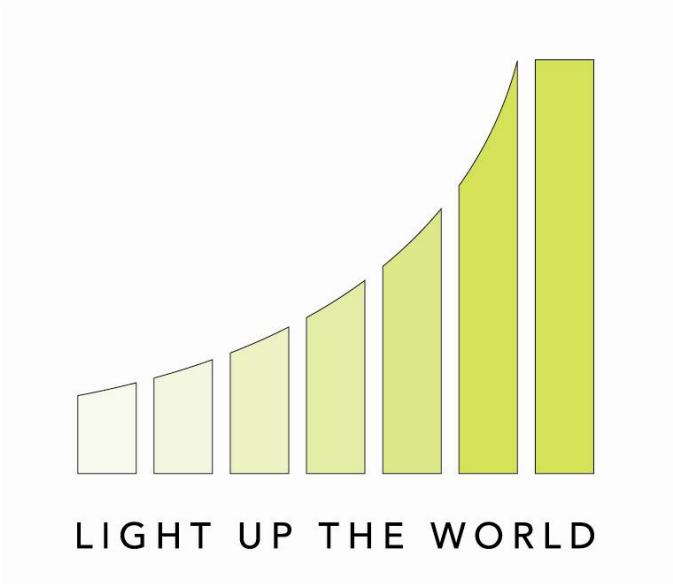

Project Implementation Manual

Table of Contents

Light Up The World (LUTW) is a pioneer and world leader in utilizing Solid State Lighting (SSL) technologies to improve the quality of life of the poor and disadvantaged in the developing world. We utilize affordable, high-efficiency, durable, and long lasting lighting products such as LEDs and CFLs, powered by renewable energy to ecologically sensitive and remote rural areas. This technology is having a positive impact on the lives of people that are without access to electricity throughout the world through economic savings, asset building, promoting opportunities for better education, improving economic productivity, better health and safety in addition to the benefits for the environment.

LUTW implements projects in partnership with a range of NGOs, civil society groups, and governments. By combining technical, financial, and human resources, we are able to bring the benefits of high efficiency technologies and renewable energy to communities in need. Light up the World's role as a partner in community development programming is to facilitate the process of technology transfer, including feasibility studies, community sensitization, training, technical support, and monitoring & evaluation.

Bringing high efficiency light technology to communities that are not connected to the electrical grid, however, can be a very challenging undertaking. It requires a significant amount of planning, strong partnerships, and effective communication. The most successful projects involve a number of thoughtfully planned steps. Each step in the implementation process requires a number of coordinated activities to be carried out by well-organized partner organizations.

The project implementation manual is a working document that provides guidance on how to address some obstacles that may arise in undertaking a project that involves the installation of a solar photovoltaic systems and discusses some of the tactics that have been used in the field with varying degrees of success to overcome such difficulties. The intent of the manual is to facilitate the successful and efficient implementation of projects.

I. Community Development Projects

By definition, community development is a process that involves the transformation of lives. The transformation process is by no means trivial, painless and without struggle. On the contrary, it is often complex and fraught with unexpected challenges and delays. Of course, the complexity of change depends on the activity, idea, or product that is being introduced and the relevant local institutions, customs, and behaviours associated with that which is being replaced.

Replacing common practices or conventional tools will almost always be met with resistance from some parties, typically those that have a vested interested in the continuation of the behaviour that is being modified. The size, make-up, and intent of the resisting parties will vary depending on the new activity, idea, or product, the way it is introduced, and the way in which it affects the community. Generally speaking, carrying out a project in another context is almost always more difficult than expected, no matter how trivial it may appear to implementing agent.

Introducing a new technology to communities is not a straightforward exercise. No matter how appropriate and overwhelming the establishing agent views the benefits of the technology to be, introducing something new is a complicated process that involves a significant amount of thought and planning. In the case of renewable energy home lighting systems, a project involves much more than simply installing a lighting system. The challenge of bringing a new technology lies not in the introduction in itself, but rather the work that it takes to ensure that the technology is adopted by community members in a way that ensures the long term benefits and sustainability of the new technology. For instance, this means that community members not only understand proper usage of the system, but are also willing and able to provide the resources to maintain the technology and in doing so, ensure that the household continues to benefit from the new technology. The intention of this document is to better prepare organizations with an interest in renewable energy projects for the realities of project implementation and the challenges they may encounter.

According to Rogers (2003), there are five perceived attributes of innovations that explain different rates of adoption by different individuals: relative advantage, compatibility, complexity, triability, and observability. The relative advantage attribute is the recognition by beneficiaries of the benefits and relative advantage of adopting the new system. In the case of renewable energy home lighting technologies, households should recognize the cost savings and health benefits of the system, among other advantages, in comparison with conventional lighting systems. The technology should also be compatible to their lifestyles, which means that people should not have to alter their lifestyle in a detrimental way to adopt the product. If a negative impact is perceived by the end user then the likelihood of adoption is reduced. The product should not be complex to operate. Lastly, potential beneficiaries should be able to try and observe the product before making a commitment to purchase.[1]

It is the responsibility of the organization implementing a lighting project to clearly present these attributes to project beneficiaries if the innovation being introduced is to be adopted. The probability of success in reaching this objective can be improved by good planning, communication with relevant stakeholders, and a strong understanding of the implications and perceptions of the new technology in the host community. The following can be considered as a general summary of activities to be carried out in order to realize the objective of providing solar powered lighting systems to families living in remote communities. Steps may be added and removed depending on circumstance.

1. Perform an initial study to determine the extent and nature of energy needs in the community. This purpose of the initial study is to gain a broader understanding of the social, economic, and political implications of how lighting and energy are used in the community.

2. Make reports of the findings from Step 1 to all partners (community, LUTW, other NGO participants, and donors as to the findings from the review in step 1).

3. Identify and evaluate equipment options that could be used to address lighting inequality in the community in need. Chosen equipment should be

[1] Purchases may be facilitated by microcredit loans or subsidized in part by LUTW or other partner organizations.

appropriate given the needs of the community (for instance a mobile vs. a fixed system), have a reliable and known long-term supply, be affordable to the majority of project beneficiaries etc… If the cost of a system, especially the components that need to be replaced more frequently, is beyond the financial realities of most beneficiaries then the long term viability of a project will be jeopardized.

4. Raise funds for the feasibility study (pilot project) that must follow, and that must precede the preparation of a proposal to raise funds for the project.

5. Perform the Pilot Project. Depending on the need and final application, the Pilot Project may include the design, field trial, and modification of a standard lighting installation so that it is appropriate for local conditions.

6. A Project Feasibility Study should then be completed based on the results of the Pilot Project.

7. Based on the Project Feasibility Study, determine at this point whether the project remains feasible from both a practical viewpoint, and a projected costs standpoint. The Project Feasibility Study should articulate the type of project that is feasible (i.e. microfinance without subsidy, microfinance with subsidy, or lighting system provided for a one time community financial and in-kind contribution).

8. Depending on the type of program that is deemed as feasible and appropriate, conduct meetings with the community to discuss issues such as:
   a. Community participation and “in-kind” work and donations.
   b. Community agreements relative to monthly payments, collections, maintenance.
   c. Community training in construction and maintenance.

9. From these meetings with the community an installation plan and documentation system should be developed. A strong project plan should consider local conditions and be flexible enough so that parameters may be altered in accordance with realities on the ground.

10. Approach donors and partner organizations (such as LUTW) to raise funds for the project implementation including the equipment and the community mobilization. Application to LUTW should be submitted at this point and include all relevant information gathered in the first seven steps.

11. Obtain equipment from LUTW for initial installation (some of the equipment may take months to be received from the date of order).

12. Train local staff on installation and system maintenance with receipt of the first order. Begin equipment installation.

13. Complete installation and have further community training sessions.

14. Project continues based on sustainable set-up of lighting system maintenance service providers.

15. Evaluate the socio-economic impact of the project and document lessons earned.

Some of these steps can be combined, depending on the type of funding that is pursued, but this should give a good representation of the complexity involved with the implementation of a community solar lighting systems.

II. Implementation Strategies, Challenges and Lessons Learned:

The challenges in each step of the project assessment, implementation, and follow-up vary from community to community. As a partner of ours working in Ghana, Donna Sheppard, stated in an annual report, "Challenges have come from many directions too: untangling the complicated international shipping and receiving process; designing and re-designing the best installation applications; interpreting and managing the local political climate; and remaining patient with the essential pace of progress." It is important as an implementing organization to recognize challenges early and explore strategies to deal with them.

Below are some of the most common challenges that organizations installing LUTW systems have encountered in project implementation. It is our intention that by being familiar with the experiences of others, your organization will be able to overcome some of the challenges without great difficulty.

1) Project Design and Community Consultation:

The project design stage is critical to the success of any project. It is important to remember that in the very essence, projects are dependent on functional relationships between partners. Functional relationships mean that partners communicate regularly and have clearly defined roles. Trust and commitment must be built around mutual interests and mutual objectives. It is critical that agreements are formalized. Only after relationships are defined and commitments made that a conventional blueprint for action can be set. The blueprint must include all the accountable elements of a project plan including deliverables, workplans, milestones, budgets and responsibilities. The key managerial relationships, especially in project execution and support among several partners must be explicit. Fieldwork and methodology should also be a matter for local (including the village organization) judgment.

It is critical that all projects start with the end user and intended usage in mind. A project that is intended to provide lighting for children to read when it is dark will not be judged a success if lighting provided is only sufficient for ambient room lighting. It is important to investigate these needs in consultation with LUTW.

Asia

Comments from experiences in China (2008):

"Flexibility is paramount. It is important to realize that what you intend to install, will not be installed the way you imagined. This is especially true for big systems. Being able to adapt to changes is critical so insuring that you bring EXTRAS of EVERYTHING (even things that are not in the original design but you know could be useful) is extremely helpful.

Being prepared is also fundamental to the success of a project. Even though your original design may have to be changed, a project should not be carried out without a completed original design. Being prepared is the best way to be flexible because it means you won't be missing anything major when you get there. Being prepared, would also mean, identifying some problems that you can foresee happening, and preparing a solution ahead of time. Bringing additional materials for your 'solutions/alternatives' is also helpful.

Making sure that you are informed about the project and the context is also extremely valuable. Learn as much as possible about the culture and surroundings before you go. I felt like we had prepared a lot for the surroundings and medical problems (e.g. high altitudes) that we would encounter. However, looking back, additional cultural preparation would have been very helpful."

a) Consulting the Community about System Design and where to Install Systems:

Asia

Comments from experiences in Indonesia (2010):

"We observed that households were trading batteries for cash. We observed that the battery is the first thing they traded since it might be the easiest component to trade. Unfortunately, we did not track other components in the Solar Home System. We have learnt from the previous experiences and now we put aside some budget to monitor the progress and development of the program post-installation so that we can better understand the shortcomings of our pilot project."

South America

Comments from experiences in Peru (2009):

"I don't think the battery charging system in the community building has worked out. The homes just weren't as centralized as we thought and people are not used to the idea of charging batteries. Also, it's not something we spent a lot of time on, either in the preparation stage or when training the beneficiaries. We could have considered a rent-a-battery model like the e-volv program (another NGO in Peru), but it would have required a lot more training. Selecting the owner also would be difficult, however, having an owner would have resolved the issue of who's responsible for the security of the system and it provides incentive to keep the program going."

Comments from experiences in Peru (2011):

"The only topic of discussion was the fact that the Santa Rosa systems included a device for radios. The community expressed their disappointment. We discussed at length why the system differed, and we uncompromisingly agreed to seek a solution (i.e. to install the DC-DC converter at a later date). Our local NGO partner carried out a rural diagnostic."

b) Determining the project area:

South America

Comments from experiences in Peru (2011):

"The monitoring is extremely difficult when we don't set limitations to the project area. In Pallcapampa, we installed in areas which were completely outside the intended community and we are seeing the difficulty in maintaining control of our monitoring and

evaluation plan. It is the result of depending too heavily on information/decisions from our community contact. The number of systems installed should be based on logistics/project sustainability. We have discussed solutions with our project partner and are taking precautions for future installs."

c) Project Methodology:

Central America

Comments from experiences in Costa Rica (2009):

"Installing a solar lighting system is often the easiest aspect of a lighting project. The more complicated part, in particular when microfinance payments are involved, is organizing the administration of payments, long-term support and maintenance of the systems."

2) Sensitization Activities:

Community consultation is a critical component of lighting projects. Careful planning as to how consultations will take place and which individuals will be included are critical to a project's success.

a) Working with Local Leaders:

As mentioned above, implementing a project where a new technology is introduced to a community is by definition an attempt to shift behaviour. Changing the habits that have evolved around the instrument that is being replaced must involve the ability of people in the community to observe leaders adopt and accept the changes. In many communities that are not served by the electrical grid, municipal leaders, elders and chiefs will fit this description. In certain cultural settings, if chiefs and elders are not the first to adopt the technology then it is unlikely that others in the community will be willing and/or find it appropriate to accept the technology. If leaders adopt an innovation, the other people in the village will more easily follow their example. Because of this it is critical to identify and work through influential community members. With this important role, leaders need to be adequately educated so that they are good role models for the rest who trust them. International NGOs that may not have an intimate familiarity with the society become aware of the power/political structure of the community, the institutions, and how this may affect implementation.

All stakeholders, including community leaders, need to be clear from the onset what are the goals and objectives of the project. These need to be reviewed from time to time through the installation process. Project proponents must also be aware, however, of incentives to manipulate a project to meet individual needs.

b) Communication with the communities:

Communicating with the community can be undertaken in different ways depending on what is common for community-wide initiatives.

Africa

Comments from experiences in Ghana (2006):

"During the first full year of lighting operations, the Sanctuary Advisor was involved in all of the sensitization meetings held at the community level. The first presentations were held in the villages deemed to have the highest need. All of the remaining beneficiary communities had been briefed on the lighting initiative and invited to come forward with their community contributions to 'purchase' a light by the end of March. Several

communities received repeat presentations later in the year when it was deemed that purchasing response was low."

c) Transparency of how project will be run and expected commitment:
Clarity around the objectives of a lighting project, benefits of the technology and how a project will be carried out, in each phase, are vital to gaining and maintaining support from the community.

Africa
Comments from experiences in Ghana (2006):
"During lighting sensitization meetings, it was explained to the community members that their tariff fees will be used to support a lighting maintenance program. NCRC has established an investment fund with a local investment banking firm entitled the WLI Investment Trust Fund into which all the community contributions have been paid. Ultimately, this fund will have capital investment of ¢55 million (550 units x ¢100,000 = ¢55 million, equivalent to nearly $5,500 USD) that can be invested back into the initiative to ensure its long-term maintenance and care."

d) Meetings with the community
Be generous and flexible in scheduling sufficient time to visit and meet with communities. It is recommended to schedule additional days in a project area to account for unforeseen circumstances that can delay planned activities.

South America
Comments from experiences in Peru (2011):
"We originally planned to go on Saturday but the technician cancelled because he was in another village due to an accident in the community."

3) Community/Beneficiary Contribution:
Evaluating the community or beneficiary contribution is one of the most critical aspects of project planning. The greater the ability of end users to pay for solar lighting systems, the more likely a lighting project will achieve "sustainability". There are a number of reasons why this can be expected when end users pay the full cost of the system. Part of the rationale behind this thinking is that end users who have already demonstrated a capacity and willingness to pay for the system at the start of a project will be able to purchase new components of the system as they require replacement over time. As a result, project proponents should always pay careful attention to social and economic conditions in a community so that affordability may be measured and utilized as a determinant of the community or beneficiary contribution.

One method of bringing LED lighting systems to households is through a microfinance for lighting project. In this case, the microfinance institution would provide loans to people so that they can afford to purchase the system. Microfinance projects are only undertaken in cases where people spend a significant amount of money on kerosene and other lighting sources currently.

In the case that there is no microfinance institution involved or a microfinance project is not deemed as appropriate given the economic conditions in the community where the project is taking place, the organization may wish to undertake a project where lights will be provided to people for an in-kind or financial contribution. Anecdotal evidence from community development projects throughout the world has emphasized the importance

of community contribution as critical to the success of development projects. Whether it is a financial or in-kind contribution through assisting with manual labour, material provision, or other contribution, LUTW only supports projects that involve some type of contribution from beneficiaries.

a) Community Contribution:

Africa

Comments from experiences in Ghana (2006):

"From the onset of installations, we were conscious of ensuring that everyone who receives a light contributes the pre-determined ¢100,000 tariff for it (approximately equal to $15 Canadian dollars out of a total actual unit cost of $230 CDN, or 7%). We have witnessed the collapse of other development projects that have failed to recognize the importance of a community contribution component in the overall scheme of things. Ownership of the resource encourages responsible use and sustainable management success."

Asia

Comments from experiences in Indonesia (2010):

"A few years ago we distributed a solar home system with separated battery. The majority of recipients, more than 90%, ended up trading the batteries or using it for something else. This killed the purpose of the program at the first place. If we required that households contribute at least as much as the battery cost in the market then perhaps we could have avoided this problem.

Central America

Comments from experiences in Costa Rica (2009):

"Donating the systems to families (without any financial contribution) is damaging to the community."

Comments from experiences in Costa Rica (2007):

"Families were excited about the prospect of owning them outright instead of perpetual rental payments."

b) Collection of Financial Contributions from the Community:

Africa

Comments from experiences in Ghana (2006):

"With the exception of the Dornye Health clinic light, no lighting systems have been installed until full payment has been received. We have had to quell rumours on several occasions about the details of payment, as several communities have heard that the lights are free of charge. On occasion, headmen and other individuals have given their payments in installments as they gradually sell goats and chickens to make up the full amount. We have established a receipt system and produced a PAID stamp with the name of the organization written on it. Everyone who pays for a light, receives a receipt. On the receipt, we record the name of the payee as well as the house number to reduce confusion during installation. The majority of recipients thus far have been illiterate. Unable to provide a signature, these individuals use an inkpad to produce a thumbprint. Payment for an individual lighting system must be done only at the WCHS Visitor Centre in the community of Wechiau, and payments are only able to be collected by the Financial Secretary or the Sanctuary Advisor. In this way, we have ensured that the installation team is entirely separate from the financial team. No money is ever collected in the field, although people often try! By making it clear how to pay, we have managed

to virtually eliminate the misappropriation of funds. We did have one incident in which an individual – not associated with the initiative – collected money from two unsuspecting villagers. However, that problem was quickly sorted out and not repeated."

c) Type of Contribution*:*

Africa

Comments from experiences in Ghana (2006):

"Most families do possess livestock in the form of chickens, guinea fowls, and goats, which can be sold at markets to pay the lighting tariff fees (the tariff fee of ¢100,000 is approximately equivalent to 1 goat and 2 chickens), but unfortunately, people are traditionally reluctant to sell their animals. Domestic animals are more likely to be used for ceremonies, dowry, or for financial insurance. Ironically, once their light is installed, the head of the household will frequently give a hen to the installation team as a gift of appreciation."

South America

Comments from experiences in Ecuador (2008):

"Families contribute to the project by volunteering their labour to transporting equipment from the highway to the installation location in Uwintz. Uwintz is the furthest of the Shuar communities in the region and the trip usually takes two days through very difficult terrain. If they have them, families will use horses to help move the equipment to their village."

4) Shipping / Receiving and Equipment Procurement:

a) Importing Equipment and Materials:

Importing goods to the beneficiary country should never be dismissed as a routine operation. The rules and regulations around the import of goods are different for all countries. The process and rules behind importing equipment that has been donated or is designated for a non-profit project is also different in each country. Some countries will offer concessionary rates or waive import duties for NGOs, while others view NGO shipments as an opportunity to boost government revenue (with significant pressure from International Financial Institutions to do so). Importing equipment as a donated product, and hence attempting to receive the good without paying any import duty or tax, can be more complex than importing commercial merchandise. Therefore, it is critical for the organization that is importing the material to investigate the rules and process for importing solar equipment, electrical equipment, LEDs and possibly batteries into their country.

A failure to plan for this activity may result in products being stalled at customs awaiting clearance. Products can be stalled for weeks or months, potentially costing hundreds or even thousands of dollars and delaying project implementation. Therefore, it is critical to the success of projects that implementing partners have a solid understanding of customs clearance, import charges, or an alternative strategy to shipping lighting systems to the country.

It is recommended that all equipment arrive at the installation location(s) with significant lead time to avoid any installation delays due to equipment being held up in customs. LUTW strives to have all equipment for a project arrive in country at least one month prior to the installation work starting. If equipment must be transported to the final

installation location from the first shipping destination in the project country then equipment should be sent to the country earlier so that there is sufficient time for it to be transported domestically to the place of installation. This means the organization must have a good idea of how long it will take to transport equipment from the address where the shipment is received to the final installation location. It is also critical to make arrangements for storing equipment that are consistent with this overall schedule. Transportation to and from the designated storage space must be considered in working out initial project plans. Adding extra time to allow for the shipment of equipment to arrive should help minimize the risk of project disruption due to a package being lost in transit or stuck in customs awaiting clearance.

Africa

Comments from experiences in Sierra Leone (2008):

"Although we (as a registered NGO in Sierra Leone) have the ability to clear items that are shipped to us without paying duty, this turned out to not be the case for LED lamps that were sent to us by Light Up The World via DHL. We were told that DHL deliveries are subject to import duty even if they are being used by an NGO for a project. This came as a surprise to us as the first of the six boxes that was sent to us via DHL was delivered without us having to pay any duty to clear them from customs. The first box was cleared from customs and arrived at the office **six days** after leaving Canada. It took **39 days** for the other five boxes to arrive and clear customs. The duty rate that was paid for the shipment of the final five boxes was approximately **30%** of the value of the lamps"

Asia

Comments from experiences in China (2008):

"Six boxes of LED lamps were sent to Xining in China for a project. Goods arrived in China three days after being sent from Calgary and were in customs for eight days before being cleared and sent to the final destination. DHL was unable to provide shipping receipt confirmation on their website, which is different than shipments to other countries I have dealt with so far. Four of the six boxes arrived at the final location three days after clearing customs (**14 days** in total) and the final two boxes arrived shortly afterwards. Import duty paid on the LED lamps was equivalent to approximately **20%** of the value of the shipment."

Comments from experiences in Pakistan (2008):

"We here at Pakistan are stuck at a very strange phenomenon. The Custom Department which imposes tariffs/duty on such imported items, has said that we will have to pay Rs. 16,000 (equivalent to approximately $240 CDN) per system as tax. This is equivalent to an import tax of 150%. I am 100% confident that in 2006 all types of taxes/duties/tariffs on solar panels were eliminated either for commercial or home based but don't have a clue where to get this information in hard writing and show it to our customs department."

Comments from experiences in Nepal (2009):

"The government process to release it from customs is long and takes time. Also if there is not any reliable documents they put their own assumption price and tax on it. The tax could be anywhere from 35-135% for electrical goods. If not properly defined, could seize them."

Comments from experiences in Nepal (2009):

"The equipment we received was sent to Nepal as a donation and a value of $0 was listed on the commercial invoice (the actual value of the equipment was $90 USD). The customs officials decided that the equipment must have some value and some they chose to record a price of $600 USD for the equipment. A tax was charged on the equipment at this value. The received in Nepal had to contact various departments to minimize the tax rate to 35%, otherwise a tax and penalty of 235%, which is 100% of the value as penalty being imported without proper authorization and 35% tax over the total amount.

The customs rules are if there is items with no value indicated, they value the goods themselves and put penalty and tax both. If they value an item at 100 USD the penalty would be 100 USD and thus it makes total taxable value 200 USD and 35% tax on this amount which makes 270$ altogether. It is not easy to get goods in the country. We must carefully follow their rules.

As a renewable energy component manufacturer, we can import solar lighting materials at lower custom rate. To do so we have to present a proposal indicating the villages, household numbers, system size etc along with a proforma invoice of the total importing components in advance to some Ministries and the Renewable Energy Manufacturers Association to get approval from them. If they approved the proposal then they write to the airport customs officials that a minimal tax which is around 10% of the total value should be charged. If they suspect that the invoice is under valued to lower the taxable amount, they would either buy it themselves at that face value or cease it.

For me to submit the proposal I will require:
1. The name(s) of the village(s) where we are going to install the systems along with the number of households.
2. Please send the proforma invoice with clear particulars, rate and amounts so that we can apply for the financial approval.
3. A letter saying that this is the gift items from LUTW, Canada to those villages mentioned above and that we (as the manufacturer) will install the systems for LUTW to let them know that a valid party is going to install it."

Comments from experiences in Nepal (2009):
"I cleared some LED products the other day from the custom after a week of negotiation. They were classified as a tax free commodity to be used in Renewable Energy lightings but still I had to pay other taxes like local development tax, security tax, storage charge, delivery charge, bank commission etc. The total worked out to be about 15% of the total value of the equipment."

The Middle East
Comments from experiences in Jordan (2009):
"They were in customs for about a month, that was a real learning experience. I didn't have to pay customs in the end only had to pay a local agent to get them out of customs after I personally visited customs."

Oceania
Comments from experiences in Papua New Guinea (2008):

"We arrived in Port Moresby from Sydney. We had no problem getting the lights and other equipment through Customs in Port Moresby – we declared them and were waved through when we explained the purpose of the project."

South America

Comments from experiences in Peru (2005):

"The process of importing merchandise was indeed one of the most time and effort consuming activities in the project. Importing donated goods into a country can be a very long and complex process, particularly when dealing with government agencies. On the other side, the importation duties can be very high, easily overrunning the budget assigned for a project. Because of this, it is very important that you gain familiarity with the regulations in the country you are working and the cost of importing the type of equipment (i.e solar panels, lamps, wiring, etc…) regulations. It is strongly recommended that for any project that involves the introduction of equipment to any foreign country, the paper work for donations is done in advance. It is also important that before sending any equipment, it is ensured in written form that the recipient/partner is willing to accept the merchandise and warranty its clearance from customs. It is recommended to analyze both alternatives and decide which way to go based on the money and time budget assigned to the project."

Comments from experiences in Ecuador (2008):

"At times goods can be cleared without contacting customs, at other times it seems necessary. With our last project in the country the first two boxes that was sent via DHL was cleared and received by the office without any problems. Customs said they required a letter from LUTW stating what had been sent and confirming that it was to be used for a community installation project before the final box could be cleared. The first two boxes were received by the office in Quito **three days** after being sent from Calgary. After communicating with customs and providing them with the letter from LUTW the final box was received **29 days** after it was sent."

b) Purchasing Equipment in the Country of Installation:

To avoid the added cost, and in many cases the hassle, of importing goods to a country for the first time, LUTW strongly suggests exploring the local marketplace for some components of the solar system that you intend to install. Due to the heavy weight of batteries and their general ubiquity, LUTW always recommends that the team undertaking the lighting project seek out a local supplier for this part of the system. Often, many other components/materials/tools can be found with relative ease, at a low cost and without getting involved in the customs clearing process, which can be time consuming and costly.

Asia

Comments from experiences in China (2008):

"I think it really varies depending on the country. We were concerned about China because of its political nature and trying to bring equipment across borders. We were able to purchase solar panels and batteries in China and had them shipped to a contact in Xining which worked really well. Once on the ground, we actually were able to find a solar panel manufacturer in Xining where we could have purchased the panels.

Unfortunately the previous reconnaissance missions were poor and information like this not available.

We bought all of the remaining supplies in China except for a couple of items which we weren't confident that we would find (electrical marette connectors for example). However, all regular items (wire, screws, tacks) were very easy to find. All of our tools were bought in China. One thing that I would be cautious of in the future was the quality. Our drill barely made it through one day and we used it for 5 days as we had no other supplies available. If you intend to purchase materials in remote parts of China I would budget at least three days to do complete the activity, or send one person ahead."

5) Training Field Staff on System Installation and Maintenance:

a) Planning for System Troubleshooting

It is important to address how to handle attempts to evaluate what may be wrong with a system if it is not working. Not following suggested troubleshooting steps that can be found in LUTW's Installation Manual may cause greater damage to the system as a whole and may even post a safety threat to the individual attempting to troubleshoot.

Africa

Comments from experiences in Kenya (2007):

"It was discovered that two lighting systems were in need of repair. In one case, the lighting system was attributed as a major factor in helping there eldest son pass his final high school examinations. One of the bulbs in the ROHI school had also stopped working, and been replaced by the administrator with a 40 watt incandescent light bulb. It was assessed that this was caused by moisture from the bulb that caused a short circuit. The switches for the bulbs had been pulled out and/or the switch connection broken. This was most likely caused by normal usage and corrosion of the wire. Both bulbs were tested were initially tested by using an extra battery and at first thought to be non-operational, however it was later realized that the battery being used was below the 12.4 volt threshold necessary for the operation of the lights. This is an important note, as the light has a safety which is designed to not drain the battery past half of its charge – which is to say to only partially discharge the battery. This lends to longer battery life, however, must be explained so that systems that have stopped functioning can be accurately assessed. Next the battery was examined, and it was found to be mangled – with the top being removed with what appeared to be a screwdriver. The battery in the system is a sealed led acid battery, therefore the protective casing should never be removed. However, many batteries in western Kenya are not sealed and are in need of water replacement. This is most likely why the battery top was forcefully removed, as a trouble shooting measure by the individual to see if it was in need of a refill of water. It is presumed that as the lighting system stopped working during the rainy / cloudy season of western Kenya, that the battery happened to not be charged adequately, which prompted the troubleshooting by the homeowner. The homeowner may have then removed the connection of the battery to the circuit board, and upon reconnection may have switched the positive and negative connection. This would cause a constant reverse flow of positive and negative in the battery, which may have lent to the further destruction of the battery, culminating in the removal of the battery top. This troubleshooting, because of a lack of adequate training, resulting in the destruction of the battery. This system was rewired, and a new battery was installed."

One must take precaution is engaging in troubleshooting as was necessary in this case in a project in Ghana.

Comments from experiences in Ghana (2006):
"It is always a tense moment when installed lighting systems need to be closely examined for faults. Whenever the switch plate is removed to expose the contents inside, we never know what crawling critters will have made the metal box into their home. At the headman's house in the village of Dogberipari, a scorpion was discovered living in the small space behind the aluminum plate."

6) System Installation:

Mounting the solar panel can be done in different ways depending on the installation location. For instance, a panel can be mounted directly to the roof of the building, to a bracket that is mounted above a pole that is attached to the structure that is being lit, to a pole that is separated from the building that is being or other ways depending on circumstance. Issues to consider when mounting the panel is the amount of cable that is available, making room for airflow between the solar panel and surfaces that may increase the heat of the panel, which reduces panel efficiency, and of course, local materials available to mount the panel in a stable way.

a) Solar Panel Mounting

Central America

Comments from experiences in Costa Rica (2008):
"In addressing the task of mounting the solar panel around the home I have to see the home first so I can assess the stability of the roof, the design of the home, surrounding trees as well as other factors that may affect the performance of the system."

Asia

Comments from experiences in Sri Lanka (2005):
"In Sri Lanka we have found that using the male variety of bamboo works best as the solar panel stand because it is very durable and resistant. When placing the stand into the ground we normally tie a plastic bag around the bottom part of the bamboo pole that goes into the ground so that the possibility of moisture getting into the base of the base of the bamboo base of the wood rotting."

b) Using a Battery Box

Using a box to hold the battery, and possibly the charge controller, should be considered as part of the installed system. A battery box may help to keep the battery out of potential harm from the elements (eg. rain). It can also send the important message that the battery is an item that should not be tampered with and the connections running from the battery to the charge controller (or lamps directly) should remain as is once connected.

There are many issues to be aware of when considering using a battery box such as the type of battery that it will hold, ventilation, placement in the building, durability of materials used to construct the box etc…

7) Household Usage and Behavioural Issues:

For the long term success of lighting projects, implementing partners must achieve success in training and educating new owners of the importance of taking proper care of their lights.

a) Household Usage:

The Middle East

Comments from experiences in Jordan (2009):

"They report everything is okay and it works fine. The only complaint they have is that the battery dies by 10 or 11 pm and they would prefer it go all night. Most of the Arabs I know prefer to leave a light on all night while they are sleeping. So as far as having the lights work for the women to finish their chores and the kids to do their home work it is working fine. Right now it is getting dark about 6pm so this capacity issue would be come less as the days get longer and the nights get shorter."

South America

Comments from experiences in Peru (2005):

*"*Although LUTW's lighting systems are rugged and durable, based on the experience at the Ega Village and due to the remoteness of their villages it is important that the recipients understand their very basic principles of operation. Therefore, the users can take good care of their systems (i.e. replacement of batteries, clean up of solar panels and lamps when necessary) and extend the lifetime of systems. Even though two people of each village will be trained to give technical maintenance to the installed lighting systems, it is also recommended that every home gets a half page/sticker that illustrates the basic maintenance for these systems."

b) Community Response to Solar Lighting:

Lighting projects have been, and will continue to be, received by different communities in different ways. This is due in large part to the transformative impact that artificial light has on a society. To evaluate this transformation one must understand how lighting has been traditionally used in communities as well as the previous forms of light that were used with which the LED lighting technology. The reaction from a community that has already seen the light produced from a compact fluorescent light (CFL) will be different than in a community that is accustomed to using candles. Furthermore, the reception to LED lighting technology is likely to depend to a large extent on the views of community leadership and how they view the new technology affecting their lives. This requires a familiarity with the culture and local economy.

Africa

Comments from experiences in Ghana (2006):

"The 17 communities attached to the Wechiau Hippo Sanctuary are not a uniform body of people. They vary with respect to language, tribal grouping, settlement size, leadership, locality, resources, and priorities. It is not easy to pinpoint the underlying reasons for differences in response to the lighting initiative from the various communities; however, some are more able / willing to purchase lights than are others."

c) Household Usage and Behavioural Issues:

Africa

Comments from experiences in Ghana (2006):

"Some lighting beneficiaries have been complaining of faults to their installations, however, once the team delves further, they discover that the situation has been brought on by a behavioural problem rather than a technical issue or equipment failure. While

inspecting installed systems, the lighting team has been alarmed to find the condition of many solar units. It appears that many lighting recipients never clean their solar panels. When asked, people responded *'we never wash our panel unless rain'*. Furthermore, the lighting team often arrives at communities in the middle of the day to find light switches left on and lamps burning brightly. Due to these concerns among others, the lighting team has vowed to continue with lighting system sensitization activities while waiting for the official lighting maintenance program to be put into place.

In Ghana, the installation team has learned through experience that the fewer number of steps or stages required of lighting recipients, the more likely the system will last a long time. Human factors impacting the successful operation of lights should not be underestimated. The transfer of solar lighting technology to an illiterate population carries with it a host of potential challenges. Since the start of full-fledged installation activities in 2005, we have documented numerous human activities that have been detrimental to successful solar lighting application. Chief among the issues observed are the lack of care towards switching off lights during daylight hours and the lack of interest in periodic cleaning of solar panels.

In addition to these problems of failing to maintain lighting system as recommended, lighting recipients are also willing to tamper with their non-functioning systems in an attempt to get them working once more. Though they have been informed to report the fault and await servicing from trained maintenance staff, it appears that lighting owners become impatient with the waiting, and try to fix the problem themselves. For example, we have had to repair systems that have had the polarity switched, or had elements removed, or even ones that have had some of their wires cut.

Issues with human behaviour are more challenging and diverse than are the challenges with lighting product and systems application."

8) Planning for Long-Term Project Sustainability:

Sustainability of a lighting project can be interpreted to mean that, over the long-term, families will continue to use the solar powered LED lighting systems that have been installed in their homes. There are many dimensions to sustainability. For instance, for sustainability to be possible, the technology must have been successfully 'adopted' by the recipient family. This means that the family not only values the benefits of the solar system, but also has the financial means to purchase replacement equipment once the different components lost their effectiveness or fail. For the family to 'adopt' the system, they must understand how to operate the system and how to perform basic maintenance, such as cleaning the solar panel if it is dirty. For this reason, training is key part of project sustainability.

Families that receive solar lighting systems should also have access to capable technicians who understand how to troubleshoot and, if necessary, repair the system. In addition, technicians should have sufficient motivation to travel to homes to troubleshoot, perform maintenance and inform the family on any issues related to the operation of their system. Motivation factors will vary from community to community, but generally speaking, it will involve some form of financial compensation which may be provided by the project donor in the short-term, but in the long-run, this should come from the recipient family. For this reason again, it is critical that they value the benefits of the

system to the extent that they are willing to use their own financial resources to pay for its upkeep. There are many other aspects of project design that have a direct impact on project sustainability. For these reasons, among many others, designing a sustainable project is often cited as the most challenging aspect of any lighting project.

a) Selecting individuals in the community to be receive training and scheduling training workshops

It is important to address the activity of community members to be trained carefully and with consideration of the abilities, availability, and incentives of those individuals that volunteer to take on the role of "technician" in their community. Failing to be aware of the willingness and ability of community members to be able to continue serving this role in their community in the long-term may ultimately lead to ineffectively arming a community with the capacity to maintain and sustain systems in the long-term.

South America

Comments from experiences in Peru (2011):

"We made clear beforehand that we wanted the technicians from Chayansa to participate in a workshop, but he was the only one interested and he was too busy that day to spend any significant amount of time with us. Given the lack of attendance and time we decided to postpone the training.

Scheduling of the workshops is proving a challenge. We attempt to provide as much notice as possible and to be flexible, but the seasonality of work and perhaps lack of incentive are issues. For future projects we are emphasizing the importance of commitment to the training throughout the full one year period. However, we should evaluate alternative schemes for ensuring participation and effectiveness of the training."

b) Designing a Maintenance Program:

As mentioned above, if an implementing partner is unable to secure a meaningful contribution from the beneficiary community, then the likelihood of project sustainability is low. There are many ways of designing a maintenance program to serve the needs of the community in the long-run.

Africa

Comments from experiences in Ghana (2006):

"Beneficiaries are required to pay into a lighting system maintenance fund. By 2006, contribution payments into the high interest investment account to grew into the WLI Maintenance Fund; a total of Ghana cedi ¢20,500,000 (equivalent to USD $2,050) has been deposited to date. The establishment of this fund will have a positive affect on the long term viability of lighting in communities. The account is set up to pay the salary and field expenses for travel to each of the 17 communities (by bicycle) of maintenance staff who will also set up a solar lighting shop. Batteries and other equipment will be available for individual purchase, should beneficiaries find the need for them."