiss Embassy, UNDP and the World Bank.
SPEED SME microfinance and Ideas Fund	SPEED is a joint venture between Danida and GTZ which provides SME designated capitalization to rural and urban banks for SME. It also provides the banks with training and the SMEs with non-financial support services. SPEED also has an Ideas Fund which provides grants of up to $50,000 for local businesses to develop new products.
African Rural Energy Enterprise Development	The AREED program in Ghana is actively managed by KITE.
eCommerce and Renewable Energy (eCARE)	Entrepreneur managed Rural Business Centres (shipping containers converted into solar powered ICTs).
UNDP's Multi Function Platform	The MFP program in Ghana is run by KITE which selects communities, trains entrepreneurs, and installs MFPs (diesel engine, grinding mills, oil presses, battery chargers)
European Union Energy Initiative	EU grant of €250m for African Caribbean and Pacific countries to finance energy initiatives targeted at providing energy to rural poor.
Ghana Association of Industries	Industry association promotion local private sector

7.7 IFC's Comparative Advantage

IFC has a combination of skills, experience and infrastructure that positions it well to deliver this Project, ranging from proven experience in similar market transformation projects to extensive

activity in the target region and countries. The details of IFC's comparative advantage are detailed below.

Experience in mobilizing private sector resources

IFC has been engaged in supporting commercial models for delivering modern electricity services to the underserved market for more than 10 years. Working through fund structures, direct investment, and technical assistance, IFC has leveraged its own capital, investor capital, and donor resources to support the development and execution of business models which deliver electric energy services to the underprivileged in these markets. In parallel, IFC has been an active player in the global lighting market, both as a direct investor, and as implementer of the IFC/GEF ELI Program, which lives on today as the self-sustaining ELI Quality Certification Institute. It is anticipated that the Quality Certification Institute can play an important role in establishing and administering LED performance specifications and in supporting a certification program to ensure quality product in the target countries. Such an effort is envisioned in stage 5 of the program as a means to protect against early-stage market spoiling associated with poor performing products.

Experience in promoting development of the private sector in Africa

IFC has extensive experience with the private sector in Africa. It is the largest multilateral source of loan and equity financing for private sector projects in that continent. Its expertise cuts across many different countries, and sectors. As depicted below, IFC's total commitments in Africa in 2004 and 2005 have been above US$ 400 million and a number of countries its portfolio exposure exceeds US$100 million. IFC's Private Enterprise Partnership (PEP Africa) facility uses a portfolio of technical assistance products and programs to directly support private sector development in the region. IFC programs to support leasing market development for SMEs in Ghana, as well as the recently-opened IFC SME Solution Center in Kenya provide a good platform for some of the market development initiatives envisioned under the proposed Project.

Building on IFC's private sector development program experience in the region, in 2005 "PEP Africa" mobilized US $9.5 million dollars in donor and IFC funds to deliver a new package of programs which directly support private enterprise development and boost the enabling environment for private sector development in the region. PEP Africa offices in Kenya and Ghana will serve as the administrators of the proposed Project, thus leveraging the range of private sector training and capacity building expertise IFC has established through its work in the region.

Table 6: IFC Project Financing and Portfolio in Africa (in millions of US$)

	FY04	**FY05**
Financing committed for IFC's account	405	445
Loans	242	357
Equity and quasi equity	81	36
Guarantees and risk management	82	52
Total Commitments Signed	405	445

Growing engagement in promoting energy access

IFC has been engaged in promoting energy access to non-electrified populations through its mainstream investments in the utility sector, as well as more developmental investments in solar home system enterprises and funds which target the sector. IFC advisory services also support -both

grid extensions to serve underprivileged populations and enterprise development targeting energy services provision to non-electrified populations. Current GEF programs under IFC management target energy access through photovoltaics (PVMTI) and fuel cells (The IFC Fuel Cells Initiative), both of which offer lessons specific to the African market.

In addition, IFC is an active participant in international forums addressing energy access and has commissioned studies to understand the private sector dimensions of reaching rural, non-electrified populations. In 2005, IFC organized along with the Global Village Enterprise Partnership (GVEP) a workshop on sustainable energy financing in Cambodia, and participated in GVEP's First Partner Assembly in Brazil. In 2006, as part of this continued involvement in energy access issues, IFC has become a partner of GVEP.

Through this growing engagement in initiatives to promote energy access, IFC has received an increasing number of calls for engagement from both host country governments and the private sector to support increased access to modern energy services. In response to that, and as part of its interest in developing new ways to promote energy access, IFC commissioned in 2004 an independent study on how to promote new lighting technologies to non-electrified populations. Part of this exploratory effort to define an appropriate IFC role in accelerating access to energy involved missions to Brazil, Africa, and India to understand the different lighting products offered to the local communities, the distribution channels for reaching this community and the pattern of development of other lighting technologies such as flashlights into rural, non-electrified communities. Lessons derived from this work, plus visits with LED manufacturers and designers in China, coupled with extensive consultation with the LED industry globally, have informed IFC's planning of this Project.

With this combination of experience, industry access, and institutional competency, IFC undertook the process of developing this concept more than three years ago. IFC began to engage the academic community, NGOs, the private sector and research institutions to explore the potential, the limitations, and the delivery vehicles for expanding access of the rural poor to modern lighting services. Specific activities undertaken include:

- IFC staff served as advisors for a special seminar jointly administered by the Stanford University Engineering and Business Schools which focused on refining the technology and delivery models LED -based system which provides task lighting for reading and focused work in a one-watt package supported by a rechargeable battery. IFC continued its collaboration with the academic community through engagement with LED market and technology experts from Stanford University, Lawrence Berkeley National Lab, Battelle Pacific Northwest Lab, Humboldt State University, as well as affiliated research arms of several major lighting companies.
- IFC consultants produced a series of documents which assessed the global market, and reviewed the state of the technology and the end-user market product distribution infrastructure which might be adapted for modern lighting services in India.
- IFC directly engaged the lighting industry, working through the Efficient Lighting Initiative and participating in industry conferences, such as the solid state lighting industry's annual meetings, Light Emitting Diodes 2004 and 2006, and Strategies in Light 2007. This effort received a strong response from the lighting industry, and over 130 companies having expressed interest in pursuing non-electrified markets.
- IFC visited Chinese LED manufacturing facilities to better understand the economics, competitive dynamics, and product quality issues in the industry.
- IFC participated in key international events on energy access in 2005, such as the Global Village Energy Partnership Asia Regional Workshop and the Global Village Energy Partnership First Partner Assembly.

- Field visits to South Africa, Kenya, Tanzania, and Ghana to explore distribution channels, market aggregation vehicles, end-user needs and practices, existing market conditions, regulatory environments, and complementary programs.

8 Project Budget, Financial Modalities, Financial Plan and Cost Effectiveness

The Project cost is estimated at $12.15 million for 4 years of operations. The operational budget is estimated at $6.4 million, and the additional $5.75 million is estimated for target industry in-kind contributions, and IFC investment in companies entering this market. Further to that and based on (i) earlier IFC experiences in market transformation projects, (ii) IFC's experience working with donors in Africa, and (iii) preliminary discussions IFC has held with donors and international industry players, IFC believes it will be able to substantially leverage GEF funding. In particular, IFC expects (i) substantial investment from participating private firms, whose contribution would be in the form of both cash expenditures and in-kind staff investment[8], and (ii) support from donors - IFC has held consultations with private foundations and has found a strong interest in the issue of energy access in Africa and on IFC's market based approach. To reach the $12.15 million:

- IFC is requesting GEF to fund $5,400,000 to support the project operational budget, estimated at $6.4 million.
- IFC will seek $1,000,000 from a combination of other donors and IFC cash contributions to complete the funding for the Project operating costs.
- IFC will seek $750,000 from private firms in co-financing during the course of the Project. Those will consist largely of in-kind contributions, such as costs of attending project activities (e.g. industry meetings), additional market research, business development and other marketing costs.
- IFC will target making investments of $5,000,000 (or more as appropriate) to support the Project. Those investments would be subject to market needs and could take many forms, such as credit lines or guarantees to local financial institutions to support companies involved in the Project and/or debt or equity for companies interested in local manufacturing or assembly.

Concerning co-financing, the Project has commitments for co-financing from the Government of Luxembourg ($500,000), Government of Norway ($400,000), and has been provisionally awarded a grant by the European Commission (€ 2,800,000 or $3.5 million of which about 50% is "earmarked" for dissemination/replication). These commitments are currently being formalized and should be in place by the end of 2007 (Calendar Year). In addition, the Project is expected to generate significant amounts of leverage through the funding to the World Bank Group project "Lighting Africa". About $4.6 million has been secured for Lighting Africa, and there are ongoing discussions with donors to further fund an African wide program on off-grid lighting building upon this GEF/IFC pilot.

The table below provides the operational budget. It has both costs for specific components, and overall project costs. We note that the PMO's primary mandate is to directly support the participating companies, and it is envisioned that 20% of its time will be dedicated to administration, and 80% of its time will be fully dedicated to that end, for instance, facilitating partnerships, supporting the development of individual strategies, enabling further market assessment any company may want to undertake, etc. Hence, it is not a mere overhead cost on the administration of the Project. To reflect that, we also prepared a table highlighting the cost per component, which allocates the PMO-related costs to each component, and provides a picture of the different costs of the sub-components

[8] While IFC will seek substantial contributions by the participating private companies, it will do so in a way which is even-handed and provides similar opportunities to all firms able to make appropriate levels of commitment to support the common efforts housed in the Project. Further detail on IFC's approach will be developed during appraisal.

Figure 21a: Indicative Budget –Uses of Funds

		Total	Year 1	Year 2	Year 3	Year 4
Project Administration - Staff Costs for Project Management		484,000	121,000	121,000	121,000	121,000
Travel Costs Directly Related to Project Implementation		60,000	15,000	15,000	15,000	15,000
Office equipment, vehicles and supplies		207,000	129,000	26,000	26,000	26,000
M&E	M&E (includes $30K last year for post-project M&E)	150,000	30,000	30,000	30,000	60,000
Total Project Management Cost		**901,000**	**295,000**	**192,000**	**192,000**	**222,000**
Project Components Costs						
	Of Which					
Component 1	Forming and Sustaining Private Sector Consortium	54,000	25,000	25,000	2,000	2,000
	Industry In-Kind Contribution (1)	50,000	40,000	10,000		
Total		*104,000*	*65,000*	*35,000*	*2,000*	*2,000*
Component 2	Market Assessment, including cost of products for field test	1,080,000	360,000	360,000	180,000	180,000
	Industry In-Kind Contribution (1)	50,000		50,000		
Total		*1,130,000*	*360,000*	*410,000*	*180,000*	*180,000*
Component 3	Distribution Channels Mapping and Engagement	410,000	50,000	200,000	100,000	60,000
	Industry In-Kind Contribution (1)	50,000		50,000		
Total		*460,000*	*50,000*	*250,000*	*100,000*	*60,000*
Component 4	Mobilizing industry - webportal, industry networking/mobilization engagements, conveying findings, local assembly feasibility study, etc	1,150,000	200,000	400,000	350,000	200,000
	IFC Financial support to companies entering the market, if necessary (1)	5,000,000		1,000,000	2,000,000	2,000,000
	Ongoing support and monitoring of products market penetration	525,000	137,834	137,650	124,758	124,758
	Industry In-Kind Contribution (1)	300,000			150,000	150,000
Total		*6,975,000*	*337,834*	*1,537,650*	*2,624,758*	*2,474,758*
Component 5	Peformance Standard and Certification Process Development	500,000	100,000	150,000	150,000	100,000
	Consumer education campaign	500,000	0	200,000	200,000	100,000
	Support to local Fis (banks, leasing, microfinance) to engage in off-grid lighting sector	300,000		100,000	100,000	100,000
	Capacity Building to relevant local institutions (energy business associations, manufacturing/industry business associations, solar energy associations, etc)	200,000		70,000	70,000	60,000
	Other Activities for Market Development, as defined by consortium of lighting companies	780,000		250,000	350,000	180,000
	Industry In-Kind Contribution (1)	300,000			150,000	150,000
Total		*2,580,000*	*100,000*	*770,000*	*1,020,000*	*690,000*
Total Components Costs		**11,249,000**	**912,834**	**3,002,650**	**3,926,758**	**3,406,758**
TOTAL BUDGET		**12,150,000**	**1,207,834**	**3,194,650**	**4,118,758**	**3,628,758**

(1) Per approved Project and current PAD, this co-financing is subsequent to CEO endorsement

Figure 21b: Source of Total Funds

Source	Type	Use	Amount
GEF	Grant	Project Operating Costs	$5,400,000
IFC/donor	Co-finding in Grant/Cash	Project Operating Costs	$1,000,000
Private Firms	Co-Financing in-kind	Market Development Costs	$750,000 (Subsequent to CEO Endorsement)
IFC	Co-financing	Market Development Costs	$5,000,000 (Subsequent to CEO Endorsement, and if necessary)
Total Project Cost	***GEF, Donors, IFC and Private Sector***	***Project Operating Costs and Market Development***	***12,150,000***
Consumer	Leverage	Market Development Costs	$18,750,000 (middle case)
Private Firms	Leverage	Market Development Costs	$6,250,000 (est)
World Bank Group	Leverage	Broadening of the Program, with CDM, Development Marketplace and other countries	4,760,000 (est)
Total Project Funding Mobilization	***GEF, Co-financing and Leverage***	***Project Operations Costs and Market Development***	***$41,910,000***

Figure 22a: Cost Per Component of the Project

	Cost (US$)	Cost (% of Total)	% of GEF Funding
Project Management Office	901,000	7%	45%
Component/Phase 1	104,000	1%	52%
Component/Phase 2	1,130,000	9%	96%
Component/Phase 3	460,000	4%	89%
Component/Phase 4	6,975,000	57%	24%
Component/Phase 5	2,580,000	21%	69%
Total	12,150,000	100%	44%

Figure 22b: PMO Budget Per Source

Component	Estimated Staff Weeks	GEF($)	Other Sources ($)	Project Total ($)
Locally recruited personnel	387	184,000	300,000	484,000
Internationally recruited consultants	N/A	-	-	-
Office facilities, equipment, communications, etc	N/A	116,000	-	116,000
Vehicles acquisition	N/A		91,000	91,000
Travel	N/A	-	60,000	60,000
Miscellaneous	N/A	100,000	50,000	150,000
Total	**N/A**	**400,000**	**501,000**	**901,000**

In addition, IFC notes that private firms are expected to contribute both as co-financiers of the initial project phases and to be a key source of leverage for the project during the latter phases of the project, when companies are expected to devote substantial resources to implement their own strategies. The private sector co-financing will be, per GEF's guidelines, "subsequent co-financing" and will be sought after CEO endorsement.

IFC estimates that the funds from GEF and other donors (excluding the private sector investments) will be used to finance two main types of activities, namely (i) cross-country activities, and (ii) country-specific activities. Cross-country activities are costs to set up and implement the Project, while country-specific activities are costs related to the implementation of the Project on the ground in each country. The cross-country activities reflect's IFC's intention of leveraging market development activities – including, for example, training modules, industry outreach and capacity building efforts, and structured learning opportunities – in order to better leverage the Project budget. The multi-country regional activity approach is consistent with the strategy to provide access to a larger aggregate market in Project interactions with international and regional companies. The regional approach also enables IFC greater ability to employ adaptive management practices and adapt to emergent market opportunities across two countries while also diversifying risk of overinvestment in a single country should market conditions become problematic over the life of the Project in one or more countries.

Concerning the Project's cost-effectiveness in reducing CO2 emissions, IFC developed three scenarios for the Project, based on LED and other modern off-grid products market penetration. As presented below, the base-case scenario assumes a 2-10% market penetration of modern lighting products in Kenya, and Ghana, leading to a reduction of CO2 emissions over 10 years of 782 to 3,909 thousand tonnes, or the equivalent of $6.9 - $1.38/tone of CO_2

Figure 23: Project Cost-Effectiveness

	Low Case	Middle Case	High Case
Period of evaluation (years)	10	10	10
Market Penetration of Modern Lighting Products	2%	5%	10%
GEF Cost	5,400,000	5,400,000	5,400,000
Reduced CO2 emissions (1000 tonnes, over 10 years)	782	1,954	3,909
GEF Cost/tonne CO2 ($)	6.9	2.7	1.38

Note: Values include 10 years of savings assuming existing lighting is replaced by non-fuel-powered LED systems at the indicated market penetration; no growth in baseline. Savings are undiscounted with zero nominal energy price increases over the period of analysis. Excludes substantial increases in energy service levels for end-users. Excludes impacts among electrified households.

9 Sustainability and Replication

Sustainability

The Project will be sustainable as it will build on an existing and functioning market (off-grid lighting) and on sustainable incentives across the entire value-chain, aligning and promoting at once the mutual goals of both suppliers and end-users for better lighting solutions. As detailed in section 4.5.3 above, suppliers, distributors and end-users have compelling economic incentives for the development of this market. In addition, the Project is deliberately designed to gradually shift the leadership of the market development from IFC to the private companies, which will be ones responsible for devising, funding and implementing their individual business strategies.

Further to that, the Project will as necessary leverage IFC's financial solutions and experience in Africa to ensure that the different business models the private sector develops to provide LED-based solutions will be sustainable. For instance, as part of the project IFC will assess the feasibility of establishing local manufacturing or assembly lines for LED-based products, ensuring if appropriate that at least part of the players supplying the product are close to the market, and better able to overcome in the long-run the same barriers that exist today, such as a lack of understanding of the local demand and needs. In addition, IFC will be as necessary engaging with local financial institutions to ensure a sustainable availability of vendor financing or micro-credit to improve the affordability of LED-based products.

Replicability

The Project is highly replicable, as the opportunity it identified is global in nature, virtually identical across all or most African countries. In fact, the emerging World Group Bank program on off-grid lighting, which builds on the Project and seeks to replicate its approach across Sub-Saharan Africa is a strong evidence of the potential replicability of the Project's approach. Moreover, the Project's rationale and approach builds on market drivers that are present in most developing countries that share basic conditions such as (i) have a significant part of its population without access to the grid, (ii) extensive reliance of this population on fuel-based lighting, (iii) alternative value-chains exist and can be tapped into, and (iv) the general investment climate does not deter interest and engagement of the private sector.

An important strength for any replication effort for the Project is that costs and timeframe for replication in multiple markets should fall over time. First, as the Project expands into more countries, it will be able to substantially leverage the private sector consortium, body of knowledge it developed on products, value-chains and end-user preferences, and will have only marginal costs in building and managing the relationships established with the global lighting industry. Second, once the Project removes the barriers for market entry and demonstrates the market opportunity for lighting manufacturers, one should expect the private manufactures to take a lead in seeking additional countries, and the Project intervention, if necessary at all as this process takes hold, would be no longer extensive to drive the process.

10 Risk Management

The Project carries a number of risks which might reduce the Project's impact on the market development. These risks and the IFC mitigation strategies include:

Figure 24: Project Risks and Mitigation Strategies

Risks	Risk Level	Mitigation Strategies
Private Sector May Not Respond with Enough Interest	Low	▪ For over 3 years IFC has been engaged in a number of consultations with the private sector and has gauged a serious interest and strong motivation across a number of different manufacturers around the world. In addition IFC has delayed project development until a clear and important role for an IFC intervention which leverages IFC's comparative advantage– defined by the industry – was identified. ▪ IFC pre-appraisal process has identified interest from local manufacturers and distributors on promoting modern lighting. A few have already expressed interest in pilot projects. ▪ The Project Phase 1 is to engage the private sector. This industry engagement will continue throughout the Project implementation, thus ensuring the Project is responsive to industry interest and need. Relevance to the private sector is fundamental to the Project strategy
Despite detailed appraisal, market conditions for the penetration of LED and other modern off-grid lighting products may prove more challenging or very different than anticipated	Moderate	▪ IFC's has reviewed thoroughly the technical and economic features of LEDs, had assessed during pre-appraisal the key market drivers, and has tried to validate its preliminary assessment of the market with local players, which are more aware of nuances of the market. ▪ Also, IFC is recognizing in the Project the fact that markets are dynamic and change overtime, and trying to build a Project that would be capable of adapting to unanticipated conditions.
Consumer demand and product preferences indicate that modern lighting products cannot compete successfully with fuel-based lighting	Low	▪ Many LED and modern lighting field studies to date have indicated that technically and economically some of the modern lighting products available in the market offer a superior solution to fuel-based lighting. Limited consumer tests of LED-based products have demonstrated consumer preference for electric lights (including LEDs) over fuel-based lighting. , ▪ The Project approach of assisting the industry in thoroughly understanding end-user requirements and preferences as a basis for assembling product packages is a mitigation of this risk ▪ In addition to companies own creativity and innovation, IFC will be leveraging its business and industry expertise to fill the gaps in market development by addressing barriers to consumer acceptance, as needed. These include consumer education and product quality certification initiatives.
Existing lighting market structure and incentives create strong barriers to new lighting product introduction to the market	Moderate	▪ The Project will be driven by self-interest motivations of multiple actors in the market who would benefit from supporting the LED marketing value chain. ▪ Engagement of private sector in the process will create strong forces and innovation resources to open alternative distribution networks for the various products developed to feed different market niches ▪ Potential impact of application of new technology will create new kinds of services and options for those currently dependent on only one solution (fuel-based lighting) to the market
Fuel-based Lighting Suppliers and Distributors will react to hold its market position	Moderate	▪ IFC will seek to work from the outset with stakeholders involved in the distribution of fuel-based lighting to address their needs and incentives and actually engage them in the effort to replace fuel-based lighting with modern lighting products, so they see it more options as an opportunity to expand or diversify their businesses
Changes in Policy or Economic Environment	Moderate	▪ Option to work with 2 countries diversifies project exposure to conditions in one single country.
LED-based and other modern lighting products unable to meet consumer price-point needs	High/Moderate	▪ The superior economics of modern lighting products, such as LED-based renewable energy powered lighting systems, over fuel based lighting drive a number of micro-finance options; The Project will develop these options through a variety of intermediaries and market aggregators, where necessary to market development. ▪ Market aggregation strategies will support bulk purchases, thus enabling lower per unit manufacturing opportunities. ▪ Project-sponsored consumer surveys and field tests will provide manufacturers with realistic parameters of market need to inform product development and match the consumer price point

11 Monitoring and Evaluation

The Monitoring and Evaluation Plan (M&E) will be integral to the Project's implementation. The Project M&E will be established in a way to conform to the GEF guidelines, and is based on SMART Indicators (**S**pecific, **M**easurable, **A**ttainable, **R**elevant, and **T**imebound Indicators), which are elaborated below, and reflected in the Logical Framework (Annex B). IFC will largely base its M&E Plan on experience gained in the IFC/GEF Efficient Lighting Initiative. ELI was a groundbreaking M&E effort, representing the first multi-country global market transformation program undertaken with a fully integral, large-scale M&E effort built into the program design and execution. In contrast to the ELI approach, IFC will adopt a more cost-effective approach to M&E. We will use an independent evaluator only where an outside party brings specific value. The M&E approach will: 1. use an outside evaluator to develop the monitoring and data collection tools, and evaluate the data developed at both the mid-point and conclusion of the Project; 2. use Project staff to provide real-time monitoring throughout implementation. The ELI experience also informed IFC's development of measureable Project objectives, directly linked to market development, that enable effective monitoring and evaluation, and are directly supported by the Project success indicators.

The Lighting the Bottom of the Pyramid Project evaluation budget allocates $150,000 to fund the independent evaluator's role, under the principle described above, and the specific roles enumerated below.

Table 7: M&E Budget

Action	Cost US$	% of Total M&E Cost
Pre-Project, M&E Systems/Plan Set Up	20,000	13%
Mid-Term Evaluation	40,000	27%
End of Project Evaluation	50,000	33%
Post-Project Market Transformation Study	40,000	27%
Total	150,000	

M&E will be integrated in the Project through four main phases:

Phase I – Pre-Project: An independent M&E firm, which will serve as the evaluator throughout the Project, will be engaged as the Project evaluator. Its first assignment will be to set the framework for the evaluation process, including (i) data collection forms that will be used by the PMO to monitor Project inputs, outputs, and results during implementation; (ii) define acceptable sources of data, (iii) required processes and systems to collect data, and (iv) processes and systems to ensure quality of data, among others. In addition, the independent evaluator will identify 1 to 2 countries in Africa which share similar characteristics to Kenya, and Ghana to serve as a reference market for the Project's impact, particularly related to the levels of market penetration of LED products that were made possible because of the Project.

A baseline study will be undertaken, under the guidance of the independent evaluator, and primarily conducted by the PMO as part of the PMO's market assessment that will inform the Project strategy and help the PMO build a network of collaborators in each target market. This baseline study will determine the key indicators, which may include indicators such as market penetration of modern off-grid lighting products, detailed assessment of level of imported and/or locally product off-grid lighting products, and acceptance by consumer at the bottom of the economic pyramid of modern off-grid lighting products. The initial activity to be undertaken by the PMO will be a market assessment, intended to establish key

contacts for the Project implementation team in the target markets, to provide useful data for international companies interested in entering the market, as well as establishing baseline data for the key indicators of Project success against which future market developments will be measured. IFC will look for cost-effective ways to also establish a baseline for the comparator country market(s) against which the Project country market impacts will be measured.

This early engagement will ensure that the PMO can embed in its project management and operational policies appropriate processes and systems to support the evaluation process. This early engagement will promote transparency, accuracy and efficiency in the evaluation process throughout the Project duration.

Phase II - Mid-Term Evaluation: This evaluation will be performed by the independent evaluator, and will take place 2 years after the Project is started. Its main objectives will be to (i) identify opportunities to improve Project execution effectiveness;, (ii) refine the initial framework for evaluation being used by the PMO, and (iii) as necessary, recommend adjustments in the Project execution strategy and implementation processes to the PMO. Some of key assessments that will occur at this phase include, but are not limited to:

- Is the execution of the Project's different steps proceeding such as to provide a good chance of meeting Project goals and objectives? Specifically, have such outputs as market baselines, customer characteristics been identified/ provided to manufacturers? Additionally, at the outcome level, the evaluation will access the level of market penetration (# of units sold/ people served and the number of companies that may have become profitable.
- With regard to the implementation process, the review will assess if there is any significant difference in the progress and results achieved between the three countries which may point to the need for a readjustment of the Project in one or more countries?
- Given the additional understanding of the market conditions during the first period of the Project, will IFC be able to ensure the Project's sustainability after its exit (e.g. if vendor-financing or micro-financing is reckoned a critical factor, does IFC have indication it will be able to mobilize local banks? if local assembly is deemed a critical success factor for sustainability, have companies expressed sufficient interest in that?) Some of this information will be developed in the baseline and market study and our assumptions shall be empirically tested through early purchases of lights. Evidence of long term sustainability shall be sought through ascertaining the number of local firms in the retail distribution chain as compared to our targets. Early examples that modern lighting products are sold at a price higher than production costs will be verified at this point
- Are the processes and systems related to data collection towards the evaluation process working properly, and/or are there adjustments to be made? This shall be addressed through qualitative information gathering
- How many households and small businesses have access to affordable LED products? IFC projects a range of 2-10% of market penetration (386,000 to 1.9 million) of LED and other modern off-grid lighting products which would reduce carbon emission in Ghana and Kenya by 782,000 to 3.9 million tonnes over a 10-year period. An intermediate target for the Project is to reach 1% market penetration of modern lighting products (or 193,000), and reductions of 391,000 million tones in GHG emissions from fuel-based lighting by the end of 2nd year of the project.

Based on this mid-term evaluation, IFC will assess the Project strategy and revisit the Project's ability to meet its objectives.

Phase III - End-of-Project Evaluation: This evaluation will be performed by the independent evaluator at the conclusion of the Project execution, and will measure the Project's direct impacts - starting with total market penetration of LEDs and other modern off-grid lighting products supported by the Project

and their related GHG emissions reductions. The assessment will focus on the following key SMART indicators:

- Number of manufacturers entering the market, number of alternative lighting products available in the market and number of units sold in the markets of interest. This analysis will permit the evaluation to address the level of market penetration achieved by modern off-grid lighting products during the Project duration (unit sales)?
- How many international and local companies have entered this market during the Project's life? (See above) The target at the end of the project is 6.
- How many products are available in the market (serving how many distinct market niches)? Target: 12
- How many households and small businesses have access to affordable off-grid modern lighting products? IFC project a range of 2-10% of market penetration (386,000 to 1.9 million) of LED and other modern off-grid lighting products which would reduce carbon emission in Ghana and Kenya by 782,000 to 3.9 million tonnes over a 10-year period. The target by the end of the project is a 4% market penetration of LEDs and other modern lighting products (772,000) and reduction in GHG emissions of 1,564 million tones. An intermediate target for the Project is to reach 1% market penetration of modern lighting products (or 193,000), and reductions of 391,000 million tones in GHG emissions from fuel-based lighting by the end of 2nd year of the project.
- What happened in the reference market outside the Project scope? We expect that the reference market from where we are monitoring penetration data will be show a penetration rate of 0 to 1%.

The GEF Terminal evaluation is intended to be completed at this point, approximately six months after the close of Project operations, and upon completion of the End of Project Evaluation study, which will provide the basis of the Terminal Evaluation. Therefore the End of Project Evaluation will incorporate all GEF requirements for Terminal Evaluation. Given that IFC plans to also conduct a post-program Market Transformation Study (Phase IV, below) two years after closing country operations, IFC will need to set aside some funding from the GEF Project Trust Fund to cover the GEF portion of the Market Transformation Study Costs.

Phase IV – Post Project Market Transformation Study: This evaluation will be performed two years after the completion of the Project completion in order to assess the sustainability and longer term market impacts of the Project. It will also use the reference market trends as a comparison in order to measure direct and indirect impacts of the Project on the target market. The focus of this Market Transformation Evaluation will be the following key indicators:

- The level of market penetration which should be at least 2% by year 10. The second parameter is that 386,000 LED lights should be sold and 3.9 million tons of GHG avoided.
- Did the number of companies participating in the market after IFC's exit decline/grow/remain constant? At least 6 firms are expected to be operating in this market in year 4. By the post program evaluation we expect that more firm will be in the market or the output of the existing firm will be greater than those of the earlier 6 firms.
- Number of products in the market should be greater than 12. How many products are now available in the market?
- Is consumer finance available through commercial channels, as measured through the proportion of individuals at the both quartile indicating that the have adequate finance in year 10? (I don't think we need this) Consumer finance is not typically available for these types of products. However, specific distributors and retailers may provide credit to their purchasers. If the program offers credit to certain parties in the value chain, they may be able to extend same to the end user.
- Does the market show evidence of being sustainable in the absence of IFC's presence (ie, what are the trends)? This parameter is measured through at least half of the companies in the market indicating that the lighting products are profitable

- What happened in the reference market outside the Project scope for each of these indicators? Data on these parameters in the log frame will be collected in reference countries

LIGHTING THE BOTTOM OF THE PYRAMID

Project Appraisal Document Annexes

Annex A: Incremental Cost Analysis

Summary of Assumptions and Methodology

- To obtain per-household values for Ghana and Kenya, we consulted prior studies and conducted our own interviews and measurements during missions to each country. While the dominant source of energy use is kerosene, we also included the baseline use of candles, flashlights, LPG, and biomass. We also collected baseline data on non-fuel operating costs (equipment, replacement wicks, etc.). We combined these data with official national survey data (e.g. number of electrified households), to construct a "bottom-up" model that characterized the baseline structure and costs of providing lighting for non-electrified households and businesses. Fuel quantities were converted to expenditures using year-2005 energy and equipment costs, and to greenhouse-gas emissions using standard emissions factors. We compared our results with "top-down" national estimates of lighting kerosene demand and received good agreement.

Baseline Conditions

- We separately modeled six categories of lighting equipment to be targeted under the proposed program, i.e. kerosene wick lanterns ("tins"), kerosene hurricane lanterns, pressurized kerosene lanterns, pressurized LPG lanterns, flashlights ("torches"), candles, and biomass.

- We collected country-specific demographic information on household size and electrification rates. This was coupled with end-user-level data lighting equipment ownership and utilization information from prior literature (including ESMAP studies) and in-country surveys and interviews of local experts conducted on our Missions to the countries. This was combined with information on first costs (lanterns), operating costs (maintenance, wicks, etc), and energy prices.

- Using the above information, we developed mathematical models of baseline energy demand, expenditures, and emissions, following standard accepted practices for summing across the various types of light sources (e.g. kerosene lanterns), their baseline market penetrations (e.g. % of households owning), utilization (e.g. hours/day), energy intensities (e.g. liters/hour), and emissions factors (e.g. grams of CO2/liter of kerosene). These operating results were combined with equipment purchase and maintenance costs to obtain total costs of ownership.

Program Scenario

- In the baseline scenario (without the proposed program), near-term commercialization and successful uptake of LED and other modern off-grid lighting technologies within our target market is assumed to be negligible. This is indicated by the low market penetration of solar lighting today in our subject countries (and almost no penetration at our "bottom-of-the-pyramid" target group).

- Rather than attempting to model the per-user penetration rate (e.g. lanterns per household or per small enterprise) and corresponding energy savings across a wide range of customer types, we stipulate penetration rates in terms of fractions of total fuel-based lighting energy use. This accounts for some share of the systems being targeted to high end users (e.g. fishermen) who will also have 100% substitution of the new systems for baseline systems on the one hand and, other end user types who will partially substitute their existing fuel and partially opt for increased numbers of light sources and service levels (maintaining some level of kerosene lighting use). As the proposed technology is

entirely grid-independent and powered with renewable sources, the purchased energy savings are 100% in the cases where there is full substitution for the existing lighting equipment.

- Assumed costs of the proposed off-grid lighting products (US$25/system) were based on interviews of leading industry innovators in this area, and laboratory measurements. The performance (light levels) estimates are based on a combination of laboratory tests and field measurements of prototype LED lanterns made during the preparation of the Project.

- Several conservatisms were adopted. Not included in our savings estimates is the rising baseline, i.e. the rising number un-electrified populations, reduction in household sizes, and rapidly increasing numbers of un-electrified small and medium enterprises (which, pursuant to current trends, will in fact lead to increased fuel-based lighting energy demand during the course of the project) – perhaps by a factor of two over the coming decade. We also did not include savings due to the dual-uses (e.g. cell phone charging) that will likely be incorporated by some of the products brought to the market under this program. Equally important, given current trends, the efficiencies of one of primary technologies in this Project (LEDs) will likely double during the course of this project, translating into a halving of the equipment costs thanks to downsized PV and battery requirements.

- Extensive non-energy and productive-use benefits were identified, and documented in Annex A, but not quantified in the ICA. In addition, energy service levels increase dramatically (at least 10-fold) for recipients of the new technology

Methodology for Calculating Economic Benefits and GHG Emissions Reductions Attributable to the Project

Remarkably, there are no prior estimates of national lighting-related energy use and costs for off-grid consumers in any Sub-Saharan country. To obtain per-household values for Ghana and Kenya, we consulted prior studies and conducted our own interviews and measurements during missions to each country. We also collected data on non-fuel operating costs (equipment, replacement wicks, etc.). We combined these data with official national survey data (e.g. number of electrified households), to construct a "bottom-up" model that characterized the structure and costs of providing lighting for non-electrified households and businesses. Fuel quantities were converted to expenditures using year-2005 energy and equipment costs, and to greenhouse-gas emissions using standard emissions factors.

Baseline Conditions

We estimate that approximately $1.4 billion is spent today for off-grid lighting (excluding solar lighting) in Ghana and Kenya (Figures ICA-1 and -2), accompanied by greenhouse gas emissions of 3.9 megatonnes of CO_2/year (Figure ICA-3). Due to population growth and other demographic trends, these values will increase to approximately $2.0 billion and 5.5 megatonnes within the next decade, at current energy prices.

Figure ICA-1. Off-Grid Lighting
$1.4 billion/year (2005)

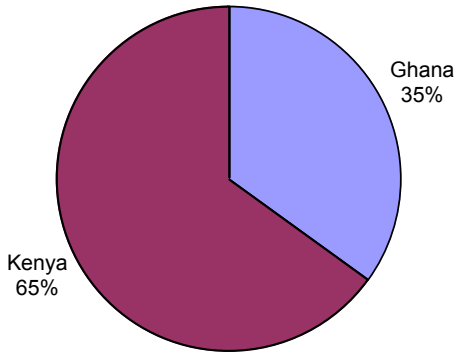


Figure ICA-2. Off-Grid Lighting by Source
$1.4 billion/year (2005)

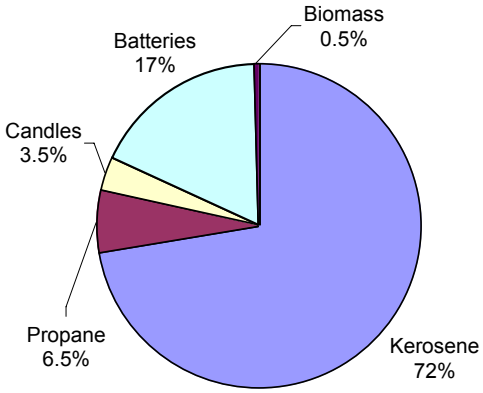
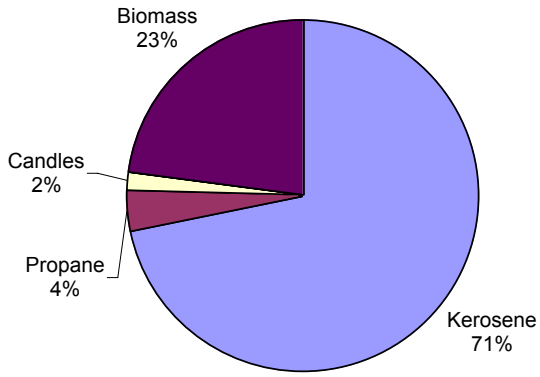


Figure ICA-3. Off-Grid Lighting
3.9 MT CO2/year (2005)



Ghana and Kenya

For a variety of socioeconomic factors, the baseline demand for fuel-based lighting is increasing more rapidly than the overall economies in our target countries. This is driven by population growth superimposed over low electrification rates, rapid growth in small and medium enterprises (many of which are non-electrified and use fuel-based lighting), and a steady trend towards reduction in household sizes, which results in more fuel-based light sources per capita). Taken together, these factors will dramatically increase baseline off-grid lighting expenditures from the current level over the 10-year time horizon of our impact analysis. As a conservatism, these rising baseline levels are not included in our savings calculations.

Baseline conditions in our target market—non-electrified homes and businesses—are characterized by a diverse mix of off-grid lighting equipment including lanterns, candles, and flashlights, plus a variety of other hard costs such as replacement lanterns and batteries as well as equipment maintenance.

Top-level GEF cost-effectiveness calculations, based on our model, are presented in Table ICA-1 and key assumptions are outlined in Table ICA-2. A more detailed characterization of the baseline market, costs, and carbon dioxide emissions is outlined in Table ICA-3. This market model will be refined during project appraisal and implementation, as more detailed data on market structure and end-user behaviour are gathered.

As an indicator of the likely conservatism of our baseline energy results (approx. $50 to 85/year-household), ESMAP research in the late 1980s estimated household outlays for off-grid lighting at up to $120/year. The Kenya Household Energy survey found a range of lighting expenditures from $36/household-year (in the year 2000) for kerosene-only households to $192/hh-year for households using a combination of kerosene and batteries. Adjusted to today's kerosene prices, the lower value would increase to $85/year and the upper value to at least $242/year (assuming no change in battery prices and similar uses of kerosene for all three tiers). Our model estimates an average $82/year for total lighting expenditures (kerosene, batteries, fuelwood) for the average rural household in Kenya for the year 2005. For Ghana, JICA (2005) estimates kerosene lighting costs of approximately $78/household-year (we estimate $86 for rural households and $49 for urban households), which also includes modest amounts of biomass and LPG.

In the baseline scenario (without the proposed program), near-term commercialization and successful uptake of modern off-grid lighting technologies within our target market is assumed to be negligible. This is indicated by the low market penetration of solar lighting today in our subject countries (and almost no penetration at our "bottom-of-the-pyramid" target group), especially when tempered by the known failure rates of existing systems, and by the very small scale of efforts such as solar lantern development observed to date (hundreds to low thousands of units adopted by end users). While IFC has observed a range of organic entrepreneurial activity in the sector, including several products which use modern off-grid lighting technology (intended, however, for relatively affluent consumers outside of our target market), the penetration rate under current conditions without a more deliberate effort by international companies to develop the market would not be expected to increase materially over the 10-year time horizon of our analysis. Thus, for the purposes of these calculations we assume a baseline that excludes the proposed modern off-grid lighting technology among poor consumers. In the Project monitoring and evaluation plan, IFC will track development of a comparator market from the region outside of the scope of the Project activities. This comparator market should provide a proxy for a refined base case analysis; enabling the evaluator to adjust the baseline assumption accordingly.

Table ICA Ia – Cost Effectiveness

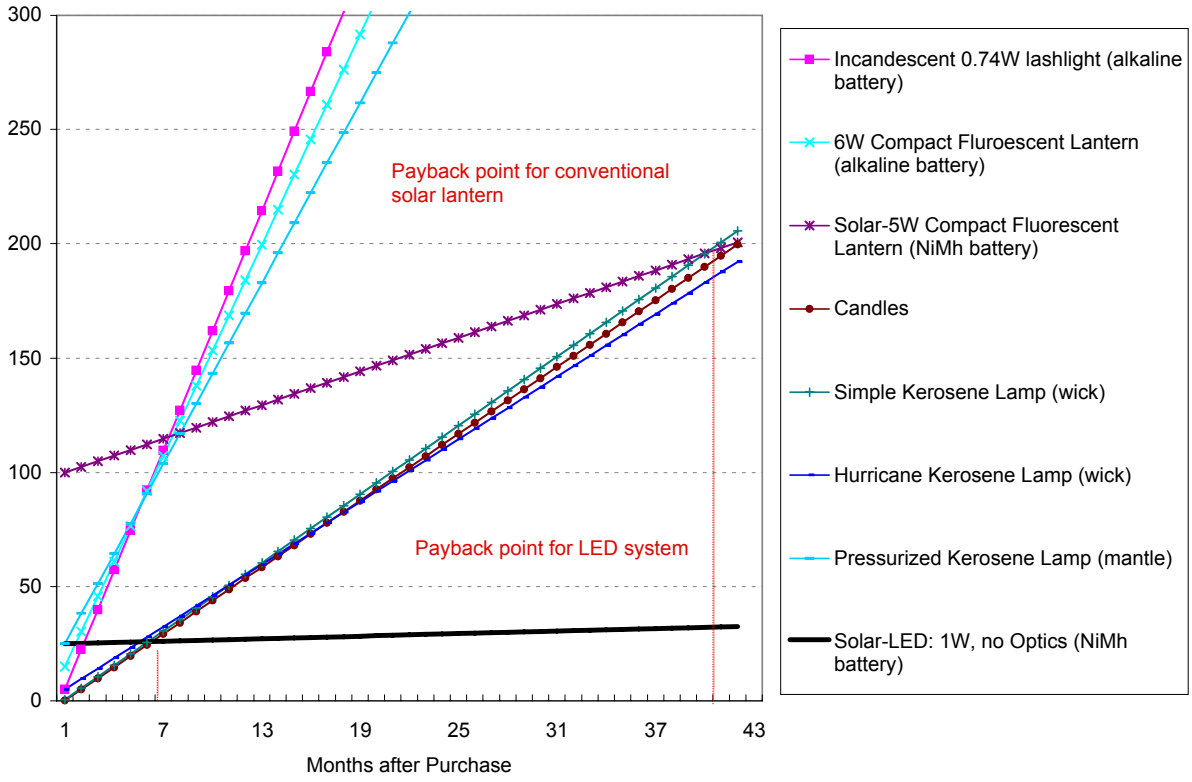
	Low Case	Middle Case	High Case
Period of evaluation (years)	10	10	10
Fuel-based lighting energy savings	2%	5%	10%
GEF Cost	5,400,000	5,400,000	5,400,000
Reduced CO2 emissions (1000 tonnes, over 10 years)	782	1,954	3,909
GEF Cost/tonne CO2 ($)	6.9	2.7	1.38

Preliminary Estimates of Direct Economic Impacts

Direct economic impacts from the project arise from reduced energy use for lighting as well as reduced equipment, operation, and maintenance expenditures. While energy services will be increased dramatically (see below), we do not include economic estimates for the no-doubt-significant value of these higher services.

Commercial energy, candles, and batteries. Under the proposed project, lighting operating cost savings accrue from three sources: reduced liquid fuel combustion (predominantly kerosene in the countries in question), candles, and batteries for lighting purposes. We include each of these cost categories in our baseline and savings scenarios. The systems we expect the private sector to bring to market under this project will be highly cost effective on a per-household basis. As shown in Figure ICA-4, the payback times will be well under a year in many cases (indicated where the heavier "LED" line crosses the cumulative cost-of-ownership curves for prevailing lighting systems. The proposed systems will also be far more cost-effective than the current generation of solar lanterns or complete solar home systems, which have higher first costs as well as higher operating costs (due to shorter light source life and more costly battery replacements).

Figure ICA-4. Cost of Ownership Comparison: Off-grid Light Sources



Note: Analysis assumes 3 hours/day operation for each type of lighting

Biomass. As discussed in the main body of the proposal, biomass is used to a modest degree in our target markets for lighting purposes. According to official national surveys for Kenya's neighbour Tanzania, 7.1% of rural households use fuel wood as their primary lighting source, and up to 19% in one region, (and the rate *increased* between 1990 and 2000) and 3.8% of rural households in Kenya reported using fuelwood for lighting, and 8% of those using wood wastes for any purpose and 3.3% of those using farm residues reported using them for lighting purposes (Kamfor 2002). Field reports indicate that fires often continue to be burned for lighting and social interaction after preparation of the evening meal, often with fuel added to increase light output once cooking is complete. We have found no prior research on the amounts of biomass energy allocated to lighting, which is a remarkable knowledge gap we intend to address in the course of this project. For the purposes of our initial estimates, we assume that 1% of household fuel wood is used for lighting purposes. Our associated cost estimates are limited to the

minority of households purchasing fuel (as opposed to collecting), and exclude the business sector. Our estimated costs and emissions impacts exclude agricultural wastes and charcoal. As seen in Figures ICA-2 and ICA-3, the cost of biomass is low (much biomass is obtained without a cash transaction), but the corresponding greenhouse-gas emissions are significant. There is considerable uncertainty around these estimates.

Equipment and non-energy operating costs. The baseline lighting equipment employed by our target population is considerably less durable than the systems we are proposing, and incurs non-energy operating costs such as replacement batteries, wicks, mangles, and equipment repairs. These costs are included in our baseline and savings estimates.

Grid electricity. While not our primary target market, we expect that the new lighting systems brought to market under this project will also find application among existing electrified homes and businesses. This will be driven by improved lighting quality, reduced operating costs, and as a response to grid reliability problems. In the Nairobi's Kibera slum, for example, end users are charged by the socket for electric lighting, which can translate into an effective cost many times higher than the prevailing retail price of electricity (approximately $0.50/kWh). We have not included potential savings from the use of LED and other modern off-grid technologies by grid-connected consumers.

We developed three scenarios for potential project impacts, with results shown in Table 1.

- Scenario I: High– 10% lighting energy savings
- Scenario II: Medium – 5% lighting energy savings
- Scenario III: Low – 2% lighting energy savings – assuming that program expenditures implicitly translate on a 1:1 basis directly into lamp purchases ($10,000,000/$25 per lamp) but no additional market leverage is achieved.

Table ICA 1b: Market Penetration Scenarios

Market Penetration	Ghana	Kenya	Total Users
2%	144,634	241,266	385,900
5%	361,585	603,165	964,750
10%	723,170	1,206,330	1,929,501

System Types and Costs

While IFC will not dictate technology characteristics or pricing, under the project a variety of technology options will be brought to the market, with different performance characteristics (and applications) and price levels. At the "entry level" of the spectrum will be stand-alone light sources (usable individually or in multiples) at price points in the vicinity of US$5 each. In practice, lights of different sizes (light output) would be offered, ranging from 0.1 to 1.0 Watts, and perhaps higher for very specialized applications, with a range in prices for perhaps $2 to $10 each. These will be powered by removable "AA" style (or similar) batteries, already available in the local marketplace. In this configuration, either disposable batteries at ~$0.20 each (lower first cost and higher operation cost) will be used, or rechargeable batteries at ~$1.25 each charged by local micro-enterprises using solar photovoltaic or grid-based charging at a cost of perhaps $0.10 per charge. Alternatively, third parties may elect to establish micro-grids with

central power at the scale of a cluster of homes or greater. Consumers can graduate from disposable to rechargeable batteries or micro-grids as they become able to afford third-party recharging or their own charging device. The next step upwards will be to stand-alone systems with integrated charging (PV, hand cranked, etc). These systems would be modular in that they could be purchased incrementally (e.g. charger ~$15-$20) plus one or more light points at perhaps $5 each. Lastly would be relatively high-end configurations including a package with multiple light sources, charging, and even ancillary services such as cell phone or radio power. These would be valued more highly, e.g. because they would defer phone charging costs of ~$10/month) and would be brought to the market at a correspondingly higher price point.

The realm of application in most cases will be "task" as opposed to "ambient" lighting. Existing LED technologies allow for rather uniform illumination over an area of 1 to 5 square meters. Indirect applications, using simple reflection off of white paper or fabric, were seen on our mission to provide highly acceptable ambient illumination, at levels suitable for social interaction over a large area.

Based on current trends, the efficiencies of LEDs will improve considerably—probably doubling—even over the short duration of this project, while the costs per unit of light output decline. Improved LED performance will allow for downsized charging systems, further reducing total system costs. As a conservatism, this learning-curve effect has not been incorporated in our savings estimates.

Conservatisms and Caveats in the Analysis

The preceding analysis did not include expected increases in baseline energy use and costs that can be expected over the period of analysis. This is driven by population growth, corresponding growth in small and medium enterprises (many of which are non-electrified and use fuel-based lighting), and a steady trend towards reduction in household sizes (Liu et al, 2003), which creates a trend towards more fuel-based light sources per capita, over and above that caused by growth in population). Moreover, according to projections from the International Energy Agency (2002), the non-electrified population will increase by 40% in Sub-Saharan Africa between 2000 and 2025.

In addition, as these economies develop, consumers will move up the traditional "lighting ladder" through increasingly more fuel-intensive lantern types (wick to hurricane to pressure) and longer operating hours, per-household lighting energy use will increase further. As fuel wood becomes scarcer, we can also anticipate a higher share of people paying for (rather than freely collecting) fuel, a small but important (and probably increasing) fraction of which is used for lighting. If observed trends continue, more biomass may be used for lighting as the cost of fuels increases. Energy price increases will, of course, also elevate the baseline costs.

The analysis also did not include fuel- or battery-based lighting used among electrified households in response to high electricity prices and/or power outages (particularly frequent at present in East Africa). We did not estimate the energy use and costs associated with grid-based end users who may opt to switch to grid-independent modern off-grid lighting sources, or those associated with increasingly popular grid-based car battery charging services (such batteries are often taken to the home and used to operate lights) or cell-phone charging which may be provided by some of the systems brought to the market under this project by private sector partners.

Taken together, these factors could as much as double the baseline energy use, and increase the expenditures by even more. In preparing this analysis, we drew on the best-available data for each country. Improved estimates will utilize new market research conducted during the course of the project.

Potential scenarios under which the project attains lower impact than described above are enumerated in section entitled "Risk Management." Actual outcomes will be particularly sensitive to assumed household size and numbers of small businesses using fuel-based lighting (which, in turn, influence the numbers of lanterns in the stock). Utilization rates and other operational assumptions are shown in Table ICA-4.

Energy savings under the program are articulated as fractions of total lighting energy, and can be equated to numbers of participating customers assuming that each unit sold goes to a different customer and is used identically. It is important to note that the potential for lighting-related CO_2 reductions from traditional whole-house solar electric systems have been curbed (Hankins 2005) in part by the limited efficacy of traditional fluorescent lighting used therein, and end-users sometimes prefer to use scarce solar electricity for other end uses (e.g. television). Consequently, among relatively affluent households, the introduction of alternative lighting may be taken as an augmentation to existing lighting rather than as a substitute (as has been observed for current solar home systems) and thus could result in little if any reduction in energy user or associated emissions. We believe that for our target market this "take-back effect" will be limited, and virtually non-existent in the case of single-vendor night-market businesses or the poorest households or refugees (which use only one light source and can barely afford the kerosene they use today). More specifically, we believe that the proposed technology will be significantly more successful than conventional solar lighting because:

a. it will provide more effective lighting at lower cost than the alternatives
b. it will be targeted at lower income households which are more likely to take the solar light as a substitute to (rather than augmentation of) existing kerosene, and
c. it will make possible more than one affordable point of light for a given consumer.

It is important to note that, even where substitution is not achieved, the standard of living (in terms of lighting service levels) is increased considerably. These dynamics will be explored carefully in the course of the project's market tests and consumer research.

The ultimate penetration rates, and thus energy and emissions savings, will be also directly linked to the mature market prices of the modern off-grid lighting systems. For the poorest households, particularly low-cost systems will be needed. While this is also the segment most associated with the use of biomass for lighting, it is also the case that even the lower wattage modern off-grid lighting product will give superior and significantly less costly or labour-intensive illumination to that provided by firelight.

Preliminary Estimates of Environmental Benefits

Greenhouse-gas reductions. GHG reductions under the project will arise from the substitutions of non-fossil lighting energy sources for fossil-based ones or for biomass-based lighting.

Our three program scenarios result in the following costs of avoided carbon dioxide emissions, respectively: $1.38/tonne, $2.7/tonne, and $6.9/tonne.

Reduced solid waste production. Based on interviews with Eveready Kenya, and our bottom-up analysis of flashlight utilization (Table ICA-3), we estimate that 260 million dry-cell flashlight batteries are disposed of annually in Ghana and Kenya. The systems we propose will offset this in two ways. Firstly, they will utilize smaller rechargeable batteries (which will last for 1 to 2 years, rather than a few days or a week in the baseline. They will also to some degree substitute for existing lighting using remotely charged car batteries (not included in the aforementioned number), which entails the introduction of battery acid and lead into the environment.

Forest resources. As discussed above, there is a measure of fuelwood use for lighting. To the extent that this project displaces this fuel with improved lighting strategies, reduced impacts on forest resources, erosion, and other well-known benefits of fuel wood conservation will accrue.

Enhanced Productivity and Associated Economic Benefits

The baseline conditions surrounding lighting correlate with severe curtailment of a variety of social needs and unproductive operating conditions for small and medium enterprises. These range from lighting for education to product sales.

The proposed project offers a cluster of social benefits that are rarely encountered with traditional energy efficiency improvements. For example, baseline service levels are normally maintained or marginally improved through energy efficiency projects. In this case, energy service levels will increase by at least ten-fold (and in some cases 100-fold), as measured in terms of illumination levels (e.g. lux, lumens per square meter). This was verified by side-by-side field measurements taken of baseline conditions and LED alternatives during the Project development, as well as prior laboratory measurements of typical kerosene lanterns versus LED light sources (Mills 2005). LED task lighting can even improve on service levels in already electrified contexts.

The following benefits are material—and in fact perhaps the most valuable—impacts of the project, but have not been quantified for the purposes of this Incremental Cost Analysis.

Literacy. There are approximately 18 million school-age children in our target countries (7 million in Ghana and 11 million in Kenya). We have observed baseline lighting services in schools as low as 2% of that specified for reading tasks, and the costs of providing this lighting often limit the number of hours available for study. Formal evening study periods are common for older students in our target countries, and typically one or two kerosene lanterns are provided for 30 or 40 students. Our proposed lighting systems can provide substantially higher levels of illumination at lower cost. We have also identified chalkboard lighting as an appropriate application for the types of systems to be developed by the private sector under this project.

Retail Sales. As discussed in the main body of this proposal, poor lighting is a constraint to both the number of hours that businesses can remain open in the evening and in rate of sales. Upon examining LED prototypes during our Missions, street sellers universally agreed that their sales and profits would increase with the improved lighting. LED systems would also avoid some market closures necessitated today by windy or rainy conditions that make it impossible to use flame-based lighting.

Safety. We have identified several safety-related benefits of the proposed systems. Firstly, they offer nighttime security lighting where it is currently unaffordable or impractical. Secondly, they eliminate an important fire hazard posed by flame-based lighting sources. Refugee camp officials interviewed during our Mission to Kenya pointed to the potential for improved women's safety in refugee camps if affordable and portable lighting was made available.

Health. Poor indoor air quality (IAQ) is a well-known health problem in the developing world. While the primary source of IAQ problems stems from the use of biomass for cooking, kerosene combustion (as well as modest fuel wood combustion for lighting purposes) contributes as well. There are also reports of frequent burns among children due to contact with hot kerosene lanterns and chimneys.

Time. Rural end users can travel long distances to obtain kerosene, batteries, or other necessary lighting products. The Kenyan household survey indicates an average roundtrip of 40km for rural households to obtain fuel. More durable and self-powered solutions will reduce this expenditure of time.

Refinement of these Estimates Using Sub-Project Data

Through its work with prospective local partners, national statistical bodies, and NGOs, IFC is identifying and collecting additional information on the off-grid lighting market. In Project Appraisal, IFC will refine its estimate of Project GHG emissions reductions further.

Table ICA-2. Preliminary Economic and Carbon Dioxide Baseline Analysis: Key Assumptions.

		Ghana			Kenya		
		Rural Households	Urban Households	Non- household	Rural Households	Urban Households	Non- household
ECONOMIC DATA							
Currency		Cedis	Cedis	Cedis	KSh	KSh	KSh
Exchange Rate	local currency/US$	9200	9200	9200	70	70	70
Energy Prices							
Kerosene	price/liter	9,000	7,000	7,000	70	60	55
LPG	price/kg	*15,114*	*15,114*	*15,114*	115	115	115
Candles	price/kg	*22,303*	*22,303*	*22,303*	*170*	*170*	*170*
Biomass	price/kg	212	212		0	0	
Operating costs							
Wicks	cost/year	*12,000*	*12,000*	*12,000*	120	120	*120*
Batteries	cost/battery	1,500	1,500	1,500	40	40	40
Replacement chimneys	cost/chimney-year	3,000	3,000	3,000	100	100	100
Torch lamps	cost/replacement bulb	*2,760*	*2,760*		*21*	*21*	
Mantles	cost per mantle	*4,600*	*4,600*	*4,600*	35	35	35
Pressure lamp service (including mantles)	cost per 1000 hours	*82,128*	*82,128*	*82,128*	625	625	625
DEMOGRAPHIC DATA							
Population (2005)	millions	13,669,404	7,360,449		24,695,601	9,133,989	
Electrification rate	%	17%	77%	*17%*	4%	46%	*4%*
with electricity	millions	2,323,799	5,667,545		987,824	4,201,635	
without electricity	millions	11,345,606	1,692,903		23,707,777	4,932,354	
People/household	number	5.1	5.1		*5.0*	*4.3*	
Total number of customers (est. 2005)	number (HHs; businesses)	2,680,275	1,443,225	3,108,204	4,939,120	2,124,184	5,000,000
of which unelectrified	number (HHs; businesses)	2,224,629	331,942	2,579,809	4,741,555	1,147,059	4,800,000
of which electrified	number (HHs; businesses)	455,647	1,111,283	528,395	197,565	977,124	200,000
Selling shops	number per 1000			*148*			*148*

Table ICA-3a. Preliminary Economic and Carbon Dioxide Baseline Analysis.

		Ghana		
		Rural Households	Urban Households	Non- household
LIGHTING SOURCES AND COST				
Kerosene - tin lantern				
Customers using this fuel for lig	%	82%	22%	*90%*
Utilization	hours/day	*2*	*2*	*2*
Consumption	liters/month	3.0	3.0	3.0
Equipment cost	cost per unit	3000	3000	3000
Cost of Ownership				
Equipment purchase	(millions/year), local currency	13,187	1,905	16,784
Fuel	(millions/year), local currency	712,096	80,012	704,941
Other	(millions/year), local currency	26,374	3,810	33,569
Kerosene - hurricane				
Customers using this fuel for lig	%	82%	22%	*82.0%*
Utilization	hours/day	*2*	*2*	*2*
Consumption	liters/month	2.4	2.4	2.4
Equipment cost	cost per unit	16,000	16,000	16,000
Cost of Ownership				
Equipment purchase	(millions/year), local currency	17,583	2,540	20,390
Fuel	(millions/year), local currency	569,676	64,010	513,823
Other	(millions/year), local currency	32,967	4,763	38,231
Kerosene - pressure lantern				
Customers using this fuel for lig	%	*3.8%*	*3.7%*	*10.0%*
Utilization	hours/day	*5*	*5*	*5*
Consumption	liters/month	15	15	15
Equipment cost	cost per unit	*222,114*	*222,114*	*222,114*
Cost of Ownership				
Equipment purchase	(millions/year), local currency	5,656	2,965	17,259
Fuel	(millions/year), local currency	164,998	67,283	391,634
Other (mantles+service)	(millions/year), local currency	15,266	8,004	46,587
LPG - pressurized lantern				
Customers using this fuel for lig	%	*2.0%*	*2.0%*	*2.0%*
Utilization	hours/day	*5*	*5*	*5*
Consumption	kg/month	11.25	11.25	11.25
Equipment cost	cost per unit	*222,114*	*222,114*	*222,114*
Cost of Ownership				
Equipment purchase	(millions/year), local currency	2,381	1,282	2,762
Fuel	(millions/year), local currency	109,378	58,896	126,841
Other (mantles+service)	(millions/year), local currency	8,035	4,326	9,317
Battery Torch				
Customers using this fuel for lig	%	53%	46%	
Utilization	hours/day	*3*	*3*	
Consumption	batteries/'month	3	4	
Equipment cost	cost per unit	15,000	15,000	
Cost of Ownership				
Equipment purchase	(millions/year), local currency	21,308	9,958	
Batteries	(millions/year), local currency	76,709	47,800	
Other (replacement bulbs)	(millions/year), local currency	286,212	133,759	
Number of batteries	millions of units/year	*51*	*32*	
Candles				
Customers using this fuel for lig	%	*3.5%*	*29.0%*	
Utilization	hours/day	*4*	*4*	
Consumption	kg/year-household	16	16	
	kg/year - national	1,521,801	6,789,573	
Cost of Ownership				
Candles	(millions/year), local currency	33,941	151,428	
Biomass				
Customers using this fuel	%	87.4%	25.6%	
Customers purchasing most or all of fuelwood	%	*17.2%*	*57.6%*	
Customers using this fuel for lighting	%	0.9%	*0.4%*	
Fraction of all biomass for light	%	*1.0%*	*1.0%*	
Annual biomass use	kg/year-household (households using bio	2,110	*2,110*	
National biomass use for lighting	kg	49,424,985	7,795,245	
Cost of Ownership	(millions/year), local currency	13,743	7,255	

Table ICA-3b. Preliminary Economic and Carbon Dioxide Baseline Analysis.

		Kenya		
		Rural Households	Urban Households	Non- household
LIGHTING SOURCES AND COST				
Kerosene - tin lantern				
Customers using this fuel for lig	%	43.9%	14.2%	*90%*
Utilization	hours/day	*2*	*2*	*2*
Consumption	liters/month	3.0	3.0	3.0
Equipment cost	cost per unit	20	20	25
Cost of Ownership				
Equipment purchase	(millions/year), local currency	87	12	225
Fuel	(millions/year), local currency	5,464	652	8,910
Other	(millions/year), local currency	260	36	540
Kerosene - hurricane				
Customers using this fuel for lig	%	66.4%	72.4%	*90%*
Utilization	hours/day	*2*	*2*	*2*
Consumption	liters/month	2.4	2.4	2.4
Equipment cost	cost per unit	450	450	450
Cost of Ownership				
Equipment purchase	(millions/year), local currency	738	346	1,013
Fuel	(millions/year), local currency	6,612	2,658	7,128
Other	(millions/year), local currency	722	338	990
Kerosene - pressure lantern				
Customers using this fuel for lig	%	3.8%	3.7%	*10%*
Utilization	hours/day	*5*	*5*	*5*
Consumption	liters/month	15	15	15
Equipment cost	cost per unit	1,690	1,690	1,690
Cost of Ownership				
Equipment purchase	(millions/year), local currency	79	33	211
Fuel	(millions/year), local currency	2,365	849	4,950
Other (mantles+service)	(millions/year), local currency	214	90	570
LPG - pressurized lantern				
Customers using this fuel for lig	%	*2.0%*	*2.0%*	*2.0%*
Utilization	hours/day	*5*	*5*	*5*
Consumption	kg/month	11.25	11.25	11.25
Equipment cost	cost per unit	*1,690*	*1,690*	*1,690*
Cost of Ownership				
Equipment purchase	(millions/year), local currency	33	14	34
Fuel	(millions/year), local currency	1,534	660	1,553
Other (mantles+service)	(millions/year), local currency	113	48	114
Battery Torch				
Customers using this fuel for lig	%	52.5%	52.0%	
Utilization	hours/day	*3*	*3*	
Consumption	batteries/'month	4	4	
Equipment cost	cost per unit	150	150	
Cost of Ownership				
Equipment purchase	(millions/year), local currency	389	166	
Batteries	(millions/year), local currency	4,979	2,121	
Other (replacement bulbs)	(millions/year), local currency	3,975	1,693	
Number of batteries	millions of units/year	*124*	*53*	
Candles				
Customers using this fuel for lig	%	3.5%	29.0%	
Utilization	hours/day	*4*	*4*	
Consumption	kg/year-household	16	16	
	kg/year - national	2,804,323	9,993,104	
Cost of Ownership				
Candles	(millions/year), local currency	476	1,696	
Biomass				
Customers using this fuel	%	89.0%	7.1%	
Customers purchasing most or all of fuelwood	%	17.2%	57.6%	
Customers using this fuel for lighting	%	3.8%	0.4%	
Fraction of all biomass for light	%	*1.0%*	*1.0%*	
Annual biomass use	kg/year-household (households using bio	3,394	3,394	
National biomass use for lighting	kg	149,194,026	5,118,730	
Cost of Ownership	(millions/year), local currency	316	36	

Table ICA-4. Technical assumptions regarding lighting technologies.

Assumptions: Light Sources	Candles	Tin lamp	Hurricane Lantern	Pressurized Kerosene Lantern	Pressurized LPG Lantern	Torch (flashlight)	White LED
Useful life (years)	2 inches/hour	0.5	2	4	5	1	5
Utilization (hours/day-device)	4	2	2	5	5	3	varies depending on which other technology is replaced
Mantles (hours/mantle)	-	-	-	252	*252*	-	-
Hours per flashlight bulb	-	-	-	-	-	15	-
Fuel Use Rate	0.011	0.05	0.04	0.10	0.075	4	0
	(kg/hour)	(liters/hour)	(liters/hour)	(liters/hour)	(kg/hour)	(batteries/month)	-
Emissions factor	3.10	0.072	0.072	0.072	0.060	0	0
	kg CO2/kg candle wax	kg CO2/MJ	kg CO2/MJ	kg CO2/MJ	kg CO2/MJ	-	-

Fuel use rates from van der Plas (1988), direct measurements, and user-reported values.

Comparative analysis of lighting systems for developing countries. Total cost of illumination services, including first costs and operation. Costs include initial purchase cost, fuel, electricity, wicks, mantles replacement lamps, and batteries. Performance characteristics of light sources var values shown are typical and include dirt depreciation factors for fuel lanterns and standard service depreciation factors for electric light per IESNA. Assumes 4 one hours/day operation over a one-year period in each case, $0.1/kWh electricity price, $0.5/liter fuel price, and equipment cost amortized over three years. Energy prices exclude the effects of subsidy or taxes. Energy prices vary widely, based on presence of subsidy, tax, and markups for remote locations. Fuel choice and utilization varies by income level, household composition, lifestyle, relative fuel prices, and cultural preferences.

	60W Incandescent Lamp (grid-connected)	15W Compact Fluorescent Lamp (grid-connected)	Incandescent 0.74W flashlight (alkaline battery)	6W Compact Fluroescent Lantern (alkaline battery)	Solar-5W Compact Fluorescent Lantern (NiMh battery)	Candles	Simple Kerosene Lamp (wick)	Hurricane Kerosene Lamp (wick)	Pressurized Kerosene Lamp (mantle)	Solar-LED: 1W, no Optics (NiMh battery)	Solar-LED: 1W, with Diffuser (NiMh battery)	Solar-LED: 1W with Focusing Lens (NiMh battery)
Performance												
Rate of energy use	60	15	0.74	6	6	0.011	0.04	0.035	0.10	1.0	1.0	1.0
Units	Watts	Watts	Watts	Watts	Watts	kg/hour	liters/hour	liters/hour	liters/hour	Watts	Watts	Watts
Lamp, wick, mantle, candle service life (hours)	1000	5000	15	3000	3000	1	200	400	235	50000	50000	50000
System service life (years)	0.68	3.42	3	7	7		0.5	2	5	7	7	7
Replacement bulbs, wicks, mantles, candles (number per year)	1.5	0.29	97.3	0.49	0.49	16	7.3	3.7	6.2	0.00	0.00	0.00
Batteries	none	none	2 D Alkaline	4 D Alkaline	1 NiMh	none	none	none	none	3 AA NiMh	3 AA NiMh	3 AA NiMh
Replacement batteries (number per year)	0	0	360	365	0.73	0	0	0	0	2.190	2.190	2.190
Energy services provided												
Light output (lumens--lamp only)	792	873	3.8	131	213	10.0	7.8	40	400	60	60	60
Useful illumination (lux, including optical losses at typical working distance)	111	122	2.4	18	30	1.4	1.1	5.6	56	8	40	600
Efficiency (lumens/Watt)	13	58	5	22	36	0.2	0.02	0.11	0.80	60	60	60
First cost (lamp + fixture)	5	10	5	15	100	0.00	0.5	5	25	25	25	25
Annual Energy Consumption												
Electricity from grid (kWh)	88	22	0	0	0	0	0	0	0	0	0	0
Kerosene (liters)	0	0	0	0	0	0	58	51	148	0	0	0
Annual Operating Costs												
Energy	$ 8.76	$ 2.19	$ -	$ -	$ -	$ -	$ 58.40	$ 51.10	$ 148.43	$ -	$ -	$ -
Replacement batteries, wicks, mantles, candles	$ -	$ -	$ 180.07	$ 182.50	$ 25.55	$ 39.33	$ 1.62	$ 3.65	$ 3.11	$ 2.19	$ 2.19	$ 2.19
Replacement bulbs or chimneys; service	$ 0.44	$ 1.17	$ 29.20	$ 1.95	$ 3.89	$ -	$ -	$ 1.43	$ 14.46	$ -	$ -	$ -
Total	$ 9.20	$ 3.36	$ 209.27	$ 184.45	$ 29.44	$ 39.33	$ 60.02	$ 56.18	$ 166.00	$ 2.19	$ 2.19	$ 2.19
Operating cost per unit of service (1st cost amortized over three years)												
Cost of light ($/1000-lumen hours)	$ 0.01	$ 0.00	$ 37.72	$ 0.96	$ 0.09	$ 2.69	$ 5.27	$ 0.96	$ 0.28	$ 0.03	$ 0.03	$ 0.03
Cost of illumination ($/1000 lux-hours)	$ 0.08	$ 0.02	$ 59.25	$ 6.89	$ 0.68	$ 19.24	$ 37.65	$ 6.87	$ 2.03	$ 0.19	$ 0.04	$ 0.003
Operating cost per unit of service												
Light production ($/1000-lumen hours)	$ 0.008	$ 0.003	$ 37.72	$ 0.96	$ 0.09	$ 2.69	$ 5.27	$ 0.96	$ 0.284	$ 0.025	$ 0.025	$ 0.025
Index: CFL (grid) = 1.00	3	1	14,317	366	36	1,022	2001	365	108	9	9	9
Illuminance ($/1000 lux-hours)	$ 0.08	$ 0.02	$ 59.25	$ 6.89	$ 0.68	$ 19.24	$ 37.65	$ 6.87	$ 2.03	$ 0.19	$ 0.04	$ 0.003
Index: CFL (grid) = 1.00	3	1	3,148	366	36	1,022	2001	365	108	10.0	2.0	0.1
Total cost per unit of service (1st cost amortized over three years)												
Cost of light ($/1000-lumen hours)	$ 0.01	$ 0.005	$ 38.02	$ 0.99	$ 0.20	$ 2.69	$ 5.29	$ 0.99	$ 0.30	$ 0.12	$ 0.12	$ 0.12
Cost of illumination ($/1000 lux-hours)	$ 0.07	$ 0.04	$ 59.72	$ 7.08	$ 1.44	$ 19.24	$ 37.75	$ 7.08	$ 2.13	$ 0.90	$ 0.18	$ 0.01
Index: CFL (grid) = 1.00	1.8	1.0	1,593	189	38	513	1,007	189	57	24.0	4.8	0.3
1W LED (with optics) pack time,(years)	2.9	not applicable (lower 1st and operating cost)	0.1	0.1	0	0.7	0.4	0.4	-			
Total cost of ownership ($/year)												
Equipment Cost ($/year)	7.3	2.9	1.7	2.1	14.3	-	1.0	2.5	5.0	3.6	3.6	3.6
Operating Cost ($/year)	9.20	3.36	209.27	184.45	29.44	39.33	60.02	56.18	166.00	2.19	2.19	2.19
Total ($/year)	16.50	6.26	210.93	186.59	43.73	39.33	61.02	58.68	171.00	5.76	5.76	5.76
Carbon Dioxide Emissions per year (kg)	96	24	0	0	0	50	154	134	391	0	0	0

Annex B: Logical Framework Matrix

Objectives	Performance Indicators	Data Sources	Assumptions
Goal: **To reduce CO2 emissions by displacing fossil fuel lighting in rural in Ghana and Kenya** The project will be establishing a platform within which manufacturers of LED lights and other modern lighting technologies shall meet to develop innovative products and distribution channels to meet the needs of the *non-electrified* populations in the above countries. The project will work with the private sector to identify barriers to the market's development, and address barriers by doing things that the industry cannot do itself (eg, provide credible, unbiased consumer information, or certify high quality products). A related goal to improve the quality of life of the *non-electrified* population through the use of lower polluting and lower cost/higher quality lighting systems.	Impact ▪ Tons of GHG avoided by displacing fuel-based lighting using LED or other electric lighting options by program end ▪ Target: reduction of 782,000 to 3.9 million tonnes over a 10-year period	• Program records • Interviews of wholesale suppliers, retailers, and manufacturers to estimate unit sales • Technical estimate of number of fossil fuel burning lamps displaced	• Increased use of LEDs would reduce overall CO2 emissions • End user adoption of LEDs beyond immediate program participants • LED products can be produced at an acceptable price point for the target market, or acceptable finance options enable access to the technology
Purpose: To accelerate the development of the African market for high quality lighting products by lowering barriers to product development, market entry, consumer acceptance, consumer access, affordability	Outcome/Impact	• Participating manufacturers • Program records • Local consultant or academic expert opinion • Stake-holder surveys or other data indicating changes attributable to our work • Consumer surveys capturing attitudes about modern lighting products and consumer habits • Market study, including retail product survey	• End users see the LED units as superior to the fuel based alternatives and move to new product • Manufacturers willing to develop acceptable products for the market and invest in distribution • Product development and manufacture successfully produces reliable and affordable product • End users would be willing to make investments once barriers are reduced.

Objectives	Performance Indicators	Data Sources	Assumptions
Component Objective 1: To lower supplier barriers to market entry. (Work with private sector firms to address constraints to entering the market. This includes identifying end-user characteristics, features of off-grid lighting systems and appropriate distribution, sales, and marketing and service channels.)	Outcome • At least 6 of manufacturers entering market in relevant countries (increase) by yr 4 • At least 12 of alternative products available in the market by yr 4 • # of foreign firms applying for operating licenses to enter the lighting market by year 2 & 4	• Program records • Surveys of market participants to identify new actors or deployment of new technology • Product surveys to determine availability, price, performance • Program records on participation costs in events (e.g. industry meetings) that companies attended. • Survey with market participants to determine estimated spending on the project	• Firms will enter the market once informational barriers are overcome • Firms will invest in product development and distribution and marketing • Project market research and field tests will accurately represent market needs and consumer preferences • Willingness of distributors to accept new product lines
Component Objective 2: To lower barriers to end-user demand (To do this, the project will stimulate introduction of lower price point products, increase sales volumes through market aggregation instruments thus reducing unit costs, stimulate competitive price pressures, mobilize consumer and retailer financing where necessary, establish product certification mechanisms to protect against market-spoiling, and provide end-user education)	Outcome • At least 386,000 LED and/or other non-fuel units purchased over 10 years. • The target by the end of the project is a 4% market penetration of LEDs and other modern lighting products (772,000) and reduction in GHG emissions of 1,564 million tones. • An intermediate target for the Project is to reach 1% market penetration of modern lighting products (or 193,000), and reductions of 391,000 million tones in GHG emissions from fuel-based lighting by the end of 2nd year of the project. • # of people with access to LED/ other lighting sources. At least 1.9 million people (assumes one lamp benefits 5 people)	• Program records • Secondary sources reporting on market trends • Market surveys at retail level. • Consumer surveys. • Sales data from manufacturers and distributors and retailers.	• Customer demand for lighting products is very high • Prices will be low enough to enable the customer switch to higher quality lights • Fossil fuel alternative does not become heavily subsidized • Product will be of high quality in terms of durability & brightness than existing product • "Hire-purchase" concept will work for a consumer good where people have low cash incomes, if consumer finance is required

Objectives	Performance Indicators	Data Sources	Assumptions
Component Objective 3: Ensure long-term sustainability of the market by establishing a thriving commercial market for modern lighting; includes capacity building within the market to design, produce, supply and service high quality and affordable products.	Outcome • # of companies finding market profitable in yr 4: Target 50% of existing firms • % of firms interested in staying in the market for next 3 years: Target 50% • % of local distributors of lighting equipment	• Program Records • Secondary Sources • Market assessment, including survey of product availability in market and survey of trade allies • Survey with participating companies	• Same as above.
Component 1 Output	• # of companies signed-up to participate in the Project by end of year 2: Target 25 • # of background market assessment provided to industry by end of yr 1; Target 2 • Results report on field tests –technology requirements of mrkt/ product features • Map of distribution channels by end of yr 1, Target 1 • # of firms provided T/A on the ground. Target: At least 5 international companies and 10 local companies – matchmaking. • # of meetings with key stakeholders, policymakers and Program Advisory Committee (indicates buy-in) in the first 3 yr: Target; 8	• Program Records	• Private sector funds, donor & IFC/ staff & resources will be adequate to get these outputs, and market conditions
Component 2 Output	• # of consumers reached through education campaigns Target – at least 250,000 in yr 4 • 1000 consumers participate in field test total, including participation in each target market in first yr.	• Program Records • Consumer survey	• See above

Objectives	Performance Indicators	Data Sources	Assumptions
Component 3 Output	• # of meetings/ consultations with key stakeholders by end of yr 2; Target: at least 4	• Program Records	• See above
Component 1 Input/Activities	• Field test/ research , interviews, business model advisory to international co.s – at least 10 co.s supported • Mapping distribution channels • Provide comprehensive market info support re: 1. consumer product preferences, 2.distribution channels	• Program Records • Industry survey & trade ally interviews • Market studies	• Resources are available from GEF/IFC & others • International and local companies interested • Companies provide a diverse range of product types for field tests
Component 2 Input/Activities	• Customer education campaigns • Develop consumer finance, if needed • Field test of at least 3 product configurations executed in at least 1000 homes – to determine consumer needs.	• Same as above	• End-users willing to participate in field tests. • End-users participate in focus groups and surveys
Component 3 Input/Activities	• Support for local distributors, including, as necessary sales, finance • Build political constituency to support LED and other modern lighting products substitution for fuel – education, policy advocacy. (Organizing consultations, meetings)	• Same as above.	• Policy environment which is welcoming to new technology solutions • Opposition from fuel-based businesses can be overcome thru new opportunities and education

Annex C: Photos From Target Markets

(Sent separately as pdf file)

Annex D: List of Meetings in Africa During Project Preparation

1	APEX Association of Rural Banks	31	Kenital	61	Tanzania Solar Energy Association (TASEA)
2	Associated Battery Manufacturers, ABM (East Africa) Limited	32	Kenya Investment Promotion Authority	62	Tanzania Traditional Energy Development and Environment Organization
3	Bright Home Solar Energy	33	Kenya Ministry of Trade and Industry	63	Technical Systems Ltd
4	Celtel	34	Kenya Private Sector Alliance	64	Technoserve, Ghana
5	Center for Environment and Renewable Energy Studies (CERES)	35	Kenya Renewable Energy Association	65	The Poly Group (distributors for LG)
6	Chloride Exide	36	Kenya Solar Energy Association (Solarnet)	66	Tunakopesha Limited
7	Coca Cola Kenya	37	Kenya Solar Technicians Association	67	Umeme Jua Ltd.
8	Coca Cola Africa	38	Kickstart	68	Unilever Tea East Africa
9	Dar Es Salaam Scientific Limited	39	K-Rep Bank	69	United Nations Development Programme
10	DENG Limited	40	Kumasi Institute of Technology and Environment	70	United Nations High Commissioner for Refugees
11	Department for International Development (DFID)	41	Kwame Nkrumah University of Science and Technology	71	USAID Ghana
12	Department of Health, Tanzania	42	Mabati Rolling Mills, Ltd.	72	White Sands Hotel & Resort
13	Dizengoff Ghana Ltd	43	Millennium Challenge Corporation	73	Wilkins Engineering
14	ENEA Electronic Arts	44	Moi University, Dept of Physics	74	Wise Energy Ltd
15	Energy for Sustainable Development (ESD)	45	National Bureau of Statistics	75	Association of Ghanaian Industries
16	ETC Foundation	46	OneTouch, Ghana Telecom	76	Solapak Kenya
17	Eveready East Africa, Ltd.	47	Practical Action (formerly ITDG)	77	AC Nielsen
18	FREDEKA	48	Rural Agenda Initiative & Network (RAIN)	78	Ghana Standards Board
19	Frigoken LTD	49	Safaricom	79	Kenya Standards Board
20	Ghana Co-Operative Credit Unions Association (CUA) Ltd.	50	Sangyug Enterprises LTD	80	Sollatek
21	Ghana Energy Foundation	51	Small Industrial Development Organization (SIDO)	81	Research International
22	Ghana Microfinance Institutions Network (GHAMFIN)	52	Solar Light Co.	82	Strategic Business Options
23	Ghana Ministry of Energy	53	Sollatek	83	Steadman-Group
24	Ghana Ministry of Environment & Science	54	Sollatek Ghana Ltd	84	Adopt-a-Light
25	Global Environment Facility Small Grants Programme	55	Solux Lantern	85	Goldfields Ghana Limited
26	Gulf Africa Petroleum Corporation (GAPCO)	56	Suntopway Solar (Uganda) Ltd	86	Phillips Lighting (Local Agent)
27	Honeycare	57	Support Programme for Enterprise Empowerment and Development (SPEED)		
28	Council for Scientific and Industrial Research	58	Sustainable Energy & Environment Enterprises Company (SEEECo)		
29	Integral Advisory Limited	59	Tanganyika Christain Refugee Service		
30	Japan International Cooperation Agency (JICA)	60	Tanzania Brewing Company		

Annex E: Market Assessment

This annex describes an indicative work plan and methodology for the market assessment. IFC will seek professional support to this task. The elements below will be adjusted and refined as appropriate following the retention of a professional services company to undertake this task.

Defining the Segments to Be Assessed - Based on the IFC team's field visits, and consultations with stakeholders and the lighting industry, the market assessment will focus on a range of segments. The first phase will encompass two segments, namely households and micro-businesses (night vendors, kiosks, etc). Additional segments will be pursued on opportunities identified by IFC, stakeholders and/or industry.

General Actions - The market assessment is expected to entail the following key components:

Phase 1 : Preparation and Fine-Tuning of Market Research

a) **Review of existing market and segment data:** As part of its project planning and design effort, IFC has collected significant market information. In addition to that, the market research company to be selected is expected to also own significant market data to provide the Project with an overview of the market, and the target segments;

b) Pilot Assessment of Small Sample of Households and Microbusinesses: A limited scale engagement with a sample of households and microbusinesses will take place to test and help refine the market research approach. Issues to be addressed will include, but be not limited to: (i) typical applications of off-grid lighting, (ii) characteristics of such application (hours per day, general or task illumination purposes, costs and general economics of lighting use), and (iii) required design features in off-grid lighting products (level and quality of light, durability, etc);

c) Procurement of Products: Based on the applications and parameters of use identified per the analysis of the small sample, IFC will procure products from the industry. For each application IFC may procure 2-4 products to create variety in the features. For instance, if households (i) define that the use of light for movement, such as a flashlight or torch, is a main application, (ii) indicate that they require 1-2 hours of use each evening, (iii) note that they prefer a product with light weight and designed so that children can also use it, and (iv) require products to be durable enough to cope with extensive outside use, IFC will use those and other end-user inputs to define the parameters of products to be procured. Further, IFC may chose a product that is PV-charged, one is that manually powered, and another that use rechargeable or disposable batteries to assess customer reactions to different nuances in the products.

Phase 2 : Scaling-Up

d) **Large-scale assessment of target segments**: Based on the findings of item b and with the products procured in item c, the research will undertake qualitative and quantitative surveys with a larger sample of households. For each segment, it is anticipated that 200-400 individuals be interviewed in each country. In addition, selection of individuals will aim to reflect overall economic, social and demographic conditions of the country (e.g. percent of rural end-users vs. urban end-users, distribution per region, etc)

   a. End-user behavior: this will encompass questions on use of light, economics, hours per day, decision-makers, behavioral issues, preferred points of sale for lighting, among other issues. This will provide key inputs on the purchase decision process and end-user needs.

b. End-user design and service preferences: end-users will, under a structured format, be given the products procured in item c for 1-3 weeks, and be interviewed individually and/or in groups to their reactions, preference features, missing features, strengths and weaknesses of different products, etc. This will provide key inputs on the design and features of the products to make them competitive against fuel-based lighting.

Phase 3 : Documentation of findings

e) **The market research will be vehicle for industry to understand end-user and market:** Throughout the phases noted above, the selected market research companies will document findings, with video, audio and reports with data collected, analysis and findings. This market material will then be available to the industry and stakeholders.

The effort is expected to last 6-8 months after the selection of the market research company. Below is an indicative field test protocol that aims to provide a guideline for the market research. This will be revised by the selected market research company.

Indicative Field Test Protocol

The following narrative is an example of how a field test would be conducted for retail vendor or residential lighting applications. If field tests are conducted in temporary shelters another similar protocol will be developed prior to the RFP. In this narrative the products for testing are referred to as "LED lights," but they could be any modern, efficient technology, such as compact fluorescent lamps.

Goal
To observe, describe and record situations in which fuel-based lighting (diesel, kerosene, oil or paraffin) could potentially be replaced by solid-state lighting that uses light emitting diodes (LEDs). This is not meant to be a statistically representative sample of any data, rather, it is an initial survey of the lighting conditions presently found in two situations: 1) vendors or retail shops in market settings; 2) residences.

Strategy
Gather information that will enable the team to describe both qualitatively and quantitatively the most common luminous (direct view of the light source) and illumination (reflected light) applications. Summarize the observed and expressed needs of the local users. The team will use this information to suggest several promising applications and to begin to develop performance specifications for generic types of LED lighting systems. The team will also use any data on numbers of light sources and volumes of fuels to attempt to estimate the energy, financial and environmental benefits of introducing LED lighting systems.

Objectives
Identify technologies presently in use. Conduct visual audits of numbers and types of light sources, and volume and price of fuels. Establish baseline illuminance for common tasks. If possible, demonstrate, compare and simply evaluate the performance of a few LED lighting devices.

Equipment and Materials
- Video camera.
- Digital camera (with "night photos" option).
- Digital audio recorder (optional).
- Illuminance meter.

- Black tube for converting the illuminance meter to a luminance meter (optional). Sketchpad or notebook.
- Graph paper or templates.
- Pens and pencils.
- 2-meter "string."
- Tape measure.
- Meter-square black, opaque cloth, marked off in a grid of 0.2-meter increments.
- Dark clothing for the person who uses the illuminance meter.

Documentation

The observer should conduct the following tasks while the other team member conducts an interview with the site host, and records this person's name and mailing and email addresses. Repeatedly reassure the host and the occupants that you are just curious about the lighting in their space… *do not make any evaluative statements about the lighting situation*. It's not "good," or "bad," it's "interesting." You are only observing the present situation so that you can discuss it with your colleagues and describe it to manufacturers. If you make evaluative statements, you could easily skew the comments of the occupants[9].

First,

- Record date, time of day, location and type of building.
- Photograph or videotape the general situation, and then photograph people at their tasks, if possible. Otherwise, photograph the light sources in the positions in which they are normally used. This can be done at any hour, and will probably provide the most useful information if done during the day or just at twilight as lights are being introduced. (See note regarding permissions[10].)
- Note any supports, hangars, fasteners, stands or other means of attaching or holding light sources. If there is a on-site power generation system (diesel generator, PV panels, etc.) also note the type of inverters, transformers, and the current (AC or DC), volts and amps provided by the supply, as well as any cables, connectors, outlets, or other infrastructure.
- Describe the type(s) and count and record the number of light sources per a reasonable unit of space. For example, count how many light bulbs are on a string over each shop stall in the market, or how many lanterns are in each room of a multifamily lodging.
- Estimate the volume of fuel for each light source, or the capacity of the power supply (liters of diesel or oil, or size, type, number and output of solar panels).

Next…

- Minimize your interaction with people until this general documentation is complete.

[9] Unfortunately, many people hold beliefs about lighting that are false. Many do not understand how remarkably adaptable our eyes can be… or know that as our eyes age we need more light in order to see fine threshold tasks, like reading. Also, some people believe that low light levels can "ruin" vision… but this is not usually the case at all; more often people need corrective lenses, or they suffer from diseases or poor nutrition that damaged their visual systems. It's likely that the team will hear some of these beliefs expressed but it's best just to listen, and not to agree or disagree unless you are confident that you have scientific basis to do so.

[10] PHOTOGRAPHY CAUTION: ***Always ask permission*** before photographing anyone, especially women and children. It is common practice for photographers to also ask permission to reproduce or show these images later; if possible, obtain a simple written consent. In return, it is also common to offer to send a set of prints to the people you photographed. Or, in some cases it is appropriate to pay, or make a donation to the organization. Most intellectual property laws establish that an individual has the rights to their own image unless they explicitly grant permission or a license to the photographer. In some cultures, "taking" a picture is thought to take something intangible away from the person, or to intrude upon their private being or their social status.

- Observe and describe people's common activities conducted in and around building, preferably during dark hours, or at least in interior spaces without abundant daylight. Try to take representative photos.
- Note the age of the people. How far are each person's eyes from the task that they are trying to do? For example, if children are studying, are they looking at a blackboard 5 meters distant, or, are they holding a book close to their face?

Finally, if the situation is amenable, try to measure some baseline illuminances. (This is a great way to have people onsite participate.) One team member should record data points and comments while the other team member positions and uses the cloth, string and illuminance meter. It's slow and difficult to do both the measurement and recording alone!

Set-up and Protocol for Measurements
Generally, we are trying to establish a quantitative baseline for both vertical and horizontal illuminance in the geometric planes that are most critical for task performance. Also, if time permits, it will be useful to have a few measurements of the illuminance on walls, at eye level of the typical room occupant, and perhaps on ceilings (if the team becomes very ambitious!).

[We have prepared a template for recording measurements, but you could also make your own. Just use whatever is most consistent and efficient for the team.]

Choose the plane that seems most task-critical.

For horizontal illuminance,

- The lintel or steps to the doorway if this is where a lamp is typically positioned.
- A bench or table where food is prepared or items are assembled or sorted.
- A desk or other writing surface used by the teacher and students in a classroom.
- The treatment tables in a medical center.
- A footstool or block or bench on the floor where someone may be reading or eating.
-

For vertical illuminance,

- Items on shelves, such as medicines, books, tools or other small objects that must be differentiated by the user.
- Blackboards or notice boards (perhaps where lists of patients are posted in a clinic).
- Locations where it is important to recognize facial features, such as at the entrance to a room, the "bargaining spot" in a retail stall, seated for an interview or examination in a clinic, and at eyelevel during social interactions, like eating communally.

Measurement Methods
The basic tools are the string, the tape measure, the square meter cloth and the illuminance meter. The observer should wear a long-sleeve black shirt to avoid reflecting light onto the illuminance meter's sensor.

Start by making a rough sketch of the geometry of the space, indicating the sizes and 3-D positions of the light sources; include any windows or doorways.

Using the string or tape, note the distance from the light source to the surface that you are going to measure. Also note the distance from the light source to the position of the person(s) who would be conducting tasks. Indicate which direction the person(s) usually face.

Illuminance

For horizontal illuminance, we want to determine the distribution of light across the surface that is most critical for the tasks.

- If the room is large or there are distinct task areas within the room and the illuminance distribution appears to vary significantly, select several areas to measure.
- The entire task surface need not be measured if the light source is positioned symmetrically with respect to the surface. In this case, those points within a quarter or half of the critical surface area should be measured.
- If there's enough room on the surface, it's best to lay out the entire cloth to avoid light spilling into the area being measured, rather than folding the cloth in half or quarters.
- Take a photograph of the set-up, preferably with a person in the typical task orientation. For the photo, lay the white tape measure across the surface.
- Remove the tape measure. Position the sensor head on each point. (The data reader should take care to step out of the path of the light!) Pull your hand away and wait 15 seconds before noting the illuminance data, calling it out for the other team member to record. Repeat this procedure for each data point on the cloth.

For vertical illuminance, we usually only need a few points along a line that is at eye-level. However, if people use the space both for tasks conducted while sitting level and while standing, measure along a line at each height.

- Have the participants hold the cloth against a wall, or suspended in a position where tasks are conducted.
- Adjust the height of the cloth until an interior row of points is at the appropriate height.
- The data observer must take care to avoid casting any shadows. Note the illuminance data for each point by calling it out to the recorder.

If time permits, and it is possible to place one or more of the sample LED lights in a position that would give a reasonably similar (or greater) illuminance than the typical set-up with fuel lighting, then the team could conduct two experiments.

First, try to create the same illuminance and illuminance distribution on the surface that you have measured. Sketch the set-up and then measure the distance at which you must position the LED light(s) to achieve this minimum illuminance.

Second, reposition the LED lights until you achieve the following illuminances, if possible. Sketch the set-up and then measure the distance at which you must position the LED light(s) to achieve this recommended illuminance[11].

Area & Task	**Horizontal Illuminance**	**Vertical Illuminance**
Classroom, general	300 lux	
Classroom, desk, pencil	300 lux	
Classroom, desk, printed	300 to 500 lux	
Classroom, blackboard		500 lux
Classroom, whiteboard		50 lux
Library book stacks		500 lux

[11] Recommended illuminances from the IESNA Lighting Handbook, 9th Edition, published by Illuminating Engineering Society of North America, 2000. Mark S. Rea, ed.

Computer station	100 to 300 lux	30 lux
Healthcare, surgery, exam and labor rooms	3000 to 10,000 lux	300 to 500 lux
Healthcare, waiting areas	100 lux	30 lux
House of worship	100 lux	30 lux
Retail	500 lux	100 lux
Residence, kitchen	300 lux	50 lux
Residence, dining	50 lux	50 lux

* Conversion: 10 lux = 1 footcandle.

Luminance

If the illuminance meter can be adapted with a black tube to approximate a 2-degree cone of view, then it could be used for rough measurements of *luminance* ("brightness" of the light source) and *luminance contrast* (difference in brightness between the light source and its immediate surroundings).

Point the meter as accurately as possible at the center of the light source. Hold steady for 15 seconds and then take a reading. Cover the meter head for a few seconds, and then point it at the adjacent area, but NOT at the light source. Again, hold steady for 15 seconds and then take a reading. Later we can calculate the *luminance contrast ratio*. Generally, the higher the ratio, the more likely it is that viewers will experience *glare*, or even *discomfort glare* (they need to blink, or they involuntarily turn their eyes away from the light source). For example, do not shine the LED lights into anyone's face! This will cause discomfort glare and could bias any comments the person may have about the LEDs.

Annex F: List of Companies that Signed Up to Participate in the Project to date

	Country	Company	Primary Activity
1	United States	YEBY Associates	Private enterprise w/ interest in lighting/energy
2	United States	Tetra Tech	Private enterprise w/ interest in lighting/energy
3	United States	Strategies Unlimited	Private enterprise w/ interest in lighting/energy
4	United States	ON Semiconductor	Private enterprise w/ interest in lighting/energy
5	United States	Kennedy & Violich Architecture	Private enterprise w/ interest in lighting/energy
6	United States	Bell Labs, Alcatel-Lucent	Private enterprise w/ interest in lighting/energy
7	United Kingdom	Jeffcott Associates	Private enterprise w/ interest in lighting/energy
8	United Kingdom	DIY Solar	Private enterprise w/ interest in lighting/energy
9	Sweden	Borg & Co	Private enterprise w/ interest in lighting/energy
10	Kenya	Energy for Sustainable Development Africa *	Private enterprise w/ interest in lighting/energy
11	Italy	Agriconsulting S.p.A.	Private enterprise w/ interest in lighting/energy
12	Haiti	toutadesign	Private enterprise w/ interest in lighting/energy
13	Finland	Motiva Oy	Private enterprise w/ interest in lighting/energy
14	United States	Yokohama Electron Co., Ltd	LED Manufacturer
15	United States	SLUSA	LED Manufacturer
16	United States	ORAMIC LLC	LED Manufacturer
17	United States	next generation lighting	LED Manufacturer
18	United States	Lighting Technologies	LED Manufacturer
19	United Kingdom	advanced leds ltd	LED Manufacturer
20	South Korea	SeoulSemiconductor.co.,Ltd. (Korean company but looking for sales manager in India)	LED Manufacturer
21	Slovak Republic	ALCOM Ltd.	LED Manufacturer
22	Madagascar	BushProof	LED Manufacturer
23	Ireland	SOLAS	LED Manufacturer
24	India	Binay Opto Electronics Pvt. Ltd.	LED Manufacturer
25	India	Alternate Lighting	LED Manufacturer
26	Hong Kong SAR	SuperNova Optoelectronics Corp.	LED Manufacturer
27	Germany	DigitaLicht AG	LED Manufacturer
28	China	XIamen Hualian Electronics Company	LED Manufacturer
29	China	Tekcore.Co.Ltd.	LED Manufacturer
30	China	LEDTECH	LED Manufacturer
31	China	Edison Opto Corporation	LED Manufacturer
32	China	Advanced Optoelectronic Technology Inc.	LED Manufacturer
33	Canada	Quantum5x Systems Inc.	LED Manufacturer
34	United States	SEU LTD	LED Distributor/Marketer
35	United States	PROFESSIONAL ALMSP, INC	LED Distributor/Marketer
36	United States	Pfizer	LED Distributor/Marketer

	Country	Company	Primary Activity
37	United States	Nebula Lighting Ststems	LED Distributor/Marketer
38	United States	Magnitude Electronics, Llc	LED Distributor/Marketer
39	United States	Enertech Solutions, Inc	LED Distributor/Marketer
40	United States	DBLD	LED Distributor/Marketer
41	United States	Chestnut Biosensors	LED Distributor/Marketer
42	United States	Chandar Systems	LED Distributor/Marketer
43	United States	Arrow Electronics	LED Distributor/Marketer
44	United Kingdom	SUSTAIN IT Ltd	LED Distributor/Marketer
45	United Kingdom	ecoledlighting ltd	LED Distributor/Marketer
46	United Kingdom	Constellation Lighting UK Limited	LED Distributor/Marketer
47	Kenya	SOLAR WORLD EA LTD	LED Distributor/Marketer
48	Kenya	FREEPLAY MARKET DEVELOPMENT LTD	LED Distributor/Marketer
49	India	Virtual Renewables	LED Distributor/Marketer
50	India	Singlewatts Solar Energy P Limited	LED Distributor/Marketer
51	India	Litetronics India	LED Distributor/Marketer
52	India	ANKURAN	LED Distributor/Marketer
53	Hungary	ples zrt	LED Distributor/Marketer
54	Ghana	Deng Limited	LED Distributor/Marketer
55	Germany	Osram	LED Distributor/Marketer
56	Canada	Philips *	LED Distributor/Marketer
57	Canada	Glenergy Inc.	LED Distributor/Marketer
58	Canada	ET ILLUMINATION INC.	LED Distributor/Marketer
59	Canada	Afro Light	LED Distributor/Marketer
60	Australia	Worksafety Solutions	LED Distributor/Marketer
61	Australia	Barefoot Power	LED Distributor/Marketer
62	Argentina	M&A SRL	LED Distributor/Marketer
63	United States	PolyBrite International, Inc.	LED Assembler
64	United States	Litecontrol	LED Assembler
65	United States	Lamina Ceramics	LED Assembler
66	United States	GLobal Energy and Light Corp	LED Assembler
67	United Kingdom	Vos Solutions ltd	LED Assembler
68	United Kingdom	GreenLed Light Limited	LED Assembler
69	United Kingdom	G24 Innovations	LED Assembler
70	The Netherlands	Led-Vision	LED Assembler
71	South Africa	CADCOM KENAKO	LED Assembler
72	Singapore	Solarviz	LED Assembler
73	Kenya	Solarelectro Co. Ltd Kenya	LED Assembler
74	Kenya	Solapak LTD.*	LED Assembler
75	Kenya	PEMAGI ENERGY LTD	LED Assembler

	Country	Company	Primary Activity
76	India	Solid State Lights	LED Assembler
77	India	MIC Electronics Ltd	LED Assembler
78	India	InnovLite	LED Assembler
79	India	Global Enterprises	LED Assembler
80	India	Globaal Elex.	LED Assembler
81	India	Avinaash Enterprises	LED Assembler
82	Ghana	SPRINGS SYSTEMS LIMTED	LED Assembler
83	Ghana	F. MALAWI ENGINEERING COMPANY LIMITED	LED Assembler
84	Canada	SGi Lighting	LED Assembler
85	Canada	Carmanah Technologies Corporation	LED Assembler
86	Australia	Gee-Tek P/L	LED Assembler
87	United States	TCC Systems, LLC	Distributor/Marketer to Rural Areas
88	United States	SunNight Solar	Distributor/Marketer to Rural Areas
89	United States	Envirofit International	Distributor/Marketer to Rural Areas
90	United States	d.light	Distributor/Marketer to Rural Areas
91	United States	Creative Systems International	Distributor/Marketer to Rural Areas
92	United States	Blackwater	Distributor/Marketer to Rural Areas
93	United Kingdom	SC Johnson	Distributor/Marketer to Rural Areas
94	United Kingdom	Nkagx Strategy Ltd	Distributor/Marketer to Rural Areas
95	The Netherlands	Free Energy Europe SA	Distributor/Marketer to Rural Areas
96	Tanzania	Secure Systems	Distributor/Marketer to Rural Areas
97	Sudan	Magzoub for electrical,solar power and electronics	Distributor/Marketer to Rural Areas
98	South Africa	Freeplay Energy plc	Distributor/Marketer to Rural Areas
99	South Africa	CBI	Distributor/Marketer to Rural Areas
100	Singapore	DRS TECHNOLOIES PTE LTD.,	Distributor/Marketer to Rural Areas
101	Kenya	THIKA EDUCATIONAL SERVICES	Distributor/Marketer to Rural Areas
102	Kenya	Solar World EA Ltd	Distributor/Marketer to Rural Areas
103	Kenya	DAVIS & SHIRTLIFF LTD.	Distributor/Marketer to Rural Areas
104	Ghana	Virtue Engineering Services ltd.	Distributor/Marketer to Rural Areas
105	Ghana	Rural Energy & Environment Systems	Distributor/Marketer to Rural Areas
106	Australia	Ultralite	Distributor/Marketer to Rural Areas
107	United States	Star Funding	Entrepreneur
108	United States	Savanna Pride, LLC	Entrepreneur
109	United States	Process Systems	Entrepreneur
110	United States	Planetwize Media	Entrepreneur
111	United States	Panalytics	Entrepreneur
112	United States	Pacific Alchemy, Inc.	Entrepreneur
113	United States	Occidental International Limited	Entrepreneur
114	United States	NYU Stern School of Business	Entrepreneur

	Country	Company	Primary Activity
115	United States	Meridian Design	Entrepreneur
116	United States	Maui Product Development	Entrepreneur
117	United States	Light Stuff	Entrepreneur
118	United States	JOFKA DEVELOPMENT	Entrepreneur
119	United States	GeoPraxis	Entrepreneur
120	United States	CoolSpell, LLC	Entrepreneur
121	United Kingdom	Student	Entrepreneur
122	United Kingdom	L3 Lighting Ltd	Entrepreneur
123	United Kingdom	GYA	Entrepreneur
124	South Africa	Individual	Entrepreneur
125	Peru	Quantum Solutions	Entrepreneur
126	Kenya	Techbiz Ltd	Entrepreneur
127	Kenya	Practical Action *	Entrepreneur
128	India	MYRRA Ventures	Entrepreneur
129	India	greenfive power pvt ltd	Entrepreneur
130	India	bohra electronics	Entrepreneur
131	Hong Kong SAR	Valence Semiconductor	Entrepreneur
132	Ghana	wilkins engineering	Entrepreneur
133	Ghana	hardcore concretes	Entrepreneur
134	Ghana	Global Sustainable Energy Services(Ghana) Ltd	Entrepreneur
135	Canada	Iza-Sar Inc.	Entrepreneur
136	United Kingdom	CARE Enterprise Partners	Investor
137	The Netherlands	Crescat Consult	Investor
138	Nigeria	industrial development communications limited	Investor
139	Kenya	Pipal Limited	Investor
140	Kenya	Bridgeworks Africa Limited	Investor
141	Kenya	Acumen Fund	Investor
142	Indonesia	Oracle Capital Holding	Investor

Annex G List of Stakeholders that Signed Up to Participate in the Project

	Country	Company	Primary Activity
1	United States	SEEDS	Donor/Foundation
2	United States	PRIVATE DONER	Donor/Foundation
3	United States	HMGI LLC	Donor/Foundation
4	United States	Development Marketplace	Donor/Foundation
5	United States	Cunningham & Doyle Trust	Donor/Foundation
6	United States	California Energy Commission	Donor/Foundation
7	India	GRAMEEN SURYA BIJLEE FOUNDATION *	Donor/Foundation
8	Ghana	Gold Coast Projects Ltd	Donor/Foundation
9	France	UNDP *	Donor/Foundation
10	France	Paris Microfinance Network	Donor/Foundation
11	Canada	Nemalux LED Lighting	Donor/Foundation
12	Afghanistan	USAID *	Donor/Foundation
13	United States	Rocky Mountain Institute	NGO
14	United States	IDE	NGO
15	United States	Harvard University/Sustainable Energy Solutions	NGO
16	United States	CADEC	NGO
17	United States	Building with Books	NGO
18	United Kingdom	SolarAid	NGO
19	United Kingdom	GVEP	NGO
20	Sweden	Engineers Without Borders *	NGO
21	South Africa	Gender and Energy Research and Training	NGO
22	India	IIEC	NGO
23	Ghana	KITE, Ghana	NGO
24	Ghana	Disability Options	NGO
25	Germany	Madagaskar Vision e.V.	NGO
26	Germany	Global Nature Fund	NGO
27	Ethiopia	WONDER	NGO
28	Ethiopia	ENSED	NGO
29	Canada	Rotary District 7040	NGO
30	Austria	Renewable Energy and Energy Efficiency Partnership	NGO
31	Kenya	freelance	Media
32	United States	WebFirst	Other
33	United States	UCOP	Other

	Country	Company	Primary Activity
34	United States	Lighting Research Center	Other
35	United States	Lawrence Berkeley National Lab *	Other
36	United States	jujodzine	Other
37	United States	International Association of Lighting Designers	Other
38	United States	ideo	Other
39	United States	Cornell University Johnson Graduate School of Management	Other
40	United States	American University	Other
41	Tanzania	National Bureau of Smbila	Other
42	Switzerland	World Business Council for Sustainable Development (WBCSD)	Other
43	Sweden	FourFact AB	Other
44	South Africa	private	Other
45	Kenya	catholic university	Other
46	Italy	DEI University of Padova	Other
47	India	Studio Korjan	Other
48	India	MS	Other
49	Ghana	CSIR-INSTITUTE OF INDUSTRIAL RESEARCH	Other
50	Germany	European Patent Office	Other
51	Finland	Helsinki University of Technology - Lighting Laboratory	Other
52	Canada	Self employed	Other
53	Brazil	UFRJ - Universidade Federal do Rio de Janeiro	Other
54	Belgium	European Copper Institute	Other
55	Australia	Research Institute for Sustainable Development	Other
56	Afghanistan	DG Lights	Other

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Annex I: Response to Project Reviews to Date

Annex J: TOR for Key Positions in PMO

a) STAP Review

STAP Reviewer:	Daniel M. Kammen
Position:	Class of 1935 Distinguished Chair in Energy Energy and Resources Group & Goldman School of Public Policy Director, Renewable and Appropriate Energy Laboratory (RAEL) Co-Director, Berkeley Institute of the Environment (BiE) University of California
Contact:	T: 510.642.1139 F: 510.642.1085 Email: kammen@berkeley.edu

STAP Review

Note: two of the project consultants for this effort, Professor Arne Jacobson and Ms. Rebecca Ghanadan are my current and recently graduated students (see, e.g. the listed references: Moner-Girona, et al*., 2006, and Jacobson and Kammen, 2005).*

Some of the comment presented here grew out of both our collaborative field and analytical work on the energy markets in Eastern and Southern Africa, and our shared assessment of this project.

Overall:

This is an ambitious and potentially very important project, and should be supported.

The most exceptional feature of this project is the plan to develop essentially a new technology and market-base in Africa (some use of LED lighting exists, but it is very limited). The potential to develop this industry for the African market, and in a financially meaningful partnership with the global semiconductor industry has great promise, if managed truly to meet the 'bottom of the pyramid' needs. At the same time, the risk without oversight for this needy market segment to be served poorly is real. This project appears to have the needed safeguards in place, given the track-record of efforts in Africa (such as the prior IFC PVMTI program in Kenya[12]).

The focus on a new, application-specific, technology for Africa reduces (though does not eliminate) many of the complexities of interventions in existing markets. One of the greatest strengths of this project is the ability to leverage LED lighting at a relatively large scale due

[12] PVMTI, the Photovoltatics Markets Transformation Initiative is mentioned in the PCD, but only once (page 2). The experiences, both positive *and* negative from that effort – and from not only the large contract recipients, but also, small businesses and end users – needs to be documented and discussed in greater detail as it related in some critical ways to the efforts envisioned here.

IFC Response:

The lessons learned from PVMTI are implicit in the approach proposed for this Project, and discussion of this has been emphasized further in the Project Brief in response to this comment. Particular insights include: the need to engage alternative distribution channels used successfully for other product categories; the importance of a technology agnostic approach to enable the market to identify the optimal solution; and the need to target a lower price point than currently available solar solutions.

to the state of the international industry and the potential to meet a critical set of price and performance points that have great appeal and demand in Africa. The decision to focus on multiple countries, while challenging, is also well-taken in this context so that the market size can be increased, and so that a range of applications can be addressed.

At the same time, this arrangement leads to the two key recommendations of this review:

1. **Establish an international advisory committee, with primary membership of ministries and consumer (NGO) watchdog groups that have real oversight authority in the commercial operation in each country**. External advisors who have no commercial role in the project should also be represented on the committee. This may at first seem overly onerous, but the market potential of this partnership, and the degree to which a LED program that works as envisioned will, in effect, bind the consumers to this technology, warrant this approach. As the experience with the technology grows, and the more and less profitable market segments become clear, an oversight team will be needed to be sure that the 'Bottom of the Pyramid' approach does not in any way degenerate into a preferred push on the best-performing market segments.

   IFC Response:
   The Project design provides for the creation of three national Advisory Committees which will represent local needs. These Committees will consist of relevant government and non-governmental representatives and will meet regularly to guide the implementation of the project. In addition, the findings of each national Committee will be shared with their counterparts and all three Committees will be brought together at regular intervals to discuss the progress of the project at an international level.

2. **A more detailed market analysis that is presented in the PCD is required.** This can be done once the project is approved (as a pre-commercial assessment, but also as a baseline plan for the use of the advisory committee in evaluating project development. Aspects of this analysis could include:

   - Learning curve analysis of the technology (see, e.g. Duke and Kammen, 2003). In fact, the analysis of the amorphous silicon solar cell market potential in Africa presented in this paper could be used quite effectively in exploring what different price-points and specific products might do in the market context of these nations.
   - An analysis of technology adoption in African context (identifying priority segments), and;
   - Clearer identification of the priorities & approaches in reaching different market segments (i.e. lighting for applications across income scales).

   IFC Response:
   Step 2 of the Project's proposed 6-step implementation approach is entirely focused on market analysis with the objective of developing a detailed understanding of market segments, consumer needs and trade-offs, competitive price points, and likely adoption patterns. The reviewer's recommendations for this analysis will be incorporated into the program design.

Lighting markets in Ghana, Kenya, and Tanzania all qualify, generally, as "lighting the bottom of the pyramid" from an OECD perspective. However, the market is not at all unified, and these analyses are necessary to develop a more detailed & realistic expectations of what market support is needed (and what the environmental, fuel, and other benefits maybe).

IFC Response:
Steps 2 and 3 of the Project's proposed 6-step implementation approach will assess market needs and distribution options on a country specific basis.

Finally, one significant methodological caution. The analysis presented for this project assumes lighting "displacement" *a priori*. Namely, the LED lights will offset other, incandescent purchases. It would be a more accurate understanding to think of LEDs offering high quality, relatively low cost lighting that *may* displace/substitute or add to existing lighting options to African end-users.

While the distinction makes a difference for assumptions about GHG offsets, it does not make a difference for the claim that LEDs certainly improve upon people's existing lighting options in Africa. It is non-trivial to recognize this difference because the GHG benefits of PV in Africa have been commonly emphasized in the literature, often because of the need to meet incremental cost goals when other objectives (employment, service provision, security, quality of life) are also part of the goal set.

IFC Response:
The Project's methodology assumes market penetration and energy savings articulated as fractions of total lighting energy, as opposed to numbers of households or light sources. It is important to note that the potential for lighting-related CO_2 *reductions from traditional whole-house solar electric systems have been curbed (Hankins 2005) in part by the limited efficacy of traditional fluorescent lighting used therein, and end-users sometimes prefer to use scarce solar electricity for other end uses (e.g. television). Consequently, among relatively affluent households, the introduction of alternative lighting may be taken as an augmentation to existing lighting rather than as a substitute (as has been observed for current solar home systems) and thus could result in little if any reduction in energy user or associated emissions. We believe that for our target market this "take-back effect" will be limited, and virtually non-existent in the case of single-vendor night-market businesses or the poorest households (which use only one light source and can barely afford the kerosene they use today). We believe that the proposed technology will be significantly more successful than conventional solar lighting because: (i) it will provide more effective lighting at lower cost than the alternative; (ii) it will be targeted at lower income households which are more likely to take the solar light as a substitute to (rather than augmentation of) existing kerosene, and (iii) it will make possible more than one affordable point of light for a given consumer.*

Aspects Needing Particular Attention:
As stated above a concern is that the project document treats the market as a single entity and thus not specific enough about market development and blurring opportunities/constraints, costs/benefits across different applications and groups. A clearer market analysis framework (even if it spells out where uncertainties) would make it possible to begin to talk about priorities, barriers, and needs of different market segments as separate entities. That is, what is the composition of the market pyramid within Kenya, Tanzania,

Ghana? This would be a valuable contribution to the "bottom of the pyramid" literature and will be critical to successful project implementation.

End use analysis and product development will need to be geared differently to different groups. And talking concretely about segments will also lead to more appropriate assessments. End user needs, applications, ability to pay, distribution channels, and potential GHG/environmental benefits will all be highly specific to different market segments. One can envision an approach needing to develop different approaches for i) small business applications & urban backup applications, ii) peri-urban & rural middle class, and iii) rural non-middle class. As stated in the overall comments, this need not be completed prior to project approval, but should be planned and budgeted into the overall effort. The advisory committee could, again, be a natural recipient of the analysis.

One of the most important contributions of a highly leveraged project like this is its potential to exploit all avenues for bringing prices for LED lighting technologies down. This may be via standard learning curve demand (though likely small in global context). But more likely in catalyzing many of the specific market "innovations" needed to make prices and technologies fit lighting needs and purchasing power capabilities in Africa. It would be ideal to include a more explicit analysis of what the learning curve potential is for LED lighting over the next 5 years or so.

From a business and service perspective, it would also make sense to commission an explicit analysis of what are the key factors keeping efficient lighting technologies costly in Africa, and how this project will directly go about reducing them (i.e. are they a result of import duties, wholesale or distribution surpluses, small quantity purchases, transportation, etc). In the case of the Kenyan solar market, the evaluation and presentation back to the Office of the Vice President of the size and impact of import tariffs, was particularly important in subsequent government decision—making (Duke, *et al*, 2002; Jacobson and Kammen, 2005)

IFC Response:
Steps 2 and 3 of the Project's proposed 6-step implementation approach will assess market needs and distribution options on a country specific basis. Step 2 is entirely focused on market analysis with the objective of developing a detailed understanding of market segments, consumer needs and trade-offs, competitive price points, and likely adoption patterns. The reviewer's recommendations for inclusion of analysis on why current technologies remain expensive and the potential for learning-curve benefits in LED-based technology analysis will be incorporated into program design.

Specific Comments:
The economic analysis needs to be expanded. Technology penetration rates are a) not likely to all be so simple or similar, and b) there needs to be more analysis of the different services provided to different socioeconomic segments. Again, this task, if done properly, is a large effort, and could be formulated as a pre-feasibility effort to look at a range of technology entry points.

As well formulated by Prof. Jacobson:

> At the "entry level" of the spectrum will be stand-alone light sources (usable individually or in multiples) at price points in the vicinity of US$5 each. In practice, lights of different sizes (light output) would be offered, ranging from 0.1 to 1.0 Watts, and perhaps higher for specialized applications, with a range in

prices for perhaps $2 to $10 each. These will be powered by removable "AA" style (or similar) batteries, already available in the local market. In this configuration, either disposable batteries at $0.25 each (lower first cost and higher operation cost) will be used, or rechargeable batteries at ~$1.50 each charged by local micro-enterprises using solar photovoltaic or grid-based charging at a cost of perhaps $0.10 per charge. Alternatively, third parties may elect to establish micro-grids with central power at the scale of a cluster of homes or greater. Consumers can graduate from disposable to rechargeable batteries or microgrids as they become able to afford third-party recharging or their own charging device. The next step upwards will be to stand-alone systems with integrated charging (PV, hand cranked, etc). These systems would be modular in that they could be purchased incrementally (e.g. Charger ~$15-$20) plus one or more light points at perhaps $5 each. Lastly would be relatively high-end configurations including a package with multiple light sources, charging, and even ancillary services such as cell phone or radio power. These would be valued more highly, e.g. because they would defer phone charging costs of ~$10/month) and would be brought to the market at a correspondingly higher price point.

IFC Response:
This characterization of the market opportunities and nuances has been integrated in our proposal. The economic analysis will be refined during the appraisal process and throughout the Project life as the understanding of each specific market is improved. The needs and potential penetration rates of each market segment in each country will be key data points provided to the private sector consortium and will enable them to develop products and market entry strategies which suit demand.

The job creation potential of this project – a major benefit -- is under-emphasized and should be given much more attention. While a GEF proposal requires attention to environmental benefits, development benefits are equally (if not more) significant. The proposal discusses in a short section the possibility of local manufacture, however with a strong caveat of only doing this if it makes sense in "least cost terms".

The potential exists here to make job creation as a more explicit goal. To support the potential of local manufacture, a cost comparison analysis is in order. This area seems a large area of potential untapped benefits (and challenges) not highlighted in the proposal.

IFC Response:
Project design has been carefully structured to provide an intervention that enables but does not distort a sustainable market response. To this end, careful economic cost-benefit analysis will be provided to the private sector consortium to ensure that it gives appropriate consideration to the potential for local manufacture and makes an optimal decision when locating its manufacturing facilities.

Page 2, remove, 'young juggernaut of the solid-state lighting industry' phrase.

IFC Response:
Suggestion incorporated into submission.

Figure 6: should not be included in the PCD. This is part of a report my doctoral student Rebecca Ghanadan, who provided input to the project in writing for the World Bank. It has not been published at this time and the figure is not attributed properly to Ms. Ghanadan.

***IFC Response**:*
Suggestion incorporated into submission.

References:

Moner-Girona, M., Ghanadan, R., Jacobson, A., and Kammen, D. M. (2006) "Decreasing PV costs in Africa," *ReFocus: The International Renewable Energy Magazine*, **January/February**, 40 – 45.

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Duke, Richard. D, Jacobson, Arne, and Daniel M. Kammen (2002) "Product quality in the Kenyan solar home industry", *Energy Policy,* **30 (6)**, 477-499.

b) GEF Secretariat Review

GEF Review Sheet of Project Concept Note
January 13, 2006
Program Manager: Zhihong Zhang
Requested Project Information by Work Program Inclusion

1. **Endorsement letters from the participating countries will be required**

IFC Comments: Endorsement letters received from Ghana and Kenya.

2. **Countries and markets are specified, including the number of people/households who will make the switch from fuel-based to modern lighting. Direct and indirect GHG emissions reduction is estimated as a result of the project.**

IFC Comments: IFC selected Ghana and Kenya for Project implementation. Three (3) scenarios have been developed for market penetration by LED-based lighting products and resulting GHG emission reductions. A detailed description of the selection process and assumptions behind IFC market estimates can be found, respectively in Section 3 (Country Selection) and Annex A (Incremental Cost Analysis).

3. Markets for replication are identified and activities planned.

IFC Comments: The Project Brief describes the global nature of the fuel-based lighting problem that the Project is trying to address and the large potential for replication in other developing countries, most of which have similar conditions to Ghana and Kenya. These commonalities include (i) a significant proportion of the population lacking access to the grid, (ii) extensive reliance of this population on fuel-based lighting, (iii) existence of alternative product distribution channels, and (iv) an investment climate which does not deter interest and engagement by the international private sector.
As part of its strategy for replication, IFC has:

- Selected 2 countries that account for 10% of the total non-electrified population in Sub-Saharan Africa and almost 1% of the global non-electrified population. This provides sufficient scale to validate the project approach for address this global problem; and
- Designed a market-focused project that positions the private sector to play the leading role in developing a new market for LED-based lighting products. The benefit of this approach is that once the private sector validates the market opportunity in the target countries, it will automatically seek to expand into additional markets, requiring limited or no further IFC/GEF support.

For further details, please refer to Section 4 (Strategic Context and Project Rationale) and Section 9 (Sustainability and Replicability)

4. Document the involvement of the local key stakeholders (local governments, end-users, industry, etc.)

IFC Comments: IFC has undertaken an extensive consultation process in preparing the Project. This has strongly influenced the Project design and ensured focus on key barriers. Consultations include discussions with 50 international LED companies and over 70 meetings with local stakeholders in candidate countries. For a detailed documentation of those consultations, please refer to Section 4.5: Project Rationale, which discusses how those consultations influenced the project design, Section 6: Stakeholder Participation, Annex D: List of Meetings with Stakeholders, and Annex F (Sample of International Lighting Firms To be Invited to Join Consortium).

5. Sources of co-financing are specified.

IFC Comments: IFC describes in the Project Brief both the sources of co-financing (donors and IFC), and the sources of leverage (private sector and end-users). Based on its experience with similar market transformation projects, IFC believes the project will be able to leverage a very significant level of resources from the private sector and end-users. For more detailed discussion please refer to Section 8: Project Budget, Financial Modalities, Financial Plan and Cost Effectiveness.

6. Document collaboration with ESMAP and other partners.

IFC Comments: IFC has discussed collaboration with several partners, including other multilaterals, international initiatives such as GVEP, and local NGOs in each of the target countries. In particular, IFC has discussed collaboration with (i) ESMAP concerning its DFID-funded program for SMEs in Africa, and (ii) IBRD concerning its project in Ghana also seeking GEF funding. IFC has identified many potential areas of collaboration and synergies between these initiatives and will be pursuing those during implementation. Further, during pre-appraisal IFC has undertaken an extensive review of between 10 and 17 existing initiatives in each of the target countries seeking to bring modern energy services to non-electrified populations. IFC will seek areas of collaboration with selected existing initiatives as appropriate for the project. For details on our efforts on collaboration, please refer to Section 7.6 (Institutional Coordination and Support).

GEF Review Sheet of Project Brief
April 13, 2006
Program Manager: Zhihong Zhang
Requested Project Information by Work Program Inclusion

IFC responses to the comments from the GEF Secretariat on the Project Brief for the Project "Lighting the Bottom of the Pyramid". A summary table is provided below and the remainder of this document provides more detailed responses to GEF questions/comments.

SUMMARY OF RESPONSES

GEF Question/Comment	IFC Response
1. Identify and address barriers for consumer adoption of new technologies	The project design has identified key consumer barriers, such as high cost and low affordability, mismatch between product design and end-user needs and lack of information. The project encompasses specific actions to remove those barriers, such as focusing on more affordable LEDS, mobilizing micro-lending as necessary, ensuring proper product design and promoting consumer awareness campaigns.
2. Need to clarify use of $3.5MM of GEF funds for Step 5	IFC has set 6 main actions planned for those funds. IFC has provided a tentative language to avoid pre-determining actions to be taken 3-4 years from the start of the project, ensure the project retains the necessary flexibility to respond to the evolving market conditions. During appraisal IFC will refine its estimates and will further consult with GEF.
3. Need to clarify assumptions and methodology for CO2 reduction calculations	A preliminary summary that aims to offer additional details is provided in Annex A
4. Need specific targets for performance indicators in the logframe	Preliminary targets included (see preliminary list on Annex B). During appraisal IFC will further refine indicators and targets.
5. Document collaboration with ESMAP and other partners	IFC has consulted with ESMAP and a number of other partners, both international and local , to explore collaboration opportunities. See Project Brief on page 37 for details.
6. Explain reduction of co-financing from $12-30MM to $6.75MM	Co-financing has not fallen but has been to large extent are-categorized as leverage. In fact, the project has increased the total resources from 3rd parties raised for the project from $ 12-30MM to $78MM
7. Market penetration of 10% seems too ambitious	IFC agrees it is an ambitious target, but notes it aimed at setting a target that sets a credible, large scale and lasting market transformation and consider a 10-year period. During appraisal IFC will be refining its market penetration estimates but LEDs market penetration by the end of the project is likely to be around 4-5%.
8. Need for separate M&E budget	IFC set $300,000 for M&E. It will integrate more clearly the M&E budget in the total budget.

DETAILED RESPONSES

1. **On GEF's suggestion that barriers for consumer adoption of new technologies also be identified and addressed as part of the project design.**

   IFC fully agrees on the importance on incorporating the customer's perspective for the adoption of new technologies. Building on previous project experiences, literature and its pre-appraisal process, IFC has identified in the project design key barriers to consumer's adoption of new technologies, including (i) high product cost and limited affordability, (ii) mismatch between product design and consumer needs, (iii) lack of information on the benefits of new products and (iv) challenges around distribution and post-service sales. To address these barriers, IFC has:

   - Included in the project design actions to overcome known barriers for consumer adoption of new technologies, such a (i) mobilizing micro-lending as necessary, (ii) performing a comprehensive consumer research, and product testing to ensure LED products are designed to meet consumer needs, (iii) promoting consumer awareness campaigns, and (vi) mapping a range of distribution channels to ensure products are delivered and serviced properly, and
   - Retained for the final part of the project (Step 5) sufficient flexibility to respond with a range of actions to new or unanticipated barriers for consumer adoption of LED that may be found during the course of the project.

   Importantly, IFC's focus on LED-based lighting solutions derives from the first-cost barrier which greatly constrained development of a robust solar home system (SHS) market. In large part because of the affordability issue, SHS's have not penetrated beyond the wealthier segments in Africa. Stand-alone LED lighting systems provide an opportunity to penetrate this market through systems ranging from $25-$100, versus typical SHS cost of $600-$1,000.

2. **On the fact that Step 5 calls for $3.5MM of GEF funds, but lacks clarity concerning the actions to undertaken and how GEF funds will be used**

   Based on previous experiences with market transformation projects, IFC believes that it will have to engage in several fronts to build the necessary institutions to support the long-term development of LED markets. As discussed in the Project Brief, IFC's envisions undertaking 6 main actions during Step 5, namely (i) Support and Mobilizing Financing, (ii) Assessing the Potential for Local Manufacturing/Assembly, (iii) Aggregated purchasing, (iv) Performance and Quality Assurance, (v) Raising End-user Awareness, and (vi) Pro-actively Managing Solid Waste from Batteries. IFC has provided a total cost estimate of $3.5 MM based on previous experiences as it found that a detailed budget for each activity would be premature as market conditions, and the required intervention, will vary during the course of the project. Experience shows that IFC will likely have to emphasize some of the aforementioned actions while deemphasizing others, and probably add or drop one or two actions. Hence, IFC language did not mean to be cautious but to reflect the need to plan some key actions while remaining able to rapidly adapt the project actions when market conditions change. Should GEF Sec require, IFC can during appraisal develop some indicative numbers per action under Step 5, as well can have a specific consultation with GEF Sec by the end of Step 4 to discuss the envisioned actions for Step 5.

3. On the request for a clearer explanation of the key assumptions and the method for calculating CO2 emissions reduction.

IFC will review and incorporate in the Project Brief a summary of the Incremental Cost Analysis assumptions and methodology. A preliminary summary is provided in Annex A of this document.

4. **On the need to provide specific targets for each of the indicators in the logframe.**

IFC will review the logframe to include specific targets. A preliminary review is provided on Annex B of this document. Further refinement of targets will be developed during appraisal.

5. On collaboration with ESMAP and other partners

IFC has consulted with a number of international and local partners to explore opportunities for collaboration. Please refer to page 37 of Project Brief. Should GEF require additional information on that, IFC will be pleased to provide it.

6. On the drop in co-financing from $12-30MM (Concept Note) to $6.75MM (Project Brief) and GEF's request for a proportional reduction of GEF funds.

IFC estimate for co-financing was not reduced but re-categorized. At the concept level, IFC estimates were based on a preliminary assessment of 3rd party resources IFC anticipated raising for the project. At that stage, IFC did not differentiate between co-financing and leverage, and aimed only at ensuring that realistically the project would raise enough 3rd party resources to meet minimum GEF requirements. In the preparation of the Project Brief, IFC developed a much more detailed evaluation of the amount of 3rd party resources that IFC could raise, and if those would fall into the "co-financing" or "leverage" category according to GEF definitions. The total amount of resources IFC envisions raising, both as co-financing and leverage, has indeed increase substantially from the Concept Note to the Project Brief, from $12-30MM to $78MM. IFC reckons that the requested GEF financing of $6MM is the minimum necessary to ensure an appropriate implementation and management of the project as envisioned to create the market impact projected.

7. **On the fact that the project's base case market penetration for LEDs – at 10% - could be too ambitious.**

IFC recognizes the challenge for a new technology to reach a 10% market penetration. Yet IFC has opted for targeting what it reckons to be the necessary level of penetration if a credible lasting market transformation is to be achieved. Based on that target, IFC then planned the appropriate level of resources and set the key settings of the project design, such as creating a strong sense of competition amongst LED companies. The goal is to have a realistic target, but deliberately test a more aggressive and large-scale market transformation model. This target, however, should be seen as indicative and over a 10-year period, based on the preliminary assessment performed during the pre-appraisal effort. IFC envisions reviewing and detailing its target during the appraisal process and setting specific milestones and timeframe for the market penetration by the completion of the project. Subject to further refining during appraisal, IFC would expect the market penetration by the end of the project to be around 4-5%.

8. **On the need for a separate M&E budget and for its integration into the project budget.**

   IFC has budgeted $300,000 for an independent evaluator to monitor and evaluate the project (see page 48 of Project Brief). IFC will provide a detailed budget for M&E and integrate it in the overall project budget.

GEF Requests on Bilaterals on May 19,2006
IFC Summary of Changes in the Document

GEF Question/Comment	Changes in Document	Doc Section
9. Identify and address barriers for consumer adoption of new technologies	Language included to further stress that barrier identified affect not only suppliers, but also consumer's adoption of new technologies	Section 4.5.4 of Project Brief. Also included in Executive Summary
10. Need to clarify use of $3.5MM of GEF funds for Step 5	Language included clarifying use of GEF funds under Step 5	Section 8 of Project Brief
11. Need to clarify assumptions and methodology for CO2 reduction calculations	Summary of assumption and methodology included	See ICA in Project Brief. Also included in Executive Summary
12. Need specific targets for performance indicators in the logframe	Specific targets included	See Annex on Logframe. Also included in Executive Summary.
13. Document collaboration with ESMAP and other partners	Documented in Project Brief	Section 7.6 of Project Brief
14. Explain reduction of co-financing from $12-30MM to $6.75MM	Explained on bilaterals. See Annex on IFC response to GEF SEC Review Sheet on Project Brief	Annex H
15. Market penetration of 10% seems too ambitious	Explained on bilaterals. See Annex on IFC response to GEF SEC Review Sheet on Project Brief	Annex H
16. Need for separate M&E budget	Included budget line specific to M&E	See Figure 16

Annex J: TORs for Leadership Positions in Project Management Offices

Annex K: TOR for Key Consultants for First 24 Months

1. SENIOR PROGRAM MANAGER (1 POSITION)

Based in Kenya or Ghana

The International Finance Corporation (IFC), the private sector arm of the World Bank Group, will pilot in Kenya and Ghana a new global program that leverages the private sector to increase access to modern lighting for low income households and businesses that rely only on fuels for lighting (e.g. kerosene, candles).

Fuel-based lighting is a large yet, underdeveloped market at the bottom of the economic pyramid. The total global spending on fuel-based lighting is estimated at US$38 billion/year and in Kenya and Ghana the total spending on fuel-based lighting is estimated at US$ 1.4 billion/year. The program will form a global consortium of international and African companies, and support these firms in successfully entering and competing for this market in Ghana and Kenya, bringing better and more affordable products to households and businesses using fuel-based lighting. Among others activities, the program will assist companies in understanding consumers' needs, identifying local and/or international partners, developing, commercializing and financing modern off-grid lighting products that can commercially displace fuel-based lighting products. For more information on the program, please visit www.ifc.org/led.

IFC is seeking a qualified individual to provide leadership to the implementation of this program in Kenya and Ghana. This is a critical role for the success of the program, and offers a unique opportunity for someone with substantial managerial experience in marketing or business development seeking a challenging role with high developmental impact. The ideal candidate would have the following experience and skills:

→ 12+ years of experience in management roles related to the development of new businesses or markets, development and roll-out of new products, etc., acquired preferably in the private sector.

→ Proven experience with activities such as market assessment, consumer surveys, product development, setting business partnerships, developing and implementing marketing/sales strategies, etc.

→ Proven record in establishing and managing relationships with a large number of international and local stakeholders at the private, public sectors.

→ Hands-on experience doing business in Africa.

- → Ability to establish and manage all administrative aspects of a new program, including staff, budgeting, financial management, and reporting, among others.

- → Entrepreneurial mind-set, and ability to provide the leadership and drive to a new program that will require continuous creative thinking, and ability to revisit/adjust path quickly based on the needs of the private sector consortium.

- → Experience in managing and mentoring a multi-country team, supported by a range of local and international consultants.

- → Excellent interpersonal skills, and experience in working in a matrix organization, effectively dealing with conflicts and building consensus within the organization.

- → Ability to interact effectively with a number of business cultures, encompassing private, public, and civil society organizations from both developed and developing countries.

- → Willingness to live in Kenya, or Ghana for a 4-year period, and to travel regionally and internationally as necessary.

- → Excellent presentation and communication skills, and fluent written and verbal command of English.

- → Experience with energy issues and development challenges in Africa would be an advantage.

- → Graduate degree in areas relevant to the program. An MBA would be an advantage.

2. PROGRAM COUNTRY LEADER (2 POSITIONS)

Kenya and Ghana

The International Finance Corporation (IFC), the private sector arm of the World Bank Group, will pilot in Kenya and Ghana a new global program that leverages the private sector to increase access to modern lighting for low income households and businesses that rely only on fuels for lighting (e.g. kerosene, candles).

Fuel-based lighting is a large yet, underdeveloped market at the bottom of the economic pyramid. The total global spending on fuel-based lighting is estimated at US$38 billion/year, and in Kenya and Ghana the total spending on fuel-based lighting is estimated at US$ 1.4 billion/year. The program will form a global consortium of international and African companies, and support these firms in successfully entering and competing for this market in Ghana and Kenya, bringing better and more affordable products to households and businesses using fuel-based lighting. Among others activities,

the program will assist companies in understanding consumers' needs, identifying local and/or international partners, developing, commercializing and financing modern off-grid lighting products that can commercially displace fuel-based lighting products. For more information on the program, please visit www.ifc.org/led.

IFC is seeking two qualified individuals – one to be based in Kenya and the other in Ghana – to act as the Country Leader for the Program. Reporting the General Program Manager, the Country Leader will be responsible for leading all key program activities in her/his country and will be part of the program's overall management team. The ideal candidate would have the following experience and skills:

→ 6+ years of experience in the management of initiatives/programs related to the development of new businesses or markets, development and roll-out of new products, etc., acquired preferably in the private sector.

→ Experience with activities such as market assessment, consumer surveys, product development, setting business partnerships, developing and implementing marketing/sales strategies, etc.

→ Experience in managing relationships with organizations at the private, and/or public sectors.

→ Experience doing business in Africa.

→ Ability to work independently and lead a small country team supported by external consultants.

→ Excellent interpersonal skills, and experience in working in a matrix organization, effectively dealing with conflicts and building consensus within the organization.

→ Ability to interact effectively with a number of business cultures, encompassing private, public, and civil society organizations from both developed and developing countries.

→ Willingness to live in Kenya, or Ghana for a 4-year period, and to travel regionally and internationally as necessary.

→ Excellent presentation and communication skills and fluent written and verbal command of English.

→ Experience with energy issues and development challenges in Africa would be an advantage.

→ An advanced degree in business or others fields relevant to the program.

Annex K: TOR for Key Consultants to be Retained in Years 1 and 2

Below are the indicative terms of reference for key consultants that will be retained in the first 24 months of the project. These terms are indicative and subject to adjustments to respond to the project and market needs.

A. Consultant for Project Component 2 – Market Research

Indicative Terms of Reference for Market Research Firm

Background

- The project Lighting the Bottom of the Pyramid will involve a market research component, to quantify the demand for low-cost lighting and provide potential designers and manufacturers with the information necessary to produce low-cost lights that will be usable and affordable for off-grid households.

- Consumer research will necessitate a large-scale survey of households, starting in Kenya and Ghana, and will be undertaken by a selected market research firm.

- To that end, IFC will retain a qualified market research firm to carry this work

Indicative Scope of Work

The market research firm should carry the work under the following guidelines:

- Phased approach:
    - Pilot phase: Interviewing a small sample of households for information on user preferences, which will help to develop design specifications and performance metrics to guide procurement of 3-5 already-manufactured products for testing
    - Test Phase: Interviewing a larger sample of households, where the procured products will be tested, for statistically significant information on user preferences across different customer segments

- Segments:
    - First phase to include households, and micro-businesses, such as night vendors and kiosks
    - Other segments as determined by the Project's PMO in consultation with the industry
    - All participants will be off the electric grid, but both the pilot and test phases will include rural and urban households. The pilot phase will interview several respondents in each region, and will conduct a number of focus groups. Initial responses will help to delineate the most important metrics for consumer differentiation between products, such as size, cost, or brightness. Responses from the pilot phase will be used to select 3-5 products available

on the market which provide variation across the determined metrics, so that the larger survey may test each metric.

- Sample Size:
  - Approximately 1,000 households and 300 small businesses will be surveyed in each country during the second test phase, providing a sample in nearly all regions and across various consumer characteristics such as income and urbanization.
  - Selected households will first be approached with a pre-survey asking about their current lighting uses and behaviors. After the initial survey, they will be asked to use a randomly assigned sample of one of the 3 to 5 product models for several days, answer a post-survey, and repeat the process with a second product type to allow comparison.
  - Upon completion of the two rounds of product trials in all households, the survey results will be analyzed to determine the distribution of reactions on each product and performance metric. Reactions can also be broken down by consumer characteristics.

- Sharing of Findings:
  - To promote ongoing dialogue with the private companies who will ultimately use the consumer feedback, the market research firm will provide incremental updates prepared for the company audience, as well as participating in discussions with members of the private sector consortium.
  - The firm will share findings after the initial phase of desk research, after the pilot phase, and after the larger test phase.
  - Along with photo documentation, the firm may also work with a filmmaker to create a short documentary or video clips of the process to enhance participating companies' ability to understand the market

- Knowledge Sharing:
  - To facilitate replication of the market research methodology to other segments, and potentially other countries where the original firm may not always be able to engage, the firm will document each phase of its methodology in writing, including surveys, descriptions of logistics, and lessons learned in retrospect upon completion of the project.

Timeline

- As complementary activities, the distribution research and consumer/product design research can be carried out concurrently or in close succession. The IFC expects the consumer research phase to take approximately 5 months, and to be completed by December 2007.

B. Consultant for Project Component 3: Mapping of Supply Chain and Distribution Channels

Indicative Terms of Reference for Consultant

Background

- The Lighting the Bottom of the Pyramid project entails an assessment of the supply chains and distribution channels that can deliver low-cost lighting products. The distribution assessment will require large-scale surveys of business practices to reach off-grid markets in Kenya and Ghana, and will be undertaken by a selected research firm, and identification and profiling of possible distributors.

- The IFC has already planned a consumer research survey with households and micro-businesses in Kenya and Ghana. While the consumer survey will focus on lighting uses and needs and pilot several product models to inform companies how to better design products for the "bottom-of-the-pyramid" market, we expect that consumer and product design research will not be enough to fill the information gap. Companies entering the market will also need to understand the existing or potential distribution systems that could most effectively deliver such products to off-grid households, and which ultimately determine end-user pricing.

- To support a better understanding of the distribution channels and map and profile potential distributors, IFC will retain a qualified consultant to carry this work.

Indicative Scope of Work

- The IFC envisions the distribution mapping to provide a comprehensive understanding of current and potential distribution players to participate in the project, the economics of these chains and successful existing models of distribution of products to the same population targeted by the project.

- This mapping effort will profile the different types of channels that could reach end users in off-grid areas, including energy-specific and non-energy-based channels, rural-based and urban-based channels. The survey will cover a large number of businesses in most regions of the country.

- The distribution research will also interview distributors and retailers directly. Survey data will map the costs, lead time, and markups associated with each stage of the supply chain, as well as quantifying the approximate number of agents at each stage and the number and location of consumers reached. It will also profile the different types of channels that could reach end users in off-grid areas, including energy-specific and non-energy-based channels, rural-based and urban-based channels. The survey will cover a large number of businesses in most regions of the country.

- To promote ongoing dialogue with the private companies who will ultimately use the supply chain information, the distribution research firm will provide incremental updates to the project's private sector consortium, as well as participating in online discussions and conference calls with members of the private sector consortium.

- To facilitate replication of the distribution research methodology in other countries where the original firm may not always be able to engage, the firm will document each phase of its methodology in writing, including surveys, descriptions of logistics, and lessons learned in retrospect upon completion of the project. Along with photo documentation, the firm may also work with a filmmaker to create a short documentary or video clips of the process, providing media tools for future publicity to potential investors and partners, both in meetings and on the project web site.

Timeline

- As complementary activities, the distribution research and consumer/product design research can be carried out concurrently or in close succession. The IFC expects the distribution research phase to take approximately 5 months, and to be completed by December 2007.

B. Consultant for Development of Performance Standards and Specifications for Off-Grid Lighting Products

Indicative Terms of Reference for Consultant

Indicative Terms of Request for Expressions of Interest and Scope of Work

The intent of this request is to enable potentially interested consultants to decide whether or not to prepare and submit an expression of interest. The selected consultant will be invited to submit a combined technical and financial proposal based on Terms of Reference to be provided.

The objective of this assignment is to develop standardized means that consumers can use to compare various LED lamps for off-grid lighting, and to verify LED lighting product quality and performance. Information from the market research will feed into the work envisaged under this assignment. The proposed work will include: development of consumer-friendly metrics for the measurement of LED lighting preferences in various off-grid configurations such as area lighting, task lighting, etc.; formulation of tests with adequate pass/fail criteria required to evaluate quality and performance of LED lamps for off-grid lighting; drafting performance specifications and test protocols following illumination industry practices; testing samples of LED lamps to validate the test procedures and effectiveness of metrics; and developing criteria for accreditation of test laboratories to perform the tests. To deliver the services, the consultants will need to have

experience and expertise in LED lighting design and specification; consumer lighting needs assessment, especially in developing country contexts; laboratory facilities with the necessary testing equipment and qualified staff to conduct validation tests; and ability to develop metrics that relate consumer needs/preferences to technical performance criteria that can be then written into technical specifications.

The IFC now invites eligible consultants to indicate their interest in providing the services. Interested consultants must provide information indicating that they are qualified to perform the services (brochures, description of similar assignments, experience in similar conditions, availability of appropriate skills among staff, etc.). Consultants may associate to enhance their qualifications.

Consultants will be selected in accordance with the procedures set out in the World Bank Group.